Modes of production, metabolism and resilience: toward a framework for the analysis of complex social-ecological systems

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Summary of contents

The field of environmental sociology has undergone drastic change in recent decades, in context of a broader reconfiguration of the terrain of sociological theory and practice. Systems-based approaches to the study of human society, located at the interface between the natural and social sciences have since yielded to a fragmentary body of theory and practice. Subsequent developments such as the emergence of actor network theory, linguistic constructivism and epistemic relativism, have sought not only to question the status of scientific discourse as immutable authority, but also the legitimacies of positivism and macro-theoretical modeling as tenable research programs. This thesis suggests that much of this critique is misdirected, informed as it is by false dichotomies of theory and method which empahsise the separatism of the social, and the difficulty of normative analysis.

Over the past twenty years, sociologists have begun to re-engage with systemic theory, albeit with a plethora of new anti-reductionist informants rooted in epistemologies of emergentism, complexity and critical realism. Parallel developments in Marxian ecological thought and human ecology offer further conceptual complementarities and points of dialogue, with which to develop new methodologies for the study of human collectives as 'social-ecological systems'. The objectives of this work are thus twofold; (1) to advance an alternative basis for theory and practice in environmental sociology, drawing upon the informants of complexity theory, resilience-based human ecology, and Marx's concepts of mode of production and metabolic rift; (2) to contribute to this largely theoretical body of knowledge, by operationalising the preceding informants within a specific case study; that of communal farming, or the 'rundale system', in nineteenth century Ireland.

The ecological dynamics of the rundale system are thus explored through the imposition of a range of quantitative, archival and comparative methods, as an exercise in the explanatory capacities of the investigative framework developed throughout this work. This methodology rejects existing explanatory models which emphasise the role of 'prime movers' in the generation of differential ecological outcomes, toward an account which emphasises both macro-structural complexity, and the augmentation of adaptive capacity from below.

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Abbreviations

AMP [Asiatic Mode of Production]

AGIL [Adaptation, Goal-attainment, Integration, Learning]

ANT [Actor-Network Theory]

CDB [Congested Districts Board]

CMP [Characteristic Metabolic Profile]

CSO [Central Statistics Office]

DOA [Department of Agriculture]

DC [Devon Commission]

EKC [Environmental Kuznets Curve]

GST [General Systems Theory]

H.C. [Houses of Commons British Parliamentary Paper]

LST [Living Systems Theory]

NAI [National Archives of Ireland]

NLI [National Library of Ireland]

PCMP [Pre-Capitalist Mode(s) of Production]

PI [Poor Inquiry]

QCA [Qualitative Comparative Analysis]

RDS [Royal Dublin Society]

RIA [Royal Irish Academy]

OSI [Ordnance Survey Ireland]

SET [Social Entropy Theory]

TCD [Trinity College Dublin]

TFR [Total Fertility Rate]

Introduction

The research presented in this thesis began with simple curiosity; it seemed quite untenable, given the ideological loading of the term, that a form of communism had not only occupied extensive tracts of Irish lands throughout history, but that it had survived into recent decades. The rundale system has long held a certain fascination for Irish historians due to its troublesome prevalence in the cartographic record and comparative absence from historical record. As a system of communal cultivation characterised by equality of land allocation through collective governance, popular conflicting accounts have interpreted it both as a functional adaptation to the 'ecological niche' of the Irish Western Seaboard or, controversially, as a modern survival of an archaic, embryonic mode of production of great antiquity. Beyond such empirical concerns with its origins and spatial distribution, the rundale system raises theoretical concerns of some antiquity - such as those concerning the place of communal modes of production as precursors to the development of capitalism within Marxist historical-materialism - and other issues permeating foundational debates of sociology, concerning the relationship between the natural and the social, and systems-based conceptualisations of societies and social order. The emphasis of this thesis is on these latter concerns, and in this sense, the rundale system functions as an empirical anchor around which to develop new conceptual frameworks and methodologies for the investigation of social-ecological systems. Given the specific format of this thesis – more of which presently - it is worth sketching a brief outline of the essential characteristics of rundale in order to provide an intuitive anchor for the theoretical discussions which follow, and to ensure the forthcoming abstractions display a measure of practical relevance.

It is not difficult to appreciate why the rundale system has engendered such fascination; the very prospect of a social form based not on competitive exploitation, but on reciprocity and cooperation offers much to capture the imagination, and the tantalising prospect that its ubiquity should have escaped the physical record has sparked much debate – as yet unresolved - between historians, geographers and archaeologists. Desmond McCourt (1950) began his seminal doctoral thesis on rundale in Ireland by stating that the concept of a singular 'rundale system' was redundant. Rather than a specifically defined entity, the rundale system instead consisted of a configuration of characteristics according to place and time, existing within a framework of broad similarity. Although this variation renders any singular depiction of a homogeneous rundale system problematic, existing literature is emphatic on a number of common structural and institutional characteristics.

Readers who wish to glean advance insight into the specifics of rundale as a coherent system are directed to table 6.4, which details critical identity components, relations, and identity-loss thresholds of the rundale system. This in turn functions as an ideal typical model, in which the manifold complexities of rundale manifest as various concrete configurations. The essential structural and institutional characteristics of rundale are further summarised by Desmond McCourt as follows;

> "The normal economic unit was the joint-farm which was leased in common by the joint-tenants, or partners, who co-operated in the work of the farm, each contributing his share of the joint-rent and combining in the make-up of 'coars' or teams, for ploughing and other work in common. Each townland had one or more such farms depending on the environmental possibilities it offered for settlement and tillage. The land of the joint-farm was held in rundale by which individual holdings, to assure equal quality as well as quantity, consisted of open plots and strips scattered through the arable land...Where physical conditions gave rise to patches of natural meadow by stream, or river, or in many marshy hollows, the same principal of equality governed the allocation of lots, which were held in proportion to the arable shares...This morcellation of property led to confusion and inefficient husbandry, but, carried to excess by continual subdivision of holdings among heirs, especially when population was rapidly increasing relatively fixed areas of land in the nineteenth century, it frequently undermined the whole system...To maintain equality of holding over a period of time and especially to accommodate an increasing number of holders within the open-field community the strips of meadow and arable were redistributed periodically by lot, usually every year, or every three years or so" (1955b: 47-48)

The institutions and practices of the rundale system were thus oriented toward the nominal equalisation of opportunity, and distribution of risk amongst joint stakeholders according to the mechanisms of collective allocation and regulation. Structurally, the nucleated spatial patterning of rundale settlements has served as its core diagnostic criterion, as illustrated below in plate 1. Such settlements, ubiquitous across certain districts of Ireland – particularly the Western Atlantic fringe – are characterised by an absence of typical functional entities associated with villages (i.e. churches and public houses), their haphazard layout, and the close spatial proximity of habitations where residents were often connected by close bonds of kinship.

Plate 1. Townland of Termon, Barony of Erris, Co. Mayo, 1840 (6-inch Ordnance Survey)[1]

Farms were commonly divided into a permanently cultivated infield, surrounded by an outfield which, although not under continuous cultivation, could be set in periodic tillage after fallowing, reclamation, or when the need for additional tillage beyond that supplied by the infield arose. Furthermore the outfield, and its surrounding common lands, served a critical function in the distribution of the commune's fertiliser; throughout the growing season, during which the infield was set under crop, the outfield functioned as a grazing ground for the livestock of the commune, thus ensuring that the forthcoming crop remained undisturbed. The practice of off-site herding known as 'booleying' took place in temporary dwellings located in proximity to the commune, where village herders – often women and children – would tend to livestock. Following harvesting of the autumn crop, livestock returned to graze on the infield stubble, providing a crucial source of fertiliser for subsequent growing seasons. This essential division between infield and outfield is evident below in plates 2 and 3, which illustrate the general morphology of Dooagh village, Co. Mayo.

[1] Ordnance Survey Ireland. 2012.

Plate 2. Village of Dooagh, Achill Island, Co. Mayo, 2006 (Ordnance Survey Arial Photograph)[2]

Plate 3. Village of Dooagh, Achill Island, Co. Mayo, 1840 (6-inch Ordnance Survey)[3]

The apparent haphazardness and disorganisation of both physical layout and cultivation strategies under rundale belie a number of innovations unique to such systems, which served to augment their capacity for agricultural productivity. The rundale system is a phenomenon

[2] Ibid. This 'deltaic fan' configuration is typical of many such coastal settlements. Although comparatively recent, this image illustrates the basic morphological division of infield and outfield; the area immediately surrounding the village typically assumed this role, although smaller individual vegetable plots known as *garraí* were often kept next to houses as private reserves. The majority of tillage was conducted on the infield however, with the outfield occupying a position concentrically distant from the settlement. Lands further afield were typically utilised as commonage for seasonal herding and grazing.

[3] Ibid.

typically associated with peripheral locations of marginal, unproductive land, and is popularly interpreted as a mode of resource governance ideally suited for exploiting conditions of ecological constraint. Consequently, many rundale settlements adopted the practice of setting crops in 'lazy beds', a labour-intensive form of spade husbandry in which crops were sown in ridges interspersed with furrows, thereby providing sufficient drainage, aeration, and permitting the selective application of fertiliser. Such systems of cooperative labour were ideally suited to reclamation, as was often required under the burgeoning demographic regimes of expanded fertility throughout the eighteenth century, and the pooling of both land and labour offered a mechanism by which incentives to hedge resources and labour for individual gain were effectively suppressed.

According to Elinor Ostrom, such systems confer a number of competitive advantages over private proprietorship when resource appropriators are faced with problems such as '...(1) the value of production per unit of land is low, (2) the frequency or dependability of use or yield is low, (3) the possibility of improvement or intensification is low, (4) a large territory is needed for effective use, and (5) relatively large groups are required for capital-investment activities' (1990: 63). Central to coping with these endemic constraints under the Irish rundale system, was the manner in which share allocation was managed through collective consent. Arable land was typically assigned in lots, comprised of scattered strips located in areas of varying soil quality across the infield, according to which each tenant received his land in a series of strips allocated by collective lottery. Permanent boundary demarcations such as fences and ditches were conspicuously absent, given that livestock required free reign of the infield lands in order to provide fertiliser during the winter months. Evidence suggests that a concomitant practice of share reallocation known as 'change-dale' survived within many regions into the nineteenth century; consequently, the tenant received not a specific quantity of ground in private property, but merely the notional entitlement to a share in the lands of the commune. In certain instances, communes were presided over by a communal council or deputed headman who held responsibility for managing share allocations, organising necessary collective works, and the delivery of rents.

Despite the ingenuity of such an approach to share allocation and resource maximisation, the rundale system did not exist in isolation from its broader systemic context, nor was it immune to contradictions from within which served to undermine the fundamental institutions of communal property. Although rundale thrived under conditions favourable to its demographic and physical expansion, its viability suffered under the pressures of market and landlord-driven enclosure, the necessities of combined subsistence and cash-crop production under the estate

system, and the economic and demographic watershed of the Irish famine (1845-1852), where after a succession of state endorsed redistribution schemes served to re-establish former occupants of these 'congested districts' as discrete private proprietors. Contradictions internal to the system also hastened its demise, such as the accumulation of private capital which in turn undermined the capacity of the commune to reproduce itself as a communal entity. Furthermore, the system was prone to interpersonal conflicts concerning boundary demarcation which often ended in troublesome litigation, and the vicissitudes of economy and environment which conspired to critically undermine the very means of subsistence on which the tenantry depended, through the visitation of disease, and the growth of international trade and labour markets which fundamentally altered the incentives of landlordism, and estate management.

Students of the disciplines in which debates on rundale have featured prominently, such as historical geography, may be disappointed by the forthcoming discussions; the objective of this work is not to resolve the question of the origins of rundale, despite the inherent appeal of such speculation. Furthermore, the forthcoming work does not seek to resolve prominent questions concerning the historical morphology of Irish settlement, the hypothesis of the 'Celtic' descent of communality, nor the contentious question of the presence and distribution of the 'Einzelhof' mode of settlement, which so concerned early historical geographers of the Queens School of Irish studies such as Estyn Evans. Instead, the rundale system is here invoked in service of a number of urgently warranted critical investigations concerning current theory and practice in comparative-historical sociology, environmental sociology and human ecology.

Discussion of the specifics of the rundale system is largely reserved for part II, although some reference is made to concrete examples throughout part I as necessary. As a result, the contents of part I are very much directed toward theoretical elaboration and refinement, although this exercise is presented with implicit consideration of its applicability to the specifics of the Irish case study. The core objective of this work is not, however, to develop a model intended merely for the investigation of communal agriculture in nineteenth century Ireland; instead, it seeks to engage with a range of theoretical and substantive issues in sociology, geography, human ecology and methodology. As a result, although the following work functions as an integrated whole, emphasis throughout is on the capacity of its elaborations to address a range of substantive issues beyond the confines of its case study; this alternative methodology is in turn constructed from a close engagement with the informants of systems and complexity theory, Marxist historical materialism, and resilience-based human ecology.

Following the elaboration of this conceptual and methodological template throughout chapters 1 to 5, during which selective vignettes of empirical enrichment are offered as required, this investigative framework is subsequently applied to the phenomenon of rundale, thus offering new perspectives and insights on its ecology, its reproductive dynamics, and its position within the broader matrix of nineteenth-century Irish society. In this sense, the contribution of this work to existing knowledge on rundale concerns moving away from the manner in which it has typically been treated and theorised in existing literature as merely a functional adaptation, or a mode of peasant mentality, toward a more holistic conceptualisation of rundale as a complex social-ecological system[4].

Conceptualising such entities in a systemic manner has proven an elusive prospect within sociological theory, despite the ubiquity of such models in broader scientific fields. The form of critique pursued throughout the first part of this thesis thus speaks to a number of key debates in systemic sociological theory, environmental sociology, Marxian ecological theory, historical materialism, and human ecology. Readers who wish to forearm themselves with some sense of direction are advised to refer to tables 5.1 and 6.1, in which the logical coherence of the forthcoming conceptual and methodological frames is asserted.

To this end, chapters 1 to 5 are structured around a number of related theoretical questions;

1. How might social-ecological systems be conceptualised as combined *social*-ecological systems? Where can the ontological lines between nature and society be drawn? How might change within complex systems be represented or explained?

2. How might information about such systems be organised and represented in a way that approximates their 'actual' dynamics? – is such an approximation of reality possible or desirable?

3. Should such representations conform to an abstract depiction of relations, linkages and mechanisms - as one variant of systems analysis – or should they be quantified?

4. Can such an approximation be triangulated with multiple data sources or modelling strategies? Does this reflect a hierarchy of ontology? Are some systemic dimensions more amenable to certain forms of measurement such as demography or culture?

5. Can stability or sustainability be assessed in a non-normative manner? Is it possible, or desirable to specify 'healthy state' criteria as normative assessment guidelines?

[4] Readers may refer to table 6.3 for an overview of the state of theory, and the range of interpretive theoretical frames typically invoked in existing studies of rundale.

Chapter 1 begins this task with an epistemological foregrounding rooted in a critique of mid-twentieth century general, and social systems theory. The lineage of systemic thought is familiar to all students of social science; what is less well integrated into current sociological theory and practice is the 'second wave' of systemic theory or 'complexity theory', which succeeded the restrictive general systems program. Beginning with a critical re-evaluation of the legacies of Talcott Parsons and other prominent theorists of a systemic orientation, this discussion suggests, in an attempt to re-position the ideological baggage that often accompanies the prospect of systemic representation, that antecedent forms of systemic thought have suffered from misappropriations of key systemic concepts, an overreliance on idealistic structural elaboration, and an excessive recourse to notions of stability and equilibrium. Once these outstanding issues are addressed, an alternative epistemology of the social is advanced, drawing on the informants of complexity, emergence, and critical realism which suggests, contrary to the static, structuralist models advanced by the antecedent general system program, that such systems are inherently dynamic, metabolic entities engaged in a continual exchanging of matter and energy with their environments. These conclusions form the basis of a framework for further theoretical elaboration which seeks both to collapse the natural-social dichotomy, and to represent the heterogeneity of structural variants in a manner which addresses with the complex, multi-scale constitution of such entities.

Chapter 2 addresses both historical and contemporary theory concerning the natural-social dichotomy, which has characterised much environmental-social thought throughout its brief formal history. Given that sociology has thrived on a model of 'Durkheimian exceptionalism' which emphasises the independent-causative properties of the social, and their amenability to measurement and study; existing research exhibits an explicit division between constructivist and realist orientations, according to which a separatist ontology of nature-society is continuously reproduced. In order to recast this restrictive dichotomy, an approach to historical typology in which the primacy of the labour process as mediator between society and nature is outlined, which in turn permits conceiving of the development of human productive forces as historically specific modes of social-ecological metabolism.

Chapter 3 shifts focus toward grounded questions of operationalisation and measurement, by establishing a number of critical points of mutual compatibility between complexity theory and contemporary human ecology. With clear origins in the systems and complexity program, researchers operating under the rubric of resilience ecology have adapted a number of informative heuristics which greatly assist the task of operationalising the abstract informants of chapters 1 and 2. Contrasted with *engineering* resilience as a measure of a systems' return

time to ‘base state’ parameter values following disturbance, *ecological* resilience assesses the amount of disturbance a system may undergo before transition to an alternate state is induced (Gunderson 2003). The probability of a particular system crossing this threshold is determined by its *adaptive capacity*, as a heuristic assessing the systems capability to appropriately respond to feedback. This approach to analysis resolves much of the restrictive ‘optimal state’ assumptions associated with classical systems theory in both sociology and the sciences, and further offers a number of heuristics with which to assess systemic constitution and change, such as the concepts of adaptive cycle, panarchy, regime and identity. Adapting these informants in turn permits the conceptualisation of social-ecological systems as complex entities in a non-hierarchical manner, and to impose a measure of evaluation on their reproductive activities, or ‘adaptive capacities’.

Lacking a coherent theoretical device with which to fully incorporate the social, chapter 4 proposes Marxian historical materialism, and the concept of ‘mode of production’ as a device with which to typify and express the essential dynamics of social systems as historically constituted entities with their own internal logics, and complex trajectories of development. The concept of mode of ‘production’ offers a general, abstract typology of historical forms of social organisation, according to the manner in which surplus products of production are distributed or appropriated. This framework is in turn rooted in an epistemology of totality, which displays evident compatibilities with the informants of complexity. Building on fundamental ontologies of society and nature established in chapter 2 through a discussion of the centrality of the labour process, this chapter examines the mode of production of primitive communism as articulated within Marx’s historical materialist apparatus, in which the dynamics of change are located within an essential dualism of communality and individualism, which pervades and animates communal life.

Having established such a general context, attention turns toward a recent, prominent strain of Marxian eco-criticism, which has sought to recover the concept of ‘metabolic rift’ from Marx’s work, in service of a critique of contemporary capitalism. Chapter 5 suggests that this debate has remained both at too high a level of abstraction, and has seen little implementation in historical-sociological research. Furthermore, the concept of metabolic rift animates the framework of resilience substantially, by theorising the contextual, historical, and ultimately, social conditions under which inequalities of resource distribution manifest. In his critiques of Malthus, Marx made frequent reference to the necessity of historical contextualisation, rather than recourse to immutable laws of population and diminishing returns which posited a trans-historical movement toward resource depletion. Consequently, this chapter sketches the

preliminaries of a crucial informant which sensitises us to the manner in which the social form of rundale in Ireland, as a concrete expression of the mode of production of primitive communism, engendered its own form of metabolic rift specific to its colonial context. Finally, an integrated conceptual framework is advanced, in which attempts are made to draw together the informants of the preceding chapters in order to propose a general theoretical framework informed by critical realism, for the unification of the natural and the social according to the substantive requirements of historical-sociological investigation.

Chapters 6, 7 and 8 build on the tentative empirical enrichments offered throughout chapters 1 to 5, and are structured around a number of substantive research questions, specifically;

1. How might an understanding of the social form of rundale be advanced which is both historically grounded, yet open to incorporate its many variants? How may its development be conceptualised and represented as a dynamic process? What is the essential category with which this explication might be grounded?

2. In what sense have previous studies succumbed to various forms of reductionist determinism, or essentialism in their analyses of rundale? In this respect, how might a complexity-informed framework address the prospect of balancing generalizability and specificity through the development of ideal types?

3. How might the differential distribution of ecological risk, in the form of diminished capacity for resilience, be quantified? How does communality feature within, and inform the generation of, this macro-typology?

4. What forms did the relationship between communality and resilience take, and what specific variables functioned to augment, or diminish probabilities of resilience at settlement level? How might such an assessment be operationalised?

5. What were the concrete forms of configurational diversity within rundale, what did these regimes look like, and where were they located?

6. How did rundale communes augment their adaptive capacities from below through purposive intervention? How did these specific strategies work, and what forms did they take? Was the rundale system sustainable?

Chapters 6, 7 and 8 thus begin a more extensive empirical enrichment of the general framework established in part I. Chapter 6 outlines a case-oriented methodology for the investigation of social-ecological systems drawing on the work of Charles Ragin and David Byrne, which maps the heuristics of chapters 1 to 5 onto a clear methodological template. The remainder of this chapter details the social form of communality in Ireland, by examining the specific nature of communal property such as it manifested in the colonial context of Ireland. This material is enriched with the comments of Marx and Engels on Ireland, after which a model of the macro-

complexities of Irish social structure is outlined, which in turn speaks critically to more restrictive characterisations of Irish society of this time. Finally, the chapter concludes by offering an overview of a number of implicit and explicit forms of determinism to which existing studies and theoretical pronouncements on rundale have succumbed. A brief 'sociology of knowledge' is offered, before an ideal-typical model of rundale, rooted in a resilience and complexity-informed framework of systemic identity is offered.

Chapter 7 begins a more grounded operationalisation of theoretical informants, by subjecting an aggregate, county-level dataset (N=32) to an optimisation clustering procedure, in order to assess the potential differential distribution of resilience across the 'state space' of nineteenth century Ireland. This typology offers a cursory, albeit case-oriented analysis of the presence of various 'social-ecological regimes', according to which certain areas, exhibiting significant correlations with high levels of rundale, are observed to occupy particularly tenuous positions. This exercise addresses a number of existing works which have sought to reduce the macro-complexities of Irish social structure in their assessments of the impact of the Irish famine. Following the establishment of this contextual framework, investigation turns to a lower level of aggregation, in which a set of union level data (N=130) are subjected to a series of exploratory regressions, employing a number of resilience indicators as outcome. Results of this exercise illustrate the aggregate, negative effect of communality on outcomes such as seasonal consistency of yield, and uptake of relief rations during the famine period. Furthermore, this exploratory work illustrates trends concerning diminishing long-run fertility which corroborate the predictive and explanatory capacities of the concept of metabolic rift.

Chapter 8 examines the internal complexities of 'regimes of communality' by subjecting the preceding datasets to a qualitative comparative analysis, in which significant diversity is identified in the configurations of relations and attributes giving rise to higher densities of rundale. This intuitively case-centered exercise is in turn invoked as further corroboration of the necessity of a 'mode of production' approach, which is capable of conceptualising the co-existence of multiple modes of production in varying states of devolution according to place and time. Finally, focus shifts toward a qualitative explication of the strategies employed by rundale communes in order to augment their adaptive capacities, such as the mechanisms of communal governance and share allocation, their specific strategies and techniques of tillage and pastoralism, and the manner in which limited fertilisation resources were maximised through modes of communal regulation. Chapter 8 conclude by examining the decline and subsumption of the rundale system as a consequence not only of growing internal conflicts, but of its relations with the colonial apparatus, and the burgeoning world system.

Finally, the critical question of sustainability is considered, and it is concluded that although the rundale system exhibited many strategies and adaptations of considerable ingenuity, that ultimately, context is crucial. Furthermore, it is not only context which matters, but also insights on conflict *internal* to the system, driven by tensions between communality and individualism as revealed through Marx's pronouncements on primitive communism and metabolic rift which render this crucial source of compromised viability visible. Finally, consideration is given to the implications of this research for future conceptual elaboration, and substantive work in environmental sociology. In doing so, the utility of the conceptual and methodological approaches developed and employed within this thesis is asserted as a means not only of assessing the ecological dynamics of precapitalist modes of production, but as transferable guidelines for contemporary study which eschew methodological partisanship, insist on the abandonment of restrictive, divisive ontological separatisms, and assert the necessity of cross-disciplinary collaboration. These conclusions suggests that future research stands to be enriched substantially by retaining the possibilities of the systemic program, and by holding firm - albeit with significant qualification - to questions of causality, sustainability, and normative assessment inherent in the 'modernist promise'.

Plate 4. Village of Dooagh, Achill Island, Co. Mayo, circa 1880-1900[5]

[5] French, Robert. 1880-1900. "Donach [sic] Village, Achill Island, Co. Mayo" *National Library of Ireland; The Lawrence Photograph Collection*, 192. W.L.

"What is under postmodern fire, however, is perhaps less the notion of some practical ranking of priorities than the assumption that such priorities are eternal and immutable…it is just *absolute* hierarchies which postmodernists find insidious. But there seems nothing terribly objectionable about absolute hierarchies either. It is hard to imagine a situation in which tickling the starving would be preferable to feeding them...."

- Terry Eagleton, *The Illusions of Postmodernism* (1996:94)

1

The evolution of systemic theory: foundational epistemologies for the analysis of socioecological systems

As an exercise in early twentieth-century interdisciplinary collaboration, *general systems theory* confronted the perceived limitations of post-industrial revolution scientific reductionism, by offering a generalisable conceptual apparatus for the description of multiple variants of social and natural systems. Within this chapter, specific attention is paid to Parsonian functionalism, as a perspective which appropriated emerging scientific concepts of organicism, evolution and mechanicism, and consequently drew much criticism both within and beyond the social sciences for its misappropriation of key systemic concepts. Sociology has endured a consequent hostility to systemic approaches due to a perceived inseparability of the notion of function from its parent conceptual model of the social system. The forthcoming discussion thus argues the separatism of functional logic from the exercise of systemic model specification, in light both of functionalism's foregoing misuse of the mechanicist concept of equilibrium, and its abstract level of modeling with the social role as analytical unit.

In concert with this critique, a brief history of later twentieth-century general systems theory is offered, paying particular attention to its development of structural models, and its articulation of the components and subsystems of metabolic maintenance. Consideration suggests that ultimately, general systems theory's specification of structure retains an ontological separation of nature and society, and further demonstrates insensitivity to historical contingency through its focus on cross-sectional structural specification. Consequently, recent developments in complexity theory are outlined with a view to forwarding a process-oriented model of systemic constitution capable of coping with contingent interactions in complex, open systems. To this end, the conceptual and methodological linearism of general systems theory is criticized, and an alternative set of concepts and ontological groundings, rooted in complexity theory and critical realism is offered. The subsequent re-orientation of the systemic apparatus toward social systems as dissipative, metabolic entities allows us to overcome the static limitations of previous iterations of systems theory, whilst retaining a 'systemic', yet generalisable approach to the analysis of heterogeneous social-ecological systems. This alternative epistemological grounding is offered as a foundation from which to introduce the contributions of resilience ecology, metabolic rift and mode of production in subsequent chapters, as well as a basis from which to incorporate new developments in case-oriented, comparative methodologies.

1.1. Situating the significance of systemic thought

To characterise Parsonian functionalism as the foundation from which modern sociology emerged undoubtedly glosses over the complexities of sociology's development as a heterogeneous discipline. Such a conclusion does however, reflect a general tendency within social theory texts to present the development of social thought as a roughly linear progression from preoccupations of grand theory, to a state of methodological and theoretical pluralism (Wallace and Wolf 2006; Johnson 2008; Turner 2009). For the social sciences in general, their current state of epistemological plurality is a consequence of decades of critical dialogue with functionalist thought, the origins of which will here be located within a matrix of broader developments in systemic and scientific thinking from beyond its own disciplinary boundaries. In this sense, Talcott Parsons' synthesis of European (Weberian) social thought and cybernetics, as a corrective to the empiricism of practitioners such as Robert Park, and prior 'atomistic mechanisms' of defunct social Darwinism, is regarded a key turning point toward more theoretical orientations for sociology in general (Hammond 2003). Such a conclusion undoubtedly glosses over the presence of multiple disciplinary foundations and trajectories according to place and time, but within the history of Irish sociology, it is perhaps somewhat more recognizable in terms of its influence.

Irish social science is indelibly imprinted with the theoretical legacy of early twentieth century functionalist systems theory, and the classical depiction of Irish society as one of a 'homogeneous, traditional peasant culture' (Gibbon, 1973: 485) forwarded by Arensberg and Kimball (1968), owes its origins to a particular brand of functionalist thought, the popularity of which was in full sway amongst American social scientists of the 1930's. In this respect, Byrne, Edmondson and Varley's introduction to the reissue of Arensberg and Kimball's '*Family and Community in Ireland'* pays particular attention to Lloyd Warner's[6] use of functionalist theory within his own studies of American urban neighbourhoods. According to Byrne et al, this manifested as an "…[interest] in making comparisons between modern and traditional societies, in categorizing cultures along a continuum ranging from 'simple' to 'complex', and in making universal generalizations about human behaviour." (Byrne,

[6] Wilson was responsible for directing the anthropological fieldwork of the Harvard Irish Study (1931-1936), through which Arensberg and Kimball completed their doctoral fieldwork in Co. Clare. Arensberg's foreword the *Family and Community*, reflecting Warner's perspective, states; '...to a certain approximation it is useful to regard society as an integrated system of mutually inter-related and functionally inter-dependent parts' (1968: xxx). It is perhaps no coincidence that Arensberg began his anthropological career as an undergraduate field researcher in Warner's urban projects.

Edmondson and Varley, 2001: xxxii). The 'systematic' element of such early functionalist thought thus resided in its cross-population applicability as a general framework of social inquiry, and narrative of social order.

The origins of such modes of reasoning are familiar to all students of sociology, and are crudely traceable to Durkheim's earlier concerns with the interconnectedness of institutions, and their respective roles in maintaining social order through value consensus. Despite extensive subsequent debate concerning the validity of such grand theories however, this view of early twentieth century Irish society as a functionally static unit of cooperative labour, impartible inheritance, and generational extension within the household unit held currency for many decades. Consequently, this perspective remained largely unchallenged until extensive disagreement erupted amongst historical demographers concerning the extent and distribution of the stem family in national-level analyses of household structure throughout this period (Gibbon 1973, Gibbon & Curtin 1978, Fitzpatrick 1983, Varley 1983, O'Neill 1984, Corrigan 1993, Gray 2008)[7]. What is therefore important to acknowledge from the beginning is that aside from the questionable empirical history of Irish social structure, the 'application of ideas' itself has its own history, the genesis of which must be located beyond the borders of Ireland. Far from a discursive exercise in the history of social thought, an overview of the development of the social-scientific project of grand theory reveals moments of striking interdisciplinary dialogue, and offers a point of departure from which to assess the conceptual trajectories and subsequent specializations of the various disciplines under consideration within this thesis. The dominant theoretical perspective of this period of 'society as a functioning system' owes it origins to functionalists' appropriation of 'scientism' as a project of totalizing theory, a project under which early twentieth-century natural scientists were beginning to move away from reductionist atomism, toward holistic models of complex entities as integrated systems. Accordingly, considering the object of the forthcoming case study is consistently, and ambiguously identified as a 'system' itself, it seems appropriate to afford this essential concept some attention in the abstract[8]. The stated objective of furthering an analytical framework for

[7] This contextual note is included in order to illustrate the stability of such a perspective throughout the formative period of Irish sociology, and the importance of recognising the influence of global debates on regional interpretations. Within the history of Irish sociology, the discarding of Arensberg and Kimball's framework must be recognised as a key point of reference from which much subsequent debate and research on Irish social structure continued.

[8] This review purposively excludes detailed discussion of applied socioeconomic systems theories such as modernization, dependency and world systems, as these fall within the remit of an economic contextualization of the research area in chapter 6 (although references will be introduced as required for substantiation). Furthermore, world-systems analysts have contributed substantially, to developments in the concept and study of metabolic rift, and this coherent body of literature is afforded specific attention in chapter 5 (see Moore 2000).

the study of social-ecological systems is thus contextualized within the historical development of what is typically referred to as *general systems theory*. To this end, an introductory overview of general and living systems theory is first offered as a point of departure with which to appreciate the adoption, and incorporation of such core systemic concepts within sociology. With this in mind, the forthcoming sub-sections (sections 1.1.1 to 1.1.3) pay critical attention to the attempts of various social and physical scientists to subsume the complexities of social organisation and historical contingency within totalizing models of systemic structure. This objective is pursued in order both to contextualise the emergence of complexity theory as a crucial informant of the methodology of this thesis, and to dispel the ideological baggage of the concept of system.

1.1.1. The 'first wave' of general systems theory

Thomas Kuhn (1962) has suggested that the history of scientific practice is that of a succession of revolutionary paradigms, in which modes of thought are progressively supplanted by incompatible new forms. A 'normal science' of consensus amongst practitioners is defined by Kuhn as one which '…like an accepted judicial decision in the common law, is an object for further articulation and specification under new or more stringent conditions' (1962: 23). This process of paradigmatic succession may be conceptualised as one of 'consensuses followed by 'crisis', throughout which practitioners divide allegiance; the success of paradigmatic succession is therefore dependent on the explanatory capabilities of the new, giving rise to a period of 'normal science'. These dominant 'normal science' paradigms are considered by Kuhn to be irreconcilable to the conditions of their predecessors (1962: 103)[9]. The history of systemic thought, much less that of sociological thought, does not quite fit within this remit of paradigmatic succession, although various authors have suggested that a current growing multidisciplinary emphasis on systems and complexity theory may slowly be creating a new Kuhnian paradigm (Urry 2005a; Castellani and Hafferty 2009: 119). The attractiveness of a coherent research programme framed within the confines of a totalizing theoretical apparatus is however, evident within the ruminations of early general systems theorists, and its trajectory and resilience in various forms across the twentieth century attests to its lingering appeal, if not it's practical utility.

[9] The relative youth of sociology in comparison to that of the 'mature' physical sciences may account for the current ambiguity of its epistemology and subject matter – although the postmodern turn offers little evidence of a trajectory corresponding to that of Kuhn (Eliot and Kiel 2004; Harvey and Reed 2004). Conversely, authors such as Masterman (1970) and Lakatos (1978) have suggested that it is possible for disciplines to experience periods of 'non-paradigm, multi-paradigm, or dual paradigm activity' (cited in Johnston and Sidaway 2004: 12).

Writing in 1956, in response to Ludwig von Bertalanffy's *General System Theory: A New Approach to Unity of Science*, (1951) Kenneth Boulding described general systems theory as a '…skeleton of science…on which to hang the flesh and blood of particular disciplines' (1956: 208). The 'skeleton' of systems theory to which Boulding referred was generating some interest across numerous disciplines as a potential 'gestalt' communicative device;

> "Thus the economist who realizes the strong formal similarity between utility theory in economics and field theory in physics is probably in a better position to learn from the physicists than one who does not. Similarly a specialist who works with the growth concept-whether the crystallographer, the virologist, the cytologist, the physiologist, the psychologist, the sociologist or the economist-will be more sensitive to the contributions of other fields if he is aware of the many similarities of the growth process in widely different empirical fields" (ibid: 199).

Seven years previous in 1949, a meeting of researchers under the broad rubric of the behavioural sciences convened at the University of Michigan to discuss the possibility of formalizing an empirically testable general theory of social and natural systems (Miller 1955)[10]. The idea of constructing such a collaborative model had already been mooted by Von Bertalanffy in 1937 during a seminar delivered at the University of Chicago, as a corrective to post-industrial revolution reductionist scientific methodology and mechanist reasoning, which had, in his opinion, remained stubbornly resilient in academic practice (Hammond 2003: 104). Three years after Miller's initial meetings in 1949, the group, now comprised of representatives from history, anthropology, economics, political science, sociology, psychology, medicine, physiology, and mathematical biology, had managed to sketch a remarkably comprehensive working programme of general systems principles (Miller 1955). Attesting to their organizational stability, if not their programmatic agreement, Kenneth Bailey delivered his presidential address to the *48th International Society for the Systems Sciences Annual Conference* in 2005, remarking on the continued relevance of the initial remit of Miller's precursor group to '…encourage the development of theoretical systems which are applicable to more than one of the traditional departments of knowledge' (Bailey 2005: 365).

[10] A comprehensive, but disjointed history of this group, variously operating as the *Committee on the Behavioral Sciences*, the *Center for Advanced Study in the Behavioral Sciences* (under the auspices of the Ford Foundation (est. 1936), and the *International Society for the Systems Sciences* is offered in Debora Hammond's (2003) *The Science of Synthesis: Exploring the Social Implications of General Systems Theory*. The political implications of post-war research funding, and the humanistic connotations of holistic conceptualisation are also addressed. The term *General Systems Theory* is credited to Ludwig Von Bertalanffy (1901-1972), whereas *Living Systems Theory* is credited to James Grier Miller's (b1916) publication of the same name (1978). These terms are used interchangeably, as both approaches inform and complement each other, and the authors share common origins in the above groups – the term 'systems theory' is a non-specific umbrella term for work within these traditions. The intricacies of these earlier debates and divergences are beyond the scope of this present discussion, and the reader is directed to Hammond (2003) and Skyttner (2005) for a comprehensive history.

According to Graeme Snooks, '…the holy grail of systems theory is the development of a general dynamic theory that can explain and predict the emergence of order and complexity in a universe of increasing entropy' (2008: 12). Skyttner describes general systems theory as operating on an abstract level '…with general properties of systems, regardless of physical form or domain of application…as an epistemology [which] structures not only our thinking about reality but also our thinking about thinking itself' (Skyttner 2005: 40). The current body of knowledge referred to as 'general systems theory', including output both during, and subsequent to the foundation of the 'Michigan' group, includes Kenneth Boulding's *Hierarchy of Systems Complexity* (pub. 1956), James Grier Miller's *General Living Systems Theory* (pub. 1978), James Lovelock's *Gaia Hypothesis* (pub. 1979), Kenneth Bailey's *Social Entropy Theory* (Bailey 2006, 2008), and Immanuel Wallerstein's world systems theory (Wallerstein 1974)[11].

Although Ludwig Von Bertalanffy's *General Systems Theory* is typically identified as the first comprehensive work in the field (Castellani and Hafferty 2009), it is James Grier Miller's *Living Systems Theory* that has served as a point of departure for much subsequent debate, and Von Bertalanffy's precursory organicist work is generally interpreted as an attempt to move beyond the mechanicist-vitalist debates and methodologies of the early twentieth century. Mechanicism, with its origins in Newtonian mechanics and the Cartesian separation of mind and matter, operated under an assumption of '…matter as dynamic and self-moving, in which the principle of organization is inherent' (Hammond 2003: 36), offering a material, molecular basis from which to comprehend complex organisms. Early organicists such as Von Bertalanffy thus sought to reorient such a conceptual approach through reference to Darwin's specification that open systems tended toward higher-order complexities; '…if the existence of an organism is dependent upon its emergent level of organization, then it cannot be reduced to something less complex…it must be studied as a system' (Castellani and Hafferty 2009: 114).

Hall and Fagan offer the following broad definition of system, distinguishing between open and closed;

> "Most organic systems are open, meaning they exchange materials, energies, or information with their environments. A system is closed if there is no import of energies in any of its forms such as information, heat, physical materials, etc…for a given system, the environment is the set of all objects a change in whose attributes affect the system

[11] Wallerstein would later come to adopt developments in 'third wave' systems theory such as chaos and complexity (Castellani and Hafferty 2009). His 2006 *World-Systems Analysis: An Introduction* includes a chapter appropriately titled 'The Modern World-System in crisis: Bifurcation, Chaos and Choices'.

and also those objects whose attributes are changed by the behaviour of the system" (Hall and Fagen 1956 cited in Bailey 1984: 8).

Von Bertalanffy's crucial contribution was thus to advance further the concept of an open system as applied to the study of biological life, by suggesting that such systems be conceptualised as existing in a state of perpetual flow, '…by taking in a continuous supply of energy and exchanging components with its environment' (Hammond 2003: 116). According to this definition, social systems belong to the category of open system, as they require constant material exchange (i.e. the expulsion and appropriation of entropy), in order to successfully reproduce[12]. The open system differs from the closed in that '…in a closed system the inputs are determined once and for all; in an open system additional inputs are admitted from its environment' (Skyttner 2005: 53). This difference is essential to bear in mind, as a number of critical issues with functionalism's conflation of concepts intended for the description of closed systems with open systems will later be encountered. Conceptualizing organic life as a hierarchy of organisation was therefore essential for Bertalanffy in order to overcome the restrictions of thermodynamic law to closed systems; the 'steady state' of the open system was thus maintained by a combination of processes at various levels of organisation, which functioned to regulate matter-energy exchange.

In terms of systemic structure, it is Miller's Living systems theory which stands as exemplary of systems theorists endeavours to establish an exhaustive conceptual schema to which all organizational levels of human biological and social life were to be consigned[13]. Accordingly, Miller's seminal contribution identifies eight levels of hierarchical organisation, within which all forms of human and non-human collectives may be categorized: the cell, organ, organism, group, organization, community, society, and the supranational (Miller et al 1992: 3, Bailey 2006: 292). Miller's model further maintains that the concrete complexities of all biosocial life may be understood as various manifestations of 'structured open systems…[that] maintain within their boundaries their thermodynamically improbable energic states by continuous interactions with their environments' (Miller at al 1992).

The above organizational levels encompass a range of concrete systems from the human body (organism), to institutions of transnational governance (supranational), a model in which

[12] This distinction is further credited to Alfred Lotka's work (Costanza et al 1997).

[13] Cillers loosely defines structure as the '…internal mechanism[s] developed by the system to receive, encode, transform and store information on the one hand, and to react to such information by some form of output on the other' (Cillers 1998: 89). The elaboration of such structural models is thus concerned with articulating the forms of hierarchical organisation which constitute such systems, the elements that execute informed actions, and the relations between such elements.

'…systems at higher levels are suprasystems of their component lower-level systems' (Miller 1992: 2). The hierarchy itself is therefore considered sufficiently broad to accommodate variation amongst systems in terms of size, structure, and organizational complexity. Energetic states are purportedly maintained within the system boundaries by continuous interaction with the environment, from which matter, energy and information are appropriated, and to which outputs of product and waste are expelled. These collective processes are conceptualised as essentially metabolic;

> "All living systems have requirement[s] for specific sorts of matter and energy…they must secure food, fuel and other necessary inputs. They must process their inputs in various ways to make it possible for them to maintain their structure, to reproduce, to make products, and to carry out other essential activities of life. The metabolism of matter and energy is the energetics of living systems." (Miller 1992: 2)

These levels of living systems theory, and their attendant subsystems constitute, according to Skyttner, a 'near total agreement on which properties together comprise a general systems theory of open systems' (Skyttner 2005: 53). Despite the manifest implausibility of such a generalisable model, and its arguably limited investigative utility at lower levels of abstraction, its re-articulation within recent papers by Bailey (2006; 2008) corroborates something of its historical stability in academic usage. More worrying still is the restrictive manner in which this particular strain of systems theory deals with the notion of systemic stability; failures of operation or imbalances of function are expressed as pathology, or; '…a state in any living system in which, for a significant period, either one or more of its critical variables remain beyond the normal steady-state range…Either malfunctioning of the system's own subsystems, or stresses, e.g., unfavourable conditions in the environment or suprasystems, can force variables out of their normal steady-state range' (Miller 1992: 4)[14]

[14] The concept of stability with regard to social systems traces its origins to the nineteenth century work of the social physics tradition, exemplified by Vilfredo Pareto, whose concept of human collectives as systems consisted; '...of elements in mutual interrelations which may be in a state of equilibrium, such that any moderate changes in the elements or their interrelations away from the equilibrium position are counterbalanced by changes tending to restore it" (Buckley 1967: 9). It is here the genesis of the analogy of equilibrium as applied to social systems is observed, through Pareto's characterisation of the social system as one which strives to maintain such a stable state (Sciortino 2009: 106). Concerns with the interconnectedness of nature and society were also beginning to solidify as a separate field of inquiry, leading Herbert Spencer (1820-1903)[14] to extend Darwin's theories of evolution by natural selection to the study of social evolution (Hammond 2003; Barry 2007), resulting in a 'scientific' legitimation of the principles of classical free-market liberalism and selective population control. Spencer himself had trained as an engineer and, according to Sharon Kingsland, 'conceived of nature in self-regulating terms, as a moving equilibrium between opposing forces' (Kingsland cited in Hammond 2003: 78). Interestingly, this concept of 'moving equilibrium' would later be appropriated by Parsons in an attempt to integrate adjustment (but ultimately not outright change) into his conservative model of social systems (Buckley 1967).

Furthermore, the level of generality and abstraction at which such models are pitched renders their adoption, much less their operationalisation as analytical devices decidedly problematic. This is especially true of its utility within sociology; there is clearly a scale of ontological abstraction to the metabolic process according to various levels of the hierarchies of living systems theory, as the metabolic process is clearly objective at the level of the organism, whereby the elements of matter and energy processing and circulation are physically identifiable. Through study and experimentation, accurate prediction of future states and outcomes for the organism is possible, owing to the relative organizational simplicity of the system; its function is reducible to general laws, and it is a closed system with definable boundaries. An objective mechanism of metabolism is more difficult to locate at the level of the social. This difference of predictive capacity according to organizational level is summarized by Sawyer;

> "When the laws governing a system are relatively simple, the system's behavior is easy to understand, explain, and predict. At the other extreme, some systems seem to behave randomly. There may be laws governing the behavior of a system of this type, but the system is highly nonlinear – small variations in the state of the system at one time could result in very large changes to later states of the system." (2005: 3)

What the systems perspective emphasises through its hierarchy of organisation is that the presence of multiple objective metabolic processes (i.e. agriculture or human metabolism) at specific organizational levels does not limit analysis and generalization to an assemblage of case studies, but rather suggests the presence of an abstract mechanism through which these multiple lower-level metabolic processes may be ordered. What systems theorists have failed to specify however, is the mechanism through which such processes become dialectically embedded in the actions of both social institutions, and cultural & social systems, producing a *social*-ecological metabolism. Clearly a singular concept of stability renders such an exercise futile, and the alternative prospect of merely aggregating localized case studies in order to produce an understanding of complex 'wholes' is clearly unproductive (Costanza et al 1997). It must therefore be concluded that although general and living systems theory as outlined above, offers the prospect of transplanting conceptual ordering devices, it encourages local knowledge to conform to its static, empiricist subsystems models, whilst reducing the assessment of complex collective interactions to a singular restrictive measure of pathology or stable state[15].

[15] Recent attempts to pointedly operationalise such measures of disorder include the analogical adoption of the concept of entropy (Miller 1992; Bailey 2006). The laws of the conservation of energy specify that closed systems, in their appropriation of energy, transform such energies into increasingly diffuse and less useful forms (Atkins 2007). A key principle of systems theory is that open living systems by necessity counteract this tendency by appropriating more energy from their environments, stored as surplus energy; degradation of structure is consequently conditional on this reverse process of negentropy. This level of analysis is clearly beyond the scope of conventional sociology, due to the

The essential tenets of the general systems program, such as they inform the objectives of this research, may be summarised as follows; (1) a distinction between closed engineering systems, and open social/ecological systems; (2) the centrality of mechanisms of metabolic exchange to an overall understanding of systemic integrity; (3) a structuralist orientation to description and representation, and (4) recourse to restrictive heuristics of systemic stability rooted in reductionist epistemology. On the basis of these antecedents, it is not difficult to appreciate why sociology has been quick to largely eliminate systemic theory from its intellectual canon. It is throughout this early development of systems theory however, that the genesis of restrictive mechanistic and organicist concepts of collectives, and their later retention in attempts to forward a separatist programme of 'normal science' for the emerging discipline of sociology, is observed. The preceding overview thus facilitates appreciation of the genesis of reductionist-atomism, and organismic analogizing as informants of social-scientific epistemology, and their resultant preoccupations with decomposition and fragmentation, such as they informed concept building in the social sciences[16].

Consequently, discussion now moves to examine the contributions of sociology's most prominent systemic incarnation; that of Parsonian functionalism (Turner 1991; Bailey 1994; Wallace and Wolf 2006; Johnson 2008; Sciortino 2009; Holmwood 2009). This historical overview continues by contextualizing the 'scientific' programme pursued by Parsons, and suggests that by establishing such a context, the more useful components of functionalist systemic analysis may be separated, and some of its more potent criticisms recast. The familiar context of 'organismic analogising' associated with functionalist thought was established in parallel with the developments outlined above, and the promise of scientific legitimacy offered by formalising coherent systemic concepts and general laws would profoundly influence the intellectual thrust of Talcott Parsons.

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impossible task of quantifying various processes in terms of energy conservation (although this task further depends on the level of abstraction or aggregation at which the analyst work – cybernetics, for example considers detail dispensable in the production of explanatory algorithms). Furthermore, the forms of 'flow and availability' of energy within social systems are clearly conditioned by the social form under which such physical processes occur. Variables within agricultural systems such as available energy, efficiency of production and transformation of energy forms clearly depend on the influence of abstract social processes and institutions operating both within and beyond the system boundaries.

[16] Precursors to such orientations within the social sciences were evident in the nineteenth century, as the intensification of the subjective / objective dichotomy considered crucial to the separation of science from church teleology of the middle ages continued with Auguste Comte. According to Comte, the object of science was the collection of material knowledge by the objective observer, with explanation and prediction as its aim. Critiqued by sociologists today as a model of positivist epistemology, Comte's formulation held that universal, natural laws of nature, human nature and society, could be uncovered through scientific investigation (Johnson 2008: 14). The collection of facts allowed the researcher to generalise by identifying pattern and regularity, through an interpretive philosophy emphasising the objectivity of reality, empiricism, and methodological monism (Skyttner 2005: 19).

It fell to early functionalist social theorists such as Parsons to satisfy the requirements of normal science by offering a systematic body of theory with which to integrate empirical data; the project of normalisation for sociology, however, was far from linear. In this sense, Manuel-Navarette (2008) suggests that past reliance upon simple systems modeling owes its origins to the historical development of Western Science, and that '…the excessive reliability of social sciences on the paradigms and methods employed in physics have provoked a misrepresentation of what a social system is and what aspects or elements it includes' (Manuel-Navarette 2008: 3). The outstanding task, post-deconstruction of these foundational concepts of sociological theory, is to examine how such simple abstractions and reductionisms have been addressed, and indeed reinvigorated, by practitioners of complexity theory.

1.1.2. *First-wave* social systems theory: decoupling structure from function

According to Dickens, early sociological theory was '...largely constructed using analogies between societies and nature...thus societies were seen as if they were developing like live organisms, or people were seen as struggling for survival in their environment' (Dickens 1992: 56 cited in Barry 2007: 65). The historical antecedents of this mode of thought within the natural sciences have been outlined above, and interpreted as a consequence of multiple advancements across a range of embryonic disciplines over many centuries. Within this complex matrix, contributions such as Kant's separation of reason from faith further emphasised the plurality of disciplinary truth claims, and the limitation of scientific knowledge to that of the empirical, resulting in an implicit hierarchy of validity, to which the scientific method, and its attendant reductionist epistemology was accorded primacy. The context of such a conceptualisation by Kant of 'knowledge as self-critical reason' is identified by Delanty as exemplary of the ideas of scientific modernism (Delanty 2009). Sawyer further imposes a narrative similar to that presented above upon the development of social-scientific epistemology from its natural science informants since the nineteenth century; 'Since the nineteenth century, most physical and biological scientists have been reductionist atomists, believing that the only scientific way to understand a complex system is to first analyze it into its component parts, then discover the rules and laws that describe these components, and finally analyze interactions among the parts.' (Sawyer, 2005: 27)

This epistemology of reductionist *atomism* may be counterpoised with its logical opposite of *holism*, which holds that '…some complex systemic phenomena…must be studied in their own terms; that mechanistic, reductionist methods are not applicable to such systems; and that no

part can be understood except in relation to the entire system.' (Gellner [1956] 1968; Phillips 1978 cited in Sawyer, 2005: 28). The principles of the early twentieth-century *organicists* thus embodied this holistic reaction to mechanistic reductionism, with Von Bertalanffy as their most notable proponent, offering an alternative basis from which modern systems theory would later develop. With the exception of a brief period in the late twentieth century during which complexity theory received some renewed attention however, the reductionist paradigm has remained almost entirely dominant in the physical sciences (Sawyer 2005). Despite this stability, the organicist approach, as a platform for systemic theorising, did enjoy greater success than other holistic alternatives such as late nineteenth-century vitalism - with its notions of 'immaterial or supernatural forces as ordering mechanism' - in critiquing reductionist approaches (Hammond 2003: 33). The roots of the organicist conception of totality, and its subsequent appropriation into social theory thus emerged within biology, with J.S. Haldne, and E.S. Russell, whose rejections of both reductionism and mechanicism '...allows us to look on the living things as a functional unity…and to realize how all its activities…subserve in cooperation with one another the primary end of development, maintenance and reproduction' (Russell 1930 cited in Hammond 2003: 33). Biochemist Lawrence Henderson's work subsequently analogised social control to the regulatory systems of biological organisms, a perspective which was to prove highly influential for both Talcott Parsons and Robert Merton (Hammond 2003: 41).

Such organismic perspectives in biology emerged in an attempt to resolve the dichotomy of '...(1) the nature of life and the relationship between biological/psychological and physical/chemical phenomena, and (2) the processes of evolution and development' (Hammond 2003: 32). Such an approach, in turn, resulted in a tendency to view the manifest phenomena arising from the actions of constituent parts as more complex than the parts themselves, and irreducible to the parts alone. Despite its appearant origins in a materialist critique of vitalism, these principles of organicist holism imparted a non-descript function of self-organisation to the system as a whole, with comparatively little consideration of the material bases, or concrete interactions which may have produced such manifold stabilities (Levins and Lewontin, 1985: 135). The task of separating these perspectives of reductionism and holism is further complicated by Sawyer's contention that the social sciences have struggled to resolve this dichotomy since their formalisation in the nineteenth century. This tension has variously manifested as internal conflicts of ontology within the analytical approaches of individual practitioners, suggesting that dualisms of holism and reductionism are evident within individual frameworks;

> "Holists have always faced the difficult task of ontologically grounding their antireductionism…Durkheim dedicated a great deal of theoretical effort attempting to ground his sociological holism, opposing it to the nonholist theories of Tarde, Simmel, and others…If the holist accepts the ontological position of materialism – only physical matter exists – then on what grounds can an antireductionist argument be made? After all, a higher-level phenomenon is nothing but its component matter. From the late nineteenth century through the 1920s, many holists rejected materialism and held to dualist ontologies such as *vitalism* and *organicism*." (Sawyer, 2005: 27)

Prior to the articulation of organicist alternatives, and lacking a theory connecting constituent parts to their manifest 'wholes', classical social theorists thus reverted to such vague notions of inherent vitalism, or, as with Simmel, avoided the problem entirely through excessive organic analogising[17]. What is observed paradoxically in Sawyers' quotation on vitalism above, is a reconciliation of the principles of scientism – if not in its atomistic-reductionist form – with Durkheim's social scientific holism, through his adoption of organicism; demonstrating a critical point of continuity between the development of scientific thought and the subsequent development of systemic social theory. Durkheim's predecessors such as Herbert Spencer, clearly held to a more extreme form of reductionist biological analogising, by interpreting social evolution as a process of increasing structural complexity and specialisation, processes for which they identified clear concrete parallels in biological evolution (Delanty 2009: 25). Durkheim's similar commitment to the existence of external ordering devices is evident in his concept of the social fact, with which he expressed the externality of mechanisms of social attachment in the production of social integration (Johnson 2008). He held fast to Pareto's notions of stability and equilibrium however, and Sciortino suggests his work should be interpreted as attempt to push these notions beyond the realm of the descriptive;

> "...he argued that, when functional analysis was applied to issues of institutional stability and change, its status was not merely descriptive. To explain such long-term stability, it was necessary to show how the unintended consequences of actions or processes – patterned through a given institutional order – could produce a set of structural conditions where further actions and processes of the same kind will occur. In these cases, if the existence of a functional relationship could be successfully identified, such analysis would be crucial also to *explain* its persistence or constrained development. If functional analysis was coupled to issues of structural stability, functionalists could shift their analytic claims from the level of description (and interpretation) to issues of full-fledged explanation, albeit limited to issues related to the persistence in a given set of states or sequences" (Sciortino 2009: 108).

The identification of the 'existence of a functional relationship' above is of critical importance; the specification of structural complexity falls within the realm of the descriptive, and of itself

[17] This will shortly be revisited as a key source of ontological tension (between the primacy of the whole and constituents - such as they account for the dynamics of a system itself) - in later discussions of the rejection of Parsonian functionalism.

offers little offence; there seems nothing objectionable about employing such descriptive models, although this clearly places sociological analysis beyond the boundaries of 'normal' analytical science. To impute or to derive the existence of a functional relationship is to impose a theory of function upon the constituent units of the system, and this must be recognised as a critical distinction when evaluating subsequent critiques of functionalism as a coherent orientation. This invites us to remain mindful of the distinction between the heuristic possibilities of the structural model, and to separate this clearly from the theoretical task of articulating an organising mechanism of the constituent parts, or imparting the characteristic of stability to the social system by virtue of its 'appearance' as a stable entity within a static, descriptive model. This possible separation was alluded to by Robert Merton whose modifications of the functionalist approach subsequent to Parsons emphasised its interpretive possibilities, without recourse to the question of inherent systemic stability. This distinction is reflected in Sciortino's summation of the intellectual thrust of functionalism as an '...observer's tool aimed at the production of institutional accounts based on the unintended consequences of selected actions or processes to the maintenance of some larger structure in which such actions or patterns are included' (2009: 109). Having provisionally separated the project of conceptual or structural articulation from that of explanation and prediction, an understanding of the logical development of stability assumptions within the context of contemporary American sociology must be developed, as well as an appreciation of its position with these broader scientific currents, and the reasons underlying its rapid demise.

Writing in 1945, some six years before the publication of *The Social System*, Talcott Parsons (1902-1979) offered the following reflections on the status of systemic theory within sociology, and was clearly taken with the Kantian hierarchy of epistemological validity[18];

> "It is scarcely too much to say that the most important single index of the state of maturity of a science is the state of its systematic theory. This includes the character of the generalized conceptual scheme in use in the field, the kinds and degrees of logical integration of the different elements which make it up, and the ways in which it is actually being used in empirical research. On this basis the thesis may be advanced that sociology is just in the process of emerging into the status of a mature science. Heretofore it has not enjoyed the kind of integration and directed activity which only the availability and common acceptance and employment of a well-articulated generalized theoretical system can give to a science" (Parsons 1954 [1946]: 212).

[18] Although it could be argued that by 'systematic' Parsons is referring to the consistency of the body of theoretical knowledge within sociology as opposed to a formal systems model, his subsequent output suggests otherwise.

The above statement, and the content of Parsons' essay in general demonstrates a fundamental continuity with the historical formalisation of normal science and reductionist method, as expressed through his commitment to its realisation in sociology. In stating as much, Parsons identifies the achievement of scientific status as necessary for the overall advancement of social science, a project realised through the specification of an appropriate general theoretical apparatus[19]. It is further indicative of Parsons' sustained commitment to such a scientific project that he begins *The Social System* six years later with the following statement; "The interaction of individual actors, that is, takes place under such conditions that it is possible to treat such a process of interaction as a system in the scientific sense and subject it to the same order of theoretical analysis which has been successfully applied to other types of systems in other sciences" (Parsons 1991 [1951]: 1).

Parsons preliminary sketches of this proposed apparatus in 1946 distinguish between two levels of a systemic conceptual schema; the first, the level of *frame of reference*, serves to provide (as Cartesian coordinates in classical mechanics) '...the specific categories in terms of which a system is described...[and] a test of the determinacy of the description of system' (1954: 214). The second identified level, that of the *specification of structure* contends that; '...a system is composed of "units" of subsystems...and their structural interrelations...a system in mechanics is "made up" of particles as its units...The structure of the system consists in the number of particles, their properties such as mass, and their interrelations, such as relative locations, velocities and directions of motion' (ibid: 214).

The function of this combination, of levels, according to Parsons, is to provide the means with which to offer causal explanation, prediction of future states, and the 'attainment of generalized analytical knowledge of "laws" which can be applied to an indefinite number of specific cases with the use of the appropriate factual data' (ibid: 215). In suggesting as much, Parsons clearly imputes much of the programme and promise of scientific systemic theory onto the study of society, although his substantive works also drew heavily upon the terminology of cybernetics, with its focus on mechanisms of communication (Castellani and Hafferty 2009: 175). Crucially, he also outlines a clear separation between the descriptive capacities of the conceptual model, and its explanatory power; this is of critical importance, in order to avoid conflating these dual components of the conceptual system model, and its attendant project of specifying analytical laws. Furthermore, much subsequent and recent scholarship (presently to be considered), suggests that systemic theorists have indeed moved beyond using such models

[19] It is worth noting that sociology itself however, has since remained resilient to the 'inflexible box' that the paradigm of normal science supplies (Kuhn 1962: 24).

as heuristics in the search for general laws, instead applying such models with a clear sensitivity to contingent, rather than negatively reinforced agent interactions. If the specific character of 'functional' is therefore not implied by the application of a structural model to social systems, the source of such unease must rest with another dimension of Parsons thought.

Parsons' writing is notoriously dense, and at times contradictory and inconsistent (Turner 1991, Sciortino 2009). A summary of his main contributions may however be sketched through six substantive aspects of his life's work; his voluntaristic theory of social action, specification of pattern variables, strategy of structural-functionalist analysis, hierarchy of cultural control systems, structural differentiation, and understanding of the 'human condition' (Johnson 2008: 310). Although popularly portrayed as a direct continuation of the tradition of Durkheim (Wallace and Wolf 2006), the above dimensions capture a number of substantial departures. The classical dualism of structure and agency clearly preoccupied Parsons' forerunners in their search for the mechanisms of social order, and his voluntaristic theory of social action concerns itself with the problem of the relative autonomy of both social actor, and institutional order (Sciortino 2009). At the level of individual action, Parsons initially attempted to resolve this dualism by conceptualising social action as a function of goal-oriented decision making, occurring within a context where individuals were exposed to *means*, within structural *conditions*; this process and its outcomes being governed by normative regulation. As a restrictive model of general action, it thus fell to the *pattern variable*[20] to account for variation in subjective orientation, the particulars of which are adequately summarised by Johnson (2008: 313).

It was arguably the fundamental questions of stability and social order that characterised the thrust of his theory however, and the question of action clearly endured beyond the decades of functionalism's most forceful criticisms[21]. Writing in the year of his death, in a review of James Miller's *Concrete Systems and "Abstracted" Systems*, Parsons chose to recast the upper (social) levels of Miller's hierarchical systems model as those of 'human action', and to claim

[20] Turner (1991) also offers a suitable summary of the pattern variable as an attempt to account for differing subjective orientations to action (1991: xxi). These variables were ultimately outlined by Parsons as a universal set, consisting of; affectivity vs. affective neutrality; self vs. collective orientation; universalism vs. particularism; achievement vs. ascription; specificity vs. diffuseness. As normative standards governing individual choice, the respective sets of pattern variables demonstrate similarities both to Tonnies' distinction of *gemeinschaft* and *gesellschaft* (Turner 1991: xxi), and to the social contexts of Durkheim's mechanical and organic solidarities.

[21] Exemplary of such criticisms are the reactions to Davis and Moore's (1945) conservative pronouncements on social stratification, which are commonly interpreted as offering endorsement of inequality as a prerequisite to occupational specialisation (see Buckley 1958 for critical discussion).

that Miller had offered '...some of the best of the theoretical sophistication of the last generation or so, especially in biological theory...this above all involv[ing] the concept of system itself – the idea that living systems are self-regulating, within boundaries which have been developed vis-á-vis their environments, and the ideas of self-regulation by negative feedback' (Parsons 1979: 696). The 'system' framework in Parsons' opinion was merely descriptive; just as it fell to practitioners of teleogical reasoning to ascribe divine ordination to observed regularity, and to Newton to derive laws governing motion, so too did Parsons seek to explicate the 'natural laws' governing stability in human societies. The mechanism of actor-orientation was thus theorised as a function of the systems homeostatic tendencies.

Instrumental in maintaining the stability of Parsons' social system was the role of value consensus, and it is perhaps his emphasis on the mechanisms producing such consensus that caused greatest concern amongst later critics. The internalisation of values through socialisation thus reconciled Parsons' action theory to his model of systemic stability; 'The cultural system is reinforced by actions which conform to the dominant culture; the social actor receives gratifications to personality as a consequence of carrying out actions which are compatible with dominant values. Social order is maintained because social actors are rewarded for their support' (Turner 1991: xxi).

Order is produced through the coercive mechanisms governing action orientation (patterned orientations within a general context of voluntaristic selection); consequently, the model often appears as devoid of agency. Rational choice theorists such as Homans and Blau would later offer instrumental interpersonal exchange as the 'atom' from which values emerged, rather than depicting values as externally imposed by the immaterial mechanisms of consensus. Further incompatibilities of such a model with the complexities of human symbolic assignment later drew fire from the symbolic interactionist tradition, and its emphasis on the production of meaning from human interaction[22].

Sciortino identifies value consensus as an attempt to move beyond nondescript social 'wholes' in order to identify 'first movers' of societal processes - a prospect which eluded his predecessors - by theorising social structure as an unintended consequence of (voluntaristic)

[22] Attendant methodological shifts further solidified this debate, with systemic theorists often lumped under the broad rubric of 'positivist'. This is a curious position, considering previous footnotes concerning statistical inference have suggested that quantitative work is conducted with default recognition of the impossibility of fixed conclusions. Although this does not exclude all the criteria of a supposed positivist orientation, it is curious that there is nothing (in the authors opinion) to suggest a necessary connection between systemic and quantitative methodologies.

social action (Sciortino 2009: 112). Parsons crucial break from that of rational choice theorists was to suggest that these mechanisms through which individuals oriented their purposeful actions could not be derived from individual action. This undoubtedly creates a theoretical paradox whereby structure is reciprocally required to provide the conditions of voluntaristic action selection, a problem that has taken centre stage in much subsequent social theory, as evidenced in Anthony Giddens and Margaret Archer's prolific debates on the duality of structure and agency[23]. In defence of the impossibility of theorising action in terms of individual cognition, Parsons refers to the necessity of a shared normative order embedded in a shared culture, which in turn orients and delimits the range of outcomes from which any individual may select a particular course of action – the complexities of a structurally unconstrained decision making process, Parsons implies, would render human interaction impossibly cumbersome. It therefore falls to the social system to cope with resource allocation among its constituent units, and to ensure integration of its various institutions (social control) via institutionalised individualism (Parsons 1982: 118).

The internalisation of norms of conduct thus integrated Parsons' analytical sub-systems of the personality system, social system, and cultural system, in the production of regularity (Johnson 2008: 318). The formalisation of his universalist analytical framework came with his later specification of the four functional requirements of social systems (the famous AGIL acronym), which specified (A) adaptation to the environment, (G) goal attainment, (I) integration, and (L) latent pattern maintenance (ibid). It was through the operationalisation of these frameworks however that their shortcomings became obvious, and despite Johnson's (2008) recognition of the possibility of conflict, the dominant thrust of the preceding corpus of Parson's work is one in which various elements function to produce a state of stability, or at least, to counteract disruptive tendencies and restore the system to a steady state (Buckley 1967: 24; Bailey 1994).

In presenting these core ideas, this overview has consistently drawn attention to the potential separation of the structural concept of system from the notion of function. It must therefore be concluded from the above, that although value consensus and functional requirements may structure regularity in functionalist thought, the 'function' is clearly separable from the analytical account of structure. Surprisingly, this seems to have been clearly expressed by Parsons himself in his later writings; 'It has become my increasing conviction that this [structural-functionalism] is not a proper designation. The concept *function* is not correlative with *structure*, but is the master concept of the framework for the relations between any living

[23] See Doyle (2010) for a comprehensive critique of these perspectives with respect to the cultural system.

system and its environment. Functions are performed, or functional requirements met, by a combination of structures *and* processes' (Parsons 1970 cited in Gerhardt 2002: 246).

Although this point of conclusion has been reached through a roundabout discussion, it is essential to explicate the development of the particulars of functionalist thought in order to grasp the historical context through which Parsons came to impart his particular notions of functional stability to social structure. The functionalist project of scientific formalisation, although applied with greater sensitivity to the shortcomings of previous reductionism and organic analogising, borrowed heavily from its cumulative antecedents of systemic thought. Bailey (1984) interprets Parsons' use of systemic stability as an unfortunate consequence of Spencerian equations of societal equilibrium with social integration, in a misinterpretation of its use in thermodynamics, whereby a state of equilibrium in closed systems implies not stability, but rather dissolution. Its position in Parsons' earlier strives toward normal science is evident in his claim that; 'The denial of its legitimacy in the conceptual armory of social science is at least, in my perhaps not very humble opinion, symptomatic of the denial that social science itself is legitimate or realistically possible' (Parsons 1961 cited in Bailey 1984: 13).

Despite these particular retractions, the historical record demonstrates a sustained commitment by functionalism to pursuing this project through the formulation of abstract theoretical models. It is indicative of this commitment to abstract modelling that Parsons offered the following remark on James Miller's work weeks before his own death; 'The path that leads through a series of abstracted systems seems to me much more fruitful. I only hope that there will be another Miller who will explore this alternative path as thoroughly as Miller has explored his' (Parsons 1979: 705).

Having provisionally separated structure from 'function', a brief exploration of the mechanisms of stability and homeostasis in functionalist analysis – which arguably constitute the most contentious principles of its general apparatus - is now attempted. The preceding overview permits the discarding of any notions of inherent causality between constituent parts, to avoid assigning the constraint of consensual value to interpretations of human action, and to retain the possibility of developing a model through which the complex system which forms the basis of the case study presented in chapters six to eight may be grasped[24].

[24] Referred to by Niklis Luhmann as an 'observational device' (Luhmann 1962, 1984 cited in Sciortino 2009: 119).

Crucially, what is also observed within the above corpus, is a notable absence of both historical context, and environmental interaction; the latter component of this critique is thus essential, as once these notions of stability and stasis are discarded; what remains is the task of identifying a suitable conceptual tool with which to assess the historical conditions under which contradictions internal to the system-structure arise within a matrix of broader social processes, and to reconcile this with an analysis of human-ecological interaction.

1.1.3. Discarding functionalist equilibrium

Bailey (1994, 1998) offers a useful discussion of the unnecessary rejection by sociologists of certain elements of Parsons' work, and a clarifying note on functionalism's conflation of the concepts of equilibrium and homeostasis; the former specifically intended as a measure for closed systems (generally mechanical or inorganic), and the latter for open (including social) systems. In classical cybernetics, from which functionalism appropriated such concepts, systems maintain such equilibrium through negative feedback. This negative feedback resulted of a process of boundary testing, from which social order was maintained through institutionalised norm reinforcement (Byrne 1998)[25]. The question of stability appears as a primary concern for functionalism's critics cited by Bailey, as evidenced by its inherently teleological search for 'functional prerequisites' amongst social institutions (1994: 3). Operationalising the concept of stability has proven elusive for social scientists operating within a Parsonian tradition however, and it is unclear by what criteria a system may be judged to be in a 'steady state'[26]. The loose criteria of stability outlined above consisted of meeting the functional requisites of AGIL, at the four systemic levels of organismic, personality, social and cultural; '…order-peaceful coexistence under conditions of scarcity – is one of the very first of the functional imperatives of the social system' (Parsons & Shils 1951 cited in Buckley 1967: 24). Clearly, this high level of functionalist abstraction renders such measures of stability difficult to appropriate. According to Buckley, this results in the highly abstracted assumption of a tendency within any social system to; '…maintain equilibrium within certain boundaries

[25] The equilibrium alternative of 'steady state' owes its origins to J.S. Mill's Newtonian notion of a steady-state economy, which suggested that unceasing growth was not observed in nature. Elaborated by Herman Daly as a key principle of modern sustainable development, it suggests that a balance of material resource flows into production and of pollutants to the environment is crucial for long-term sustainability (Costanza et al 1997: 41).

[26] Various measures abound, such as sustained growth rates in neoclassical economics. For social systems thus conceived, the question of 'steady-state' criteria is more problematic; it is unclear by what standards social reproduction and order may be judged as stable. This important question of normative measurement is addressed in chapter 3.

relative to an environment (everything not part of the system), a property held to be very similar to the biological problem of homeostasis' (Buckley 1967: 24).

Bailey is quick to point out that this introduces confusion between open-system homeostasis and closed-system equilibrium (1994: 4) - societies being regarded as open systems – as indicative of the imprint of Pareto's prior mechanistic analogy. Ernst Mayr, however, recognised this incompatibility between biological and mechanistic concepts in suggesting the autonomy of biology from physics; '...the distinction between the organic and the inorganic [is] not a question of substance but of organization' (Hammond 2003: 32). In an earlier paper, Bailey (1984) further outlines the ambiguity of establishing a criterion of 'healthy state'; realising this confusion, according to Bailey, allows us to overcome the charges of conservatism levelled against systemic approaches. By equating equilibrium with integration, functionalists thus ignored the thermodynamic principle whereby *thermal* equilibrium ultimately implies disintegration in open systems (Bailey 1994: 6). The conservative perspective of consensus is further emphasised by recourse to notions of 'extent of prevailing societal integration' as a measure of stability. Bailey also points out that such measures of stability and equilibrium implied by functionalists remains dichotomous – a system is either in or out of such a state, with no possible quantification of variance (Bailey 1984: 3), making such concepts impossible to operationalise; 'Equilibrium, in short, is nothing but the concept of regularity under specific conditions...and of course its maintenance is by no means inevitable but, if the conditions on which it depends are changed beyond certain limits, it will disappear, again most probably giving way to other regularities than to sheer randomness' (Parsons and Shils 1951 cited in Bailey 1984: 4).

These tendencies toward self maintenance clearly render it impossible to introduce any notion of environmental externality; they remain as secondary, considered only for their consequences on the internally self-regulating system. On this point, and of further concern, particularly within Buckley's preceding quotation, is the bracketing of 'everything not part of the system'; the preceding AGIL and four-dimensional system model is clearly limited, but the above quotation further suggests that the natural-environmental dimensions of the system (including, presumably all geographical space and social actors and institutions beyond its subjectively defined boundaries) are entirely disregarded.

The level of the 'organism' is notoriously under-theorised within functionalist sociology (Smith and Jenks 2006), and in articulating his model of the social system, Parsons ignores the material reproduction of the organism, considering physical factors insofar as they inhibit the

possibility of complete communication (Parsons 1991 [1951]: 60). The concept of ecology is used analogically in the *Categorization of actor-units in object roles*, whereby 'ecological situation' is included with biological position, spatial location, temporal location and collectivity membership as a relational ascriptive quality in the relative orientation of actors (Parsons 1991 [1951]: 97). This apparent ignorance of ecology is expressed by Bailey as a function of Parsons' attempts to avoid reductionism - presumably biological reductionism; as was observed above, Parsons' voluntaristic theory of action sought to disregard explanations of action orientation based on intrinsic psychological factors. It is also critical to acknowledge a fundamental difference between these, and more contemporary models sketched below; that of the abstracted nature of these early functionalist formulations. In a comparison of Millers later *Living Systems Theory* (LST) and Parsonian functionalism, Bailey offers the following observation;

> "LST uses the concrete model while Parsons uses the abstracted systems model…this means that while Miller chooses objects such as individuals or groups as the basic unit of analysis, Parsons chooses the social role. This is a profound difference, and makes comparison of LST and Parsonian functionalism more difficult. Not only does Parsons analytically eschew the person for the role as the unit of analysis, but he also rejects reliance on physical space-time. By using the role as the unit and failing to ground the system in time and space, Parsons creates a very abstract system which is often difficult to analyse. It is difficult to determine systems boundaries or to operationalise his abstract concepts" (Bailey 1994: 5).

Clearly, for a systemic theory to accomplish the apparently disjointed tasks of holistic representation and operationalisation, as is the object of this thesis, the missing dimensions of boundary definition and historical context must be considered, and their interactions placed within the context of other system components and sub-dimensions. The critical differences between antecedent functionalist models, and Millers proposed hierarchy of living systems (above) should however, not be expressed as a distinction between 'abstract vs. concrete'; models of concrete living systems should instead be considered as general frameworks which may be abstracted to multiple contemporary and historical contexts, although the possibility of such a sufficiently general concrete concept cannot be accepted, without resorting to exhaustive empiricism.

The central concern for researchers should not be one of ascertaining the applicability, or totality of any concrete systemic model however, but of exploring more closely the processes through which analytical frameworks are developed through engagement both with abstract concepts and concrete example. Crucially, what the preceding discussion has revealed, is that the task of systemic modelling alone takes analysis only so far – presumably it falls to the

analyst to rework the imputing of functional 'natural laws' to the system dynamics; but this is not a task that can resort to the supposed axiom of homeostasis – the inclusion of the dimension of time reveals only contradiction and change, and further invites a shifting of conceptualisation to one of process, rather than stasis.

Modern iterations of integrated social-ecological systems models offer little of utility in this respect however. As an example of existing techniques, a simple model of agrarian systems is proposed by Mazoyer and Roudart which '…consists of breaking it [the agrarian system] down into two principal subsystems, *cultivated ecosystem* and *social productive system*, studying the organization and the functioning of each of these subsystems, and studying their interrelations' (2006: 46). Analogies are further drawn by the authors between their abstract system construct, and the functionally interdependent role of the various system components, the relationship of which to the construct of agrarian system advanced by the authors is clearly affirmed; '…one discovers that the presently observable multiple forms of agriculture can be classed in a finite number of categories, each category occupying a determinate place in time and space, in the same way that one classes other changing objects such as living beings, soils, plant populations etc.' (Mazoyer and Roudart, 2006: 46). The circulation of matter and energy is thus inscribed with specific spatial and temporal boundaries, and the social productive system assumes the role of a complementary, but conceptually separate entity.

The implications of this mode of conceptualization are much debated amongst sociologists, particularly regarding the theoretical separation of nature and society (Castree & MacMillan 2001, Castree 2002, Freudenburg et al 1995, Gerber 1997), but its impact is also historically evident within the natural sciences, particularly within debates prefiguring ecology, the historical context of which has been discussed above. In response to the ubiquity of such compartmentalized analytical units in ecology, Vadya (1983) identifies a commitment to 'unit-mindedness and system thinking' as a fundamental problem in the specification of analytical units, manifesting in a commitment to the concept of ecosystem in the definition of ecological case study boundaries. It is here interesting to observe that the discipline of human ecology has not been uncritical toward its epistemological foundations. Despite his proposed solution of the framework of 'progressive contextualization', the system concept, in the context of the model discussed above, appears relatively stable within contemporary ecological analysis. Vadya thus states, on the problem of systemic conceptualization;

> "This is the kind of thinking that led ecologists…to view ecosystems as 'self-regulating and self-determining systems with goals such as maximizing energetic efficiency or productivity, the efficiency of nutrient cycling, biomass, or, through an increase in

> species diversity and food web complexity, maximizing organization ('information' content) and stability…anthropologists…went even further than ecologists and argued that the self-organizing, self-regulating properties of ecosystems were expressed not only in various plant-plant and plant-animal interactions studied by biologists but also in a gamut of human activities and sociocultural institutions, ranging from mundane methods of food production to elaborate rituals or ceremonies involving the purportedly ecosystem-maintaining sacrifice of cattle, pigs, or people." (1983: 269)

The parallels between earlier functionalist thought as discussed above are evident, and the above comment offers some corroboration to Sawyer's (2005) claim that the natural sciences have had more success from implicit grand theory due to its predictive capability with respect to 'natural' phenomena. Although as was observed above, the resultant twentieth century output of social systems research borrowed heavily from such organicist notions, ultimately to its detriment.

Similar tendencies within ecological practice were noted in the seminal work of Levins and Lewontin who observe; '...despite the repeated demonstrations in philosophy of the errors of vulgar reductionism, practicing biologists continue to see the ultimate objective of the study of living organisms as a description of phenomena entirely in terms of individual properties of isolated objects' (1985: 133-134). The authors further argue that this mode of practice persists, despite broad consensus as to the ontological validity of the community, manifesting in a programme of research "...conducted on a single system – a lake a forest or prairie – and the results are measurements of and projections for that lake, forest or prairie, with no attempts to find the properties of lakes, forests, or prairies in general' (ibid). The problem thus emerges on another critical front - that of generalisation. Although concrete scientific practice may occur within an implicit systems framework on a particular defined system – whilst acknowledging internal diversity within a macro-category such as the lake above – these conclusions fail to move to generalisation, or to explicate what Levins and Lewontin refer to above as 'properties in general'. It is unclear from Levins and Lewontin, however, whether this is a result of insufficient internal theoretical debate, of the politics of competitive funding, or whether our critical 'outsiders' perspective – and its consequently insufficient technical grasp - has blinded us to the countless practical benefits to humanity of such 'vulgar reductionism'[27].

[27] It would be disingenuous to characterise ecology as entirely epistemologically uncritical, as much self-reflexive work exists within the field. Brown (2004) comments on the possibilities of metabolic theory as a potentially unifying framework for ecology 'from individual to biosphere' (Brown 2004: 1771), whereas Lawton (1999) remarks on the fragmentary nature of localised case studies, suggesting a need for ecologists to build macro-ecological theory. Ivers offers some critical reflection on the use of statistical modelling in ecology, stating that '…models [are] used to address broad ecological problems, [but] are not designed to be realistic per se, but instead are designed to increase the precision of our thinking about mechanisms that can drive, observed patterns' (Ivers 2005: 3137).

The explanatory promise of a functional approach in systems-based ecology is doubtless attractive, given its grounding presumption of internal self-regulation (the 'homeostatic' internal logic of self-organization proposed by Parsons (Turner, 1991: xvii, preface to Parsons, 1991 [1951]), and the manifest spatiality of the bounded ecosystem unit. The goal of this critical exercise, if it is to move beyond these issues, is to avoid the dual idealistic dangers of regarding the 'community' as of sole epistemological validity, thus ignoring interactions and contradictions internal to the system, and of affording ontological primacy to the constituent units, thus ignoring the 'community' as a real entity with its own logics and manifest tendencies.

Based on the foregoing assessment of functionalism's overall utility, sociology may understandably be expected to approach systemic theory with some hesitance, and the intensification of the postmodern critique of epistemic relativism in recent decades has arguably dealt further damage to the currency of general conceptual frameworks (Ashman & Baringer 2001). The preceding review has located the core problem of the functionalist approach within the notion of function (i.e. equilibrium via. value consensus) as distinct from its parent conceptual model; emphasis now moves toward an assessment of the utility of subsequent advancements in systemic thought, some of which, as will be discovered, have moved beyond this abstracted, untestable functionalism. The forthcoming discussion will focus on these subsequent developments with a particular emphasis on epistemology, or the extent to which 'the social' may be conceptualised as an entity amenable to the process of systemic representation and investigation. The ontological task of discerning the objectivity of social entities is well addressed within social theory; epistemologically, the question of articulating multiple analytical and organisational levels, as has already been summarily addressed above, requires further informants from critical realism, environmental sociology, human ecology, and Marxian historical materialism both within this chapter, and across subsequent chapters.

Accordingly, discussion now turns to complexity theory in an attempt to overcome the restrictions of linear structuralism and excessive abstraction, such as it permits the representation of systems as tentative agglomerations of complex historical interactions amongst system components which, although amenable to representation within a generalised systemic epistemology, are intrinsically prone to divergent outcomes according to nuances of context[28] (Byrne 1998; Manuel-Navarette 2008). In concert with the informants of complexity,

[28] Recent developments in sociological applications of 'deterministic chaos' are also summarily considered, but not elaborated due to the complexity of such mathematics, and the incompatibility of such an approach with the empirical shortcomings of historical work.

and in an attempt to overcome the reification of structure to a pre-existent property, the concept of 'emergence' is invoked in order to conceptualise macro-regularity as a consequence not of mechanisms such as role assignment, or functional differentiation, but of myriad micro-interactions which recursively produce structural regularities – the resultant complexities of which exceed those of their constituents (Sawyer 2001, 2005). In short, the question of accounting for and mapping complexity falls to *complexity theory* and that of the macro-theoretical expression of aggregate structural regularity to *emergence theory*, both of which offer a suitable epistemological grounding for the objectives of this research. In considering these related informants, it is hoped that an understanding may be established of how the social sciences, through adopting the critical-realist informants of complexity and emergence, may continue to advance substantial critiques of the static nature of previous systems models, of reductionist epistemologies, and the linearity of such approaches with regard to the study of social change.

1.2. *Second-wave* systems theory: emergence and complexity

In a brief biography of the formative years of Irish-born economist Brian Arthur, Waldrop (1992) recounts a particular revelation of Arthur's upon reading Horace Feeland Judson's history of molecular biology, *The Eighth Day of Creation*. Arthur's training in neoclassical economics and the self-confessed 'gospel of Adam Smith' had played uneasily on his mind for some years, reinforced by its appearant incongruence with the complex realities of human demographic behaviour – Arthur's empirical field. By Waldrop's account, it was Arthur's discovery within biology, '…that this messy, organic, nonmechanistic world was in fact governed by a handful of principles that were as deep and profound as Newton's laws of motion…the basic mechanisms were universal…and yet a tiny, almost undetectable mutation in the genetic blueprint might be enough to produce an enormous change in the organism as a whole…' (Waldrop 1992: 30), which offered Arthur a solid conceptual basis to align his discomfort with economic assumptions of systemic stability.

Upon reviewing materials on the physics of condensed matter, Arthur encountered a similar body of knowledge outlining the principles and laws by which simple physical dynamics gave rise to 'a near-infinity of complex patterns' (Waldrop 1992: 32). Within this field, Ilya Prigogine's work in nonequilibrium thermodynamics and his concern with the origins within nature of order and structure earned him the Nobel Prize in chemistry in 1977. The second law of thermodynamics specifies the transformation of energy into increasingly less useful forms, resulting ultimately in randomisation and dissipation (Atkins 2007); Prigogine's interpretation

of societies as surviving organisms focused on their acquisition of energy from their environments, their channelling of energy to maintain structure against the entropic tendency of collapse, and their expulsion of energy as pollution (Smith and Jenks 2006: 8), in a process similar to that of metabolic exchange in systems theory. The paradox to which Prigogine sought to reconcile the atomist-reductionist natural sciences was the simple fact that amongst a law-driven universe of increasing chaos, there was abundant evidence of structure and regularity. This reality was not easily comprehended, according to Arthur and Prigogine, by the tendencies of physical science to seek ordering principles through the study of elementary minute components. In human ecology, this epistemological shortcoming was already beginning to be addressed by C.S. Holling who argued that aggregations of disparate experiments and case studies alone were insufficient to grasp the complexity of a manifest whole (Costanza et al 1997). Consequently, despite 'first wave' general systems theorist's allusions to structural holism, the foregoing critiques suggest that paradoxically, the primacy of totality renders them as reductionist as their mechanicist antecedents, owing to their deference to restrictive notions of order and stability (Price 1997 cited in Byrne 1998). The alternative, according to the *Gulbenkian Commission on the restructuring of the Social Sciences*, to which Immanuel Wallerstein and Ilya Prigogine contributed, was a '...breaking down of the division between 'natural' and 'social' science through seeing both characterized by 'complexity' (Byrne 1998; Urry 2005a: 3).

This problematic of the complex relationship between element interaction and macrostructure in such totalities, as previously discussed, was not unfamiliar to sociology, and Durkheim devoted much effort to forging a 'third way' account of the 'emergence of the social from the individual and downward causation from the social to the individual' (Sawyer 2005: 100) that was neither teleological nor reducible to individual psychology. Sociologists have since struggled to resolve their collectivist-individualist and structuralist-agentist dichotomies of social order, and many have continued to contest the 'realism' of such higher-order regularities, despite complexity theory's claims to offer an alternative that is neither 'phenomenological nor positivist and reductionist' (Byrne 1998: 1)[29]. Complexity thus claims to speak directly to ontology by questioning our very assumptions regarding the nature of the social, and by offering a critical realist ontology with which to apprehend nature and society 'as if they were ontologically open and historically constituted; hierarchically structured, yet

[29] Despite its tendencies toward relativism, these critiques of realism are perhaps not entirely attributable to postmodernism, and Paul Cillers (1998) offers an account of the postmodern perspective as inherently sensitive to both complexity, and to forms of representation. For clarity, this thesis rejects these debates as superficial, and argues that the manifest qualities of social action and organisation should be considered amenable to measurement and description.

interactively complex; non-reductive and indeterminate, yet amenable to rational explanation' (Reed and Harvey 1992: 359 cited in Byrne 1998). It was this supposed rational predictive capacity of 'economics as science' that played on Arthur's mind most however; assuming that the scientific credibility of a perspective depended on the predictive capacity and consistency of its theories, how could a perspective emphasising the chaotic and contingent nature of social regularity call itself scientific? By Arthur's account, Darwin was rendered no less scientific by his inability to predict the course of evolution, nor was astronomy for its inability to predict the precise birth of stars; the essence of science was in its capacity for explanation (Waldrop 1992).

Despite first wave systems theorists' allusions to elucidating causality through structural mapping, Byrne suggests that such modes of linear representation are particularly limited in grasping the complexity of the natural and social worlds (2005: 102). The most fundamental distinction introduced by chaos and complexity is that between linear and non-linear approaches to the conceptual and mathematical modelling of social systems, particularly in their respective treatments of change and historical development. From this simple distinction, a wealth of implications emerge which contest established notions of causality, historicity, development, and the dynamics of social change.

Within statistical modelling, there is a general recognition that although conventional techniques may be used to examine relations among variable sets, and to measure and rank their relative influence, they are not particularly adept alone at representing such cases '...where there are nonlinearities, path dependency, and other complex, emergent properties' (Evans, Munroe and Parker 2005: 206). Shortcomings with such established linear modelling techniques are identified by numerous authors (Levins and Lewontin 1985; Costanza et al 1997; Byrne 1998; Manuel-Navarette 2008; Castellani and Hafferty 2009) who suggest that the path-dependent nature of social systems requires particular sensitivity to context and history. The incongruence of structuralist systems models with the question of mapping the social has been considered above, and it was suggested that their insensitivity to time renders them static, and incapable of conceptualising systemic development as a dynamic process.

Complexity extends the concepts of non-linearity and path dependence with a radical redefinition of the dynamics of social change, derived from experimental mathematics (Eliot and Kiel 2004, Hafferty and Castellani 2009). The beginnings of the movement popularly referred to as 'complexity' are typically traced to meteorologist Edward Lorenz's elaboration of the butterfly effect (MacKenzie 2005: 57). Upon restarting a weather system model using

values generated at the end of a previous run, Lorenz observed that his model subsequently produced more widely divergent patterns than expected. The problem lay with the computers' rounding of his previous parameter values to three, instead of six decimal places (Smith and Jenks 2006); a small variation in initial conditions had rendered future states and predictions decidedly more complex. This fundamental principle provokes a common misconception; although the behaviour of such a system may *appear* random, its behaviour within particular parameters is comprehensible with deterministic equations, if not predictable in the sense of typical quantitative modelling; the weather system is still constrained by conditions that render particular outcomes (modelled as attractor states) more or less likely.

The analogy of the butterfly effect derived from Lorenz's miniscule variation in parameter values, does not suggest mystic or entirely random causation but rather that the system contains within itself the conditions of its own non-linearity; '...it is the number of active variables, interactions and possibilities that cause non-predictability except in the relatively short term, not some magical magnifier' (Smith and Jenks 2006: 5). This phenomenon is expressed through a key principle of complexity; that of *sensitivity to initial conditions*, through which complex non-linear systems (i.e. Lorenz' weather system) amplify small changes to the effect of producing disproportionate, and divergent outcomes (Smith and Jenks 2006; Eliot and Kiel 2004). Sawyer offers the following distinction between chaos and complexity, illustrating the dependence of changes in complex systems on such lower-level interactions;

> "Chaos" refers to turbulent behavior in a low-dimensional system (i.e., with low degrees of freedom) where the behavior is completely determined by nonlinear laws that may exaggerate minor changes in the initial conditions and thus make the system's behavior unpredictable in practice beyond a certain time period. "Complexity" refers to ordered phenomena in a high-dimensional system (i.e., with high degrees of freedom) that emerge from a large number of interactions among system components" (Sawyer 2005: 15).

'Complexity science' as a distinctive field in itself owes its current coherence to a collaboration of researchers in the fields of systems science, cybernetics, and artificial intelligence (Hafferty and Castellani 2009), through which a formal programme of cross-disciplinary research began. Its popularisation owes significant debt to its most prominent research group, the Santa Fe institute - to which Arthur would subsequently contribute - founded in 1984 by physical chemist George Cowan. It thus shares a number of commonalities and continuities with general systems theory; its founders and proponents are drawn principally from the natural sciences, and both emerged out of a common concern with the perceived dominance of reductionism in scientific method (Hammond 2003; Skyttner 2005; Hafferty and Castellani 2009). As an

emerging paradigm, it offered, according to Eliot and Kiel, a significant challenge to accepted scientific assumptions;

> "While a Newtonian universe was founded on stability and order, chaos theory teaches that instability and disorder are not only widespread in nature, but essential to the evolution of complexity in the universe. Thus chaos theory, as relativity theory and quantum theory before it, presents another strike against the singular determinism of a Newtonian view of the natural realm" (Eliot and Kiel 2004: 2).

Chaos and complexity therefore describes a paradigm through which, for the social sciences at least, established approaches of linearism and reductionism are called to question, and the role of generalised processes in the direction of social change is subjected to critical scrutiny. The complexity account is different from established approaches to causal explanation in historical sociology however, and Goldstone (1998) identifies three such distinct prevalent modes of causal reasoning. The first, a *rational choice* approach is typically employed for cases converging on a common point of equilibrium from diverse points of origin[30]. Other modes of causal reasoning include explicating *general laws* to account for phenomena emerging sporadically from similar base circumstances, such as was attempted by Theda Skocpol's *States and Social Revolutions* (Goldstone 1998: 824). Finally, *path dependence* is called for when '...one is concerned to explain a particular unique event...that has occurred only once...despite similar initial conditions being found elsewhere' (Goldstone 1998: 843).

Path dependence represents one of the most commonly encountered approaches to developmental non-linearity in comparative-historical sociology. There are a number of issues with this position that bear elaborating before proceeding. Mahoney describes path-dependence as an inherently theory-laden device, which is called upon when the predictive capacities of general theories of institutional development or configuration fail (Mahoney 2000). Consequently, it tends to focus on deviant cases which cannot be explained on the basis of prior historical conditions (ibid). The literature variously alludes to such deviant institution's sensitivity to initial conditions (Goldstone 1998; Mahoney 2000) but in a fundamentally different sense to its forthcoming use in complexity. Mahoney identifies two distinct approaches to path dependence;

> "First, some path-dependent investigators analyze self-reinforcing sequences characterized by the formation and long-term reproduction of a given institutional pattern... Understanding the specific mechanisms that produce self-reinforcement is of

[30] Goldstone appears particularly taken with rational actor models as a basis for understanding optimal structural configuration. His position is unsurprising, given that he had previously studied under George Homans whose approach to institutional development suggested 'rational action' as the analytical base from which to assess the development of institutional properties.

> crucial importance because alternative mechanisms suggest different ways in which patterns marked by path dependence might be reversed... A second basic type of path-dependent analysis involves the study of reactive sequences. Reactive sequences are chains of temporally ordered and causally connected events. These sequences are "reactive" in the sense that each event within the sequence is in part a reaction to temporally antecedent events. Thus, each step in the chain is "dependent" on prior steps. With reactive sequences, the final event in the sequence is typically the outcome under investigation, and the overall chain of events can be seen as a path leading up to this outcome" (Mahoney 2000: 508-509).

It is in the details of this twofold typology that the problem with path-dependence may be identified. Although the mechanism of positive feedback offers a powerful alternative to functionalism's conservative negative feedback, the approach of establishing reactive sequences appears too restrictive and empiricist. It is arguably as conservative as functionalist's regression to equilibrium in its apparent halting of the direction of time with a 'final outcome' state. It is thus unable to project forward, or derive an underlying logic that may allow agents to reactively engage with an institutions' collectively perceived negativity (the dialectical basis of praxis). Path dependence thus appears null in the context of the complexity account of historical contingency, as complexity is inherently sensitive to initial conditions, but without requiring an exhaustive empirical reconstruction of initial states. The very nature of social systems' complex constitution and their non-linear trajectories makes them difficult to pin down with totalising narratives such as general laws or path dependence.

It is the implicit reduction of systemic complexity and causality that is most objectionable however; as has been outlined by general systems theory, social systems are subject to complex structural interaction. Their internal components interact, as does the system with its environment, and with other systems. Reactive sequences and institutional self-reinforcement cannot be established without a conceptual decomposition of the social system. Complexity suggests that different forms of interaction may occur at different system levels, rendering it difficult to identify 'prime movers' of systemic change or stability. Furthermore, the relationship between agent interactions in the production of higher order systemic properties is a complex process which requires clarification in subsequent sections. Causality cannot be described as such without first addressing these crucial issues (Byrne 1998) i.e. by theorising the mechanism through which interacting agents produce stable structural properties. Any alternative to the established modes of reasoning outlined above must strike a balance between recourse to general laws, and historicism. Preoccupation with such empirical reconstruction of initial conditions to the expense of generalisation is identified by Goldstone as a particular problem shared by historians (1998: 834). Furthermore, it is unclear how such a mode of reasoning, dependent on a discontinuity between predictive theory and observation may be

utilised for phenomena for which limited comparative data exist, or which offer no comparable counterpart.

Worse still, Goldstone has suggested that a productive resolution to the problem of observed common outcomes is to assume a rational actor approach, and consequent regression of institutional configurations to an unspecified optimal state of equilibrium. It will in turn be demonstrated that complexity is inherently sensitive to both contingency and the emergent properties of social systems, and as such does not require recourse to notions of path dependence in accounting for divergent outcomes. It must be stressed that this conclusion derives from the objectives, and empirical focus of this thesis, and does not suggest that this approach is generally unfit for task in comparative political work. Furthermore, as with world-systems theory, current focus for now is not on populating models of macro-structure through a-priori *manifest* analytical units such as political institutions and states, but on establishing a general epistemological foundation for conceptualising social-ecological systems.

Hafferty and Castellani identify *System Dynamics* as a key theme in existing research, which emphasises the processes through which '…complex systems evolve and adapt to internal and external conflicts and change' (2009: 127). Although social theory, particularly post-Parsonian conflict theory as popularly represented, claims to advance beyond functionalist voluntarism by viewing social relations as essentially conflict based (Swingewood 1991), the thrust of historical materialism, as a grounding principle of Marxist praxis implies a predictability and linearism to social change through exacerbated class conflict. Chaos and complexity thus challenge the role of such generalised abstractions as class dynamics, or economic relations as prime movers, and instead focus on the exponential growth of complexity, and the emergence of disruption and change from points of minute or common origin; this position being inherently historical. A working definition of complexity and an indication of its utility to historical sociology is offered by Cillers' second characteristic of complex systems; '...(ii) A large number of elements are necessary, but not sufficient. The grains of sand on a beach do not interest us as a complex system. In order to constitute a complex system, the elements have to interact, and this interaction must be dynamic. A complex system changes with time' (Cillers 1998: 3).

Given its requirement of interaction amongst constituents for the production of complexity, social systems thus fall within this broad definition of complex. To this second requirement of complexity, Cillers further adds the criteria of 'open system', 'far from equilibrium operation', 'metabolic regulation of energy exchange', and perhaps most importantly, the dimension of

time; '…complex systems have a history. Not only do they evolve through time, but their past is co-responsible for their present behaviour…an analysis of a complex system that ignores the dimension of time is incompatible' (Cillers 1998: 4). This recognition underscores a fundamental flaw in the ahistorical general systems theories outlined previously; irrespective of assumptions of tendencies toward equilibrium, this tendency is itself impossible to establish without an understanding of the historical, contextual conditions producing general states of disequilibrium. Complexity in turn confronts such linear accounts by suggesting that '…simple events generate behaviours so complex that one is tempted to call them random, yet they are entirely deterministic and can be modelled with simple mathematical equations' (Manuel Navarette 2008: 5). This claim requires that consideration be given to how conventional modelling techniques alone, in the absence of broader methodological and conceptual informants and interpretive frames, have struggled to represent such complexity.

1.2.1. Complexity's challenge to linear representation

General systems frameworks have been subjected to implicit methodological criticism through complexity, which speaks directly to the techniques used to capture and express the dynamics of such systems. The complexity programme thus suggests that although the static devices of systems theorists may suffice for description devoid of history, the developmental dynamics of social systems are far from linear; Byrne captures the analytical promise of complexity by characterizing it as 'systemic without being conservative' (1998: 51). The non-linear nature of historical development and the subsequent relative contributions of predictors to system outcomes in the established technique of regression modeling are thus questioned, and in turn offer a methodological window with which to assess the historical relationship between structure and process. According to the complexity programme, the modeling and prediction of future system states using traditional statistical techniques (i.e. linear modeling of the form; $y = (\alpha + \beta x) + \varepsilon$) is incapable of accounting for the fact that radical differences in subsequent system states may result from minute changes in system parameters from a common point of historical origin, the *sensitivity to initial conditions* specified above. For an historical system behaving in a linear manner, initial states and contexts may be used to determine subsequent system outcomes, and the linear model is isomorphic. For chaotic systems, their sensitive dependence on initial conditions (Elliot and Kiel 2004) results in 'divergent outcomes from systems that initially appeared quite similar' (ibid: 6). The complexity position on prediction, despite these noted similarities, is summarized by Mason as follows; 'Complexity theory's notion of emergence implies that, given a significant degree of complexity in a particular environment, or critical mass, new properties and behaviours emerge

that are not contained in the essence of the constituent elements, nor can be predicted from a knowledge of initial conditions.' (Mason 2008: 32)

The mathematics of chaos, as will presently be discussed, implies that such chaotic behavior may be modelled with deterministic equations (Elliot and Kiel 2004). The consequent implication for the established quantitative programme is that interactions between predictors in a linear model cannot capture the non-linearity of complex behaviour in historical systems (Byrne 1998; Elliot and Kiel 2004; Sawyer 2005; Manuel-Navarette 2008). Despite such allusions to quantitative rigor, these authors also acknowledge that the application of the principles of chaos has tended toward analogy in the social sciences, given a comparative lack of detailed time series data from which to capture such contingencies of development, and a general reluctance within sociology to engage in such techniques (Byrne 1998; Hafferty and Castellani 2009). In the established mathematics of statistical modeling, a typical multiple regression formula expresses the contribution of predictors to a particular outcome (y) in terms of the summary effects of predictor coefficients (β_i), multiplied by their case values (x_i);

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2$$

The above formula assumes that coefficient β_i is identical for all values of other explanatory variables x_i (Agresti and Finlay 2009). To cope with the potential non-linear effects of variable predictor values on outcome (y), researchers introduce cross-product terms to capture the dependence of coefficient values (β_i) on differing values of others predictors. For a model with two predictor variables as above, the formula thus becomes;

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2$$

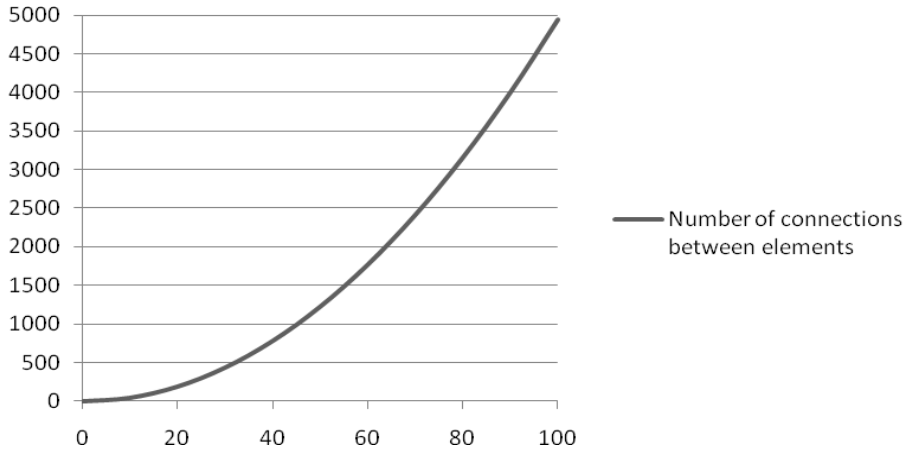
The inclusion of an interaction term produces different coefficient (β_i) and intercept (α) values depending on the input values of variables x_i, and allows for a more complex relationship than typical assumptions of independence between predictors. As a simplified, illustrative agricultural example, crop yield per unit area in a particular year (variable y) may be assumed as outcome, with variable x_1 as a measure of rental obligation as a proportion of total yearly budget, and variable x_2 as standardized quantity of fertilizer applied throughout a particular year. The interaction term allows for a hypothetical scenario in which lower rental obligations would allow for greater expenditures on fertilizer, producing different coefficient and intercept values, and consequently differing predictions of yield. The limited ability of such interaction

terms to cope with complexity is expressed by Levins, who remarks that despite systems theory's concerns; '…with complexity, interconnection and process…and despite the power of its mathematical apparatus it does not deal at all with the richness of dialectical contingency, contradiction or historicity…systems-theoretic 'interconnection' does not grasp the subtleties of dialectical mediation' (Levins 2008 :26).

The micro-social source of this incompatibility of linear modeling alone with systemic complexity is illustrated by Mason's (2008) formula demonstrating the development of complexities of interconnection at a population level, thereby illustrating heuristically the criticality of considering sensitivity to initial conditions. According to such theorists, 'complexity' is a function of iterative inter-element disturbances amplified over time (Byrne 1998; Harvey and Reed 2004; Capra 2005; Urry 2005b). Mason's formula is quadratic, and demonstrates the phenomenon by which additive increases in a communities members produces a multiplicative effect on the number of connections present in any particular community, where (y_n) = number of connections between any two elements, (n) = number of elements within the community (Mason 2008: 35). Connections increase exponentially from a dyad of one interaction; for illustration, a graph of additive population increase in increments of 20 is provided;

Figure 1.1

$$y_n = \frac{1}{2}(n^2 - n)$$



Graphic illustration of Mason's complexity function (formula cited in Mason 2008)

In short, the above formula demonstrates the exponential effect of population increase on community complexities, measured as increasing numbers of possible interconnections

between individuals. It must be acknowledged that this limited formula for now operates on the assumption of a simple definition of complexity as 'interpersonal connection'. Despite this simplicity, it is particularly useful as a heuristic for illustrating the non-linear trajectory of connectivity within an expanding social system of interacting individuals. The literature on chaotic behaviour identifies three time-based behavioural regimes to which such non-linear systems tend; (1) convergence to an equilibrium or steady state; (2) periodic behaviour or a stable oscillation; and (3) chaos (Kiel and Elliot 2004b: 20), and Kiel & Elliot's logistic map exercise adequately demonstrates such chaotic regimes emerge as a result of small disturbances to initial conditions[31].

The quadratic formula of complexity outlined above by Mason (2008), when considered in the context of Kiel and Elliot's (2004) logistic mapping exercise merely suggests the possibility of chaotic behaviour as a function of increasing complexity; its *inevitable* emergence is not substantiated either empirically or through simulation. Fisk and Kerhervé's (2006) empirical work however, suggests that increasing organizational complexity, as a function of population growth, may in itself account for the past collapse of societies. Urry also suggests the simple fact that 'large numbers behave differently from small numbers' (Resnick 1997 cited in Urry 2005b) suggests negative states should be considered as a function of community size. As yet lacking a concept or measure of such negativity, this observation for now at least suggests a break with classical dualisms of 'system' and 'system failure'; both are interconnected through their time-space evolution, through interaction between system components (ibid). This distinction between higher order and lower order complexities is thus a recurring theme within the literature (Cillers; 1998; Byrne 2005).

The role of organizational complexity is repeatedly cited as a key issue in current sustainable development discourse, which argues that systems of greater complexity are more difficult to reorient toward sustainable practice than relatively simple systems (Meadows et al 1974; Fisk and Kerhervé 2006). The limitations of the linear model are thus expressed in terms of historical contradiction; the measurement and modeling of predictor contributions to identify and rank relevant factors hypothesized to produce particular outcomes ignores the non-linear process through which communities amplify conditions giving rise to future divergent states. It must here be acknowledged that this does not imply in any sense a rejection of such

[31] Their exercise is purely mathematical and highly simplified; therefore, its applicability to concrete social systems is questionable. The heuristic nature of this demonstration must again be emphasised, and alternative methodologies are suggested in subsequent chapters.

techniques, merely a recognition of their limitations when used alone, separate from a suitable device of historical contextualization.

The explanatory power of such connection-density formulae at this cursory level is limited, and appears to differ little from Durkheim's notion of dynamic density and his structural pronouncements on organic solidarity. These accounts do however, collectively suggest alternative frameworks and methods are required, and that both a detailed quantitative and qualitative description of system states is required in order to grasp higher order complexities, such as they emerge from interaction – one which is capable of grasping the manner in which such divergent outcomes ensue from initially similar states. On the question of historical narrative and qualitative reconstruction, an interesting parallel between these suggestions of complexity and current debate amongst Marxist historians on future state predictability is observed; Urry (2005b) dedicates a substantial portion of his paper to depicting Marx as an implicit scholar of complexity. More recently, the perceived Marxist narrative of historical materialism and its attendant models of successive modes of production have responded to such charges of linearity and conservatism, by reference to later writings by Marx which suggest his abandonment of such a linear mindset (Browne 2010; Anderson 2010).

In terms of historical context Mason has also suggested that complexity is inherently concerned with seeking '…the levers of history, the sources and reasons for change, in the dynamic complexity of interactions among elements or agents that constitute a particular environment' (2008: 35). There exists a substantial body of literature to be reviewed in chapter 4 on Marx's methodology of systematic dialectic, and his 'reconstruction in thought of [forms] of social production' involving the use of abstract systems of categories (Smith 1993: 115). Dialectics particular concern with 'structured interdependence' (Ollman 2008) reveals many striking similarities to complexity's concern with dynamical systems characterised by the 'clash of mutual accommodation and mutual rivalry' (Waldrop 1993 cited in Mason 2008). Its concern with locating the 'levers of history' within abstract social forms and processes appears paradoxically incompatible with complexity's self confessed materialism of micro-interaction, although many are quick to caution that computational ability should not supplant the complementary promise of philosophical rigor (Cillers 1998; Levins 2008). It is sufficient to merely foreground this forthcoming review of dialectics for now with reference to the fact that these waves of systems and complexity theories have remained somewhat empirically focused[32] – but do claim to overcome the 'a-historical, static, de-contextualised, functionalist'

[32] This may appear contradictory given that chaos theory originated in simulation. Its subsequent adoption by the social sciences however has addressed questions of attribute measurement in dialogue with

charges levelled against general systems approaches (Mason 2008: 33). Clearly, consideration must be given to these differences and similarities when searching for possible routes of synthesis.

At this point the implications of complexity theory may be summarised as follows;

1. 'Sensitivity to initial conditions' renders prediction and explanation difficult using techniques designed for the modeling of system states under the assumption of stasis (i.e. with data from a single time point), and with assumptions of linear parameter change.
2. System growth results in exponentially expanding complexity (as illustrated by Mason's quadratic map of interconnection) creating conditions where minute changes in system parameters become amplified over time.
3. Structural systems models cannot in turn reliably represent such complex historical contingency.
4. Local behaviour and historical context become critical at key transition points in understanding the mechanisms of such transition.

These issues are set against the behaviour of a linear system by Byrne (1998) who states that for such systems, change over time in system parameters produces linear, predictable change in the system overall (1998: 26), the properties of which may be reliably represented with linear models. The problem with this approach is a growing recognition of the importance of context, and the reality that many social and natural systems cannot be interpreted as developing in such a way. Conservatism cannot account for dynamic (particularly human-mediated) change, and it is remarkable that such a position has not taken hold sooner as theoretical grounding for emancipatory critiques of modernisation policy. Causation in non-linear systems is therefore complex and contingent (Byrne 2005), and requires a re-orientation of ontology to properly represent both the interconnectedness of analytical and organizational levels within specific systems, and the divergent states toward which such systems may tend. More fundamentally, it requires resolving the problem of representing such complex development in a simultaneously holistic yet non-reductionist way. To this end, the concept of the 'attractor' is employed in complexity research to illustrate states toward which such systems may tend, demonstrating their fundamentally determinate-chaotic nature.

structural systems theory – it will presently be argued that this exercise in itself has not dealt particularly well with incorporating abstract social processes in its explanatory matrix.

Although linear representation may discern the contribution of predictors to a system attribute outcome within a cross-sectional account, the historical, chaotic amplification of contradictions within the system produces situations by which certain outcomes may be more or less likely[33], one which is not easily represented by the linear model alone. Such potential outcome states are represented in complexity analyses by visual depiction of the 'attractor'. Although the attractor cannot be reduced to a deterministic equation for representation, it does possess properties that may be described topologically. According to Stuart Kauffman, '…dynamical attractors "box" the behaviour of a system into small parts of its state space, or space of possibilities'. (Kauffman 1993: 174 cited in MacKenzie 2005: 47). Quantitatively, an attractor is a visual solution to a nonlinear equation described by a computer (Capra 2005); its dimensionality is defined by the number of variables used in its production, which constitutes a phase space (Mackenzie 2005);

> "…each point in phase space represents the system in a particular state. As the system changes, the point representing it traces out a trajectory that represents the dynamics of the system. The attractor…is the pattern of this trajectory in phase space. It is called 'attractor', because it represents the system's long-term dynamics. A nonlinear system will typically move in a variety of ways in the beginning, depending on how it is started it off, but then will settle down to a characteristic long-term behavior, represented by the attractor. Metaphorically speaking, the trajectory is 'attracted' to this pattern whatever its starting point may have been" (Capra 2005: 35-36).

Such attractions, as observed amongst a multitude of social and natural phenomena are fundamentally non-random; '…if a system does not move over time through all possible parts of a phase space but instead occupies a restricted part of it, then this is said to result from attractors' (Urry 2005b: 239). Chaotic movement is thus conditioned by feedback mechanisms which orient the system toward attractor states. Experimental mathematics, and the social-scientific research previously cited has demonstrated (according to their respective levels of abstraction) that such attractors in non-linear systems are inherently sensitive to disturbances in initial states (*sensitivity to initial conditions*), such that minor alterations in the parameter values of initially similar systems are amplified through multiple iterations - through mechanisms such as those outlined by Mason's quadratic function - to divergent outcomes. The heuristic potential of the 'attractor' resides in its ability to describe a generalized, yet dynamic set of configurations – conditioned by multiple systemic levels – to which social

[33] Interestingly, Byrne (1998) demonstrates that such attractor points must be assessed visually by sequentially mapping time series data and mining for clusters (see Aldenderfer and Blashfield 1984; Kaufman and Rousseeuw 2005, for considerations on choices of clustering algorithms – Byrne (1998) favours the agglomerative hierarchical). Smith and Jenks (2006) also state that an attractor point or strange attractor is not a determinate entity, but rather an indeterminate state toward which a particular system may tend. See Capra (2005) on the assessment of attractor topology.

systems may tend. These attractor states thus describe a systemic state as a function not of spatial-temporal boundaries alone, but of sets of general conditions.

As a brief example, pre-famine nineteenth century Ireland is variously interpreted as exhibiting a number of attractor states, represented by the productive archetypes of small farm, pastoral, tillage, and proto-industrial (O' Grada 1988, Whelan 2000)[34]. The 'phase space' of the Irish economy, with a dimensionality defined by aggregate parameters such as crop output, value of commodity trade, labour force composition, household size, migration trends, and land valuation should in turn demonstrate attractor clustering[35]. An exercise in such attractor derivation is presented in chapter 7, along with a proposed re-orientation of structural typologies to that of social-ecological regimes, as opposed to spatially defined zones. Once this descriptive 'attractor' is augmented with a developmental concept of systems as dissipative structures in the concluding sections of this chapter, its necessity in representing such complex constitution will be substantiated.

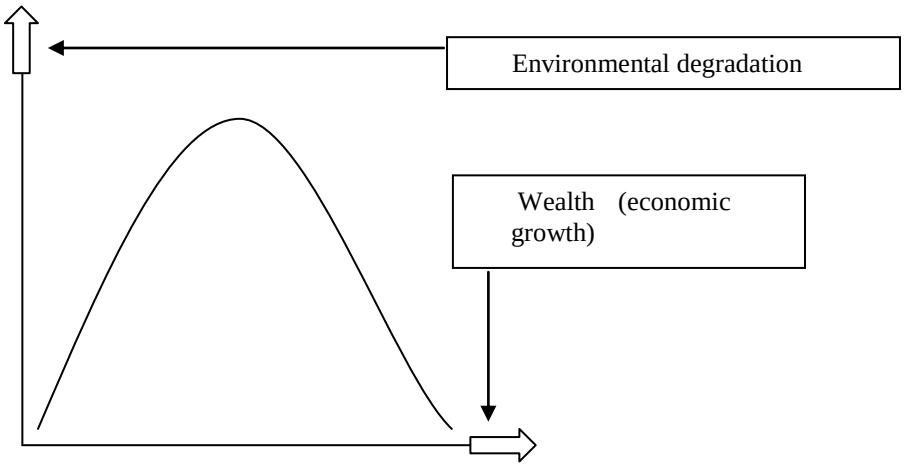
This problem of fitting observations to linear models in order to derive macro-narratives of change is prevalent within the social sciences. Although non-linear multivariate relations may be represented by quadratic or polynomial functions, complexity theory – and the nature of such functions themselves - demonstrates that this exercise, when relied upon alone without appropriate qualification and contextualisation, operates within the restrictive realm of *predictive* modeling (according to Harvey and Reed's typology of methodological abstraction, 2004). Linearity is therefore a function of insensitivity to history according to the complexity critique, which does not imply a default rejection of the linear mathematical apparatus, but rather its augmentation within a framework emphasizing historical context[36]. Irrespective of the functions used, such models retain the superposition principle, and the models themselves, although non-linear (i.e. non-additive in the case of the quadratic), still result in a predictive curve which may be represented with deterministic equations. An example of such a problem of linear representation in human ecology is the representation of ecological modernization with the environmental Kuznets curve.

[34] These archetypes are not defined as attractors by the cited authors, but are derived from spatial characteristics, and macroeconomic indicators

[35] Recorded at county and union level

[36] As will presently be encountered, there are various strategies through which such techniques may be comfortably integrated to the complexity approach through a critical-realist stratification of ontology (Bhaskar 1975).

Figure 1.2



Authors representation of the Environmental Kuznets curve (EKC), cited in Bradshaw et al, 2010

The theory of ecological modernization, as represented in figure 1.2, demonstrates a non-linear relationship between increasing wealth and environmental degradation; various correlated metrics have produced such a distribution (e.g. national wealth and rates of deforestation). The non-linear distribution of data points is in turn explained by the role of technology. According to the curve, as societies cross a particular threshold of wealth, prior to which environmental degradation increases when plotted against wealth (e.g. through periods of industrialization or modernization), the adoption of green technologies in response to demand for sustainable development, results in the ability of such modernizing states to mitigate environmental damage. The intervening variable is thus technology, which acts as a panacea to environmental destruction. Such perspectives have been heavily criticized for absolving state and citizenry of active responsibility for reform, and the modernising narrative of social change predicts the emergence of post-materialist environmental values as a result of increasing standards of living, along with spontaneous technological innovation.

Such a view has rested uneasily both with grassroots green political activists and with complexity theorists. Furthermore, recent evidence suggests that such a relationship is not empirically tenable, and that the model ignores important interactions both between metrics, and historical global inequalities in the distribution of environmental impact[37]. Accordingly,

[37] As an example of such interactions, Bradshaw et al cite '…interaction between a country's wealth and its rate of deforestation of afforestation – poor countries with little forest cover consume that remaining portion more quickly than do poor countries containing relatively more forests' (2010: 2). The authors offer a metric of absolute impact, incorporating natural forest loss, for which developed nations rank less favourably.

the ability of wealthier nations to outsource emissions intensive commodity manufacturing to less developed nations - thereby localizing environmental costs within the borders of the producer rather than consumer - is cited as a critical shortcoming of such accounting exercises (Bradshaw et al 2010). Marxists in particular have previously been heavily criticized for holding to such technological optimism, citing those who argue otherwise as anti-industrial and therefore anti-working class.

The similarities between this ecological-modernist, and previous modernization narratives such as those advanced by Rostow, are well summarized by McMichael (2004) who outlines parallels between such development ideologies, and increasing manifestations of liberal ideology in social policy (i.e. the development of transnational actors such as the International Monetary Fund in service of such an assumed modernization trajectory throughout the twentieth century). According to the preceding critique of linear modeling, and the suggestions of complexity on the historical contingency of such parameters, ecological modernization is therefore untenable due to its insensitivity to the complexities of context, such as they confer differential abilities upon nations to mitigate environmental destruction. Complexity thus adds a further layer of empirical dismissal to such predictive meta-narratives of modernization and dependency.

Using the example of an economic system, Cillers interpretation of complexity suggests that although short-term prediction of the effects of a macro-systemic intervention such as currency devaluation may be possible, these effects are 'only predictable in the short term since the spontaneous adjustment of the system involves the complex interaction of too many factors – many of which cannot be controlled at all' (Cillers 1998: 91). It must again be emphasised that despite various author's suggestions that such a project of complexity mapping is amenable to existing techniques of analysis, the data available for the forthcoming case study system cannot fulfill such formal requirements. Nonetheless, the literature is emphatic on the point that qualitative (including documentary and historical data) are suitable for inclusion in such a mode of analysis (Byrne 1998; Smith and Jenks 2006; Hafferty and Castellani 2009), and a conceptual model will presently be offered, to which such varied analytical techniques may be fitted. Consequently, if the possibility of adopting a formal complexity approach is not forthcoming, it at least encourages consideration of such complexities of causation and contingency, and the adoption of a broader view in the interpretation of data. This, as was observed above, is lacking in the elaboration of conservative, hierarchical systems models within both sociology, and general systems theory; instability and contingency are therefore axioms of the complexity approach. It must also be acknowledged, that complexity does not

merely suggest transplanting mature science methods through physics envy; '…rather it involves thinking about the social world and its intersections with the natural world as involving dynamic open systems with emergent properties that have the potential for qualitative transformation, and examining our traditional tools of social research with this perspective informing that examination' (Byrne 2005: 98).

The assessment of change in complex systems is therefore one which relies upon local knowledge (Cillers 1998; Byrne 2005) in order to fully understand how such systems direct and manage the conditions of their own transformation, and amplify contradictions to threshold limits. It is the examination of local behaviour through a comparative method that allows permits the extraction and generalisation of such mechanisms of transition, and Byrne (2005) has suggested taking such a cue from Ragin (1987) in identifying such comparative cases; '…cases are viewed as configurations – as combinations of characteristics. Comparison in the qualitative tradition thus involves comparing configurations…this holism contradicts the radically analytic approach of most quantitative work' (Ragin 1987:3 cited in Byrne 2005). This is a productive methodological avenue for a number of reasons, in that it avoids limiting case selection to manifest spatial entities (such as with world systems theory and ecological modernisation) or to variables alone and allows for the selection of abstract systems as cases[38]. 'Abstraction' in this sense is not the same as its use in functionalist systems modeling, rather it refers to the possibility of reconstructing a set of ideal-typical system attributes from fragmentary data, as is typically required in historical sociology of this sort. It also allows the analyst to overcome the excessive localism implied by *sensitivity to initial conditions,* and their detailed reconstruction[39].

This methodology of case-centered comparative work is well established as a strategy '…to conduct parallel demonstrations of theory or to analyze causal mechanisms across sets of comparable cases' (Ragin 1987: 34); this will be substantiated further in subsequent sections as an ideal-typical modeling approach. Establishing system dynamics and assessing change is therefore not a structurally derived, rule-driven process to which a singular model of transition can be applied. Consequently, the linear model, where employed, must be situated within a multidimensional methodology which empahsises context, and the potential for considerable developmental diversity. Functionalism, as was observed above, has provided a perspective of mechanically-derived equilibrium, and broader systems theory has elaborated a model of

[38] See chapter 3 of Ragin (1987), *Case-Oriented Comparative Methods*, pp 34-53.

[39] Particulars of method and 'casing' are detailed in chapter 6.

metabolic interconnection between system components. Complexity has here suggested that not only have these models proven reductionist and insensitive to context, they have, in certain instances, relied excessively on the fundamentally flawed possibility of isomorphic linear modeling. What must now be attempted is a 'fleshing out' of an alternative, dynamic concept of social systems as dissipative (evolutionary) structures, and an examination of the ontological and logical tools supplied by the complexity perspective to represent the structural complexity of such systems. The conclusion of this exercise thus forms the epistemological basis for theorizing such systems as complex, open entities amenable to measurement and analysis, and the substantive basis for advancing a methodology of case-oriented analysis.

1.2.2. Orienting complexity to the historical sociology of systems

Some avenues of complexity that are immediately applicable to the research problem of this thesis, as correctives to restrictions of linearity are the concepts of *dissipative structure* and *nested ontology* which are closely related to the conceptual thrust of *attractor states* encountered in the preceding section. The former (dissipative structures) captures the contingent dynamics of metabolic social systems by historicizing the structural components of metabolic maintenance and suggesting a focus on negentropic production as a tool of assessment. The latter (hierarchical ontology) suggests a framework through which the complex structural constitution of such entities and their amenability to measurement and modeling at varying levels of abstraction may be apprehended, without reproducing typical ontological dichotomies of objectivist-positivist / constructivist[40]. Both concepts will in turn be elaborated.

As discussed above, the complexity approach to explanation is inherently historical, as it seeks a description of system states such as they impact on the probabilities of future outcomes. It is through mapping such historical development that the process through which systems adapt to internal and external stress is observed, an avenue defined as the study of *system dynamics* by Castellani and Hafferty (2009). The authors' definition of dynamics includes two important analytical concerns; that of *trajectory*, which deals with the evolution of the system within its environmental context; and that of *self-organising criticality*, as derived from the work of Ilya Prigogine on dissipative structures. According to this latter concern, complex systems are not characterised by either a state of stability or collapse into chaos (the dichotomous measure implied by earlier functionalism). Instead, they '…achieve stability by settling into a particular

[40] See John Goldthorpe's *On Sociology* 2006 for an excellent discussion of the futility of divisive methodological debates.

phase state that allows them to manage their relative entropy, chaos and stasis' (Castellani and Hafferty 2009: 65). This perspective, as derived from evolutionary biology, has found many correlates amongst real-world social systems (Smith and Jenks 2006; Alhadeff-Jones 2009); the consequences of failure in a social systems' *self-organising criticality* is therefore system dissolution according to the laws of entropy. For complexity theorists, this collapse is ultimately a result not of the linear contribution of destabilizing variables to systemic entropy, but rather of an amplification of complexity across multiple hierarchical levels, a process which may have as much to do with minute destabilizing effects amplified over time through increased community complexity as with the constancy of social processes.

What the concept of *self-organising criticality* implies is that apparent structural regularity may result from such chaotic tendencies toward dissolution; systems thus form relatively stable institutions and mechanisms to cope with efficient resource distribution. This definition confronts a number of postmodernist misappropriations of the concept of chaos, which is often taken in evidence of the impossibility of objective measurement and study (Sokal 2001). As observed above, the process of complex development itself is one which may be comprehended with a particular set of general *rules* as distinct from the postmodernist straw positivist concept of *laws*. Once system development is understood to be constrained in complex *rule*-bound ways within confines set by parameter attributes and boundaries, the modernist promise of rational measurement is entirely intact (Byrne 1998). This possibility is in turn embodied in the ubiquity of the attractor. As Alhadeff-Jones (2008) states, the concept of self-organising criticality '…demonstrates the possibility that an irreversible process (dissipation of energy), far from a steady-state, is able to play a constructive role and become a source of order' (2008: 69). By integrating the study of system energetics in this way, an appreciation of the complex ways in which human societies confront this intractable tendency through structural, institutional, and cultural elaboration in the production of negentropy may be gleaned; '…no negation is costless or innocent; the substitute form will have to draw its energy and resources from what it supplanted and is likely to be confronted with the debris of what went before' (Smith and Jenks 2006: 7). This is crucially different from the general and living systems models of structure, which merely describe the subsystems through which pathology is processed as an anomalous, rather than endemic state.

1.2.3. Emergent properties of autopoietic systems

Before elaborating substantively on the nature of dissipative structures, a note of clarification on the concept of self-organisation, as encountered above in *self-organising criticality,* is

required; it is a concept which is here suggested as immanent in many forms of social organisation, but one which is often misinterpreted as denying agency and reflexivity to social actors. Maturana and Varela initially characterised open systems by their capacity for *autopoiesis* in the early nineteen-eighties, as a means of distinguishing between living and non-living systems - an essential distinction, due to earlier noted difficulties of imputing physical system analogies to social stability (1980, cited in Skyttner 2005). Consequently, their depiction claimed to offer a materialist account of the uniqueness of living systems (Castellani and Hafferty 2009: 176). Their focus on human systems as different in structure, but not in organisation is reflected in Niklis Luhmann's subsequent closed-system re-orientation of Parsonian systems analogizing to the identification of functional, as opposed to structural equivalents. By nature of their requirement of trans-boundary energy appropriation, living systems operate in a state of disequilibrium by attempting to fulfill their biological requirements of metabolism and growth, adaptability, and reproduction (Skyttner 2005: 60). Maturana and Varela's definition of a heteropoietic system is thus worth considering, and its applicability to the empirical terrain of this study is initially striking;

"The term *heteropoietic* implies human designed systems with a purpose. The following characteristics differentiate living systems from non-living ones.

- The presence of both structural and genetic connections in the systems;
- The presence of both co-ordination and subordination in the system;
- The presence of a unique control mechanism (e.g. the central nervous system) working in a *probabilistic* manner possessing a certain number of degrees of freedom in the system;
- The presence of processes which qualitatively transform the parts together with the whole and continuously renew the elements;
- The capability to learn or to have an extensive repertoire of instinct responses adopted to different situation (Skyttner 2005: 61)

This notion of autopoiesis, or self-organized adaptation, offers much to discard notions of essentialism in higher-order emergent social system properties. Rooted in evolutionary biology, an autopoietic system is thus '…organised as a unified whole, the parts of which continue, through multiple interactions and transformations, to realise and produce relations that have themselves produced the network of processes in the first place' (Alhadeff-Jones 2008: 70). This concept overcomes a number of issues with previous functionalist, and arguably general systems accounts of the social system. Its assumption of self-organising ecologically motivated purposive action implies a particular utility to agricultural systems, avoiding the problem of locating the persistence of observable system properties (such as mechanisms of governance or collective labour) within an abstract collective mentality. Once the assumption of self-maintenance of metabolism is accepted, such a position of cultural

reductionism becomes untenable. Furthermore, it implies an integration of the various subsystems outlined above in a qualitative process of renewal, whilst remaining mindful of the inherently unstable nature of such entropic metabolic states, although this concept will be taken up more specifically in subsequent discussions of dissipative structures. Niklis Luhmann further illustrates this concepts sensitivity to the dialectical relation of system to environment;

> "Self-referentially autopoietic systems are endogenously restless and constantly reproductive. They develop structures of their own for the continuation of their autopoiesis. In this way the environment remains as the condition of their possibility and as a constraint. The system is both supported and disturbed by its environment…the system forms its own structures in reaction to irritation from the environment in order to continue the autopoietic process or else it simply ceases to exist" (Luhmann 1986:13).

Although it adds a further layer of dismissal to the organizing logic of functional consensual integration, and places systems analysis on a firmer ecological footing, it still does not address the measures which are required to assess such disturbance as is alluded to by Luhmann's concept of 'environmental irritation'. By emphasizing the autopoietic nature of social systems however, the analytical concern becomes that of the processes through which social systems confront their entropic tendencies, rather than a structural discussion of their constituent parts and subsystems. A general logic of community-level resource maximization does not imply that 'steady states' are achieved or maintained for any period of time; what consistently presents however, is the need for a theory comprehending the historical conditions under which resource instabilities manifest, and for a device to express the production of internal pathologies. This assessment, it has been argued, cannot proceed with static systems models, such as those of general systems theory, developed through the physical sciences.

As previously outlined, early organicists such as Von Bertalanffy were confronted with the position of vitalism as a metaphysical account of collective organisation; the idea that internal structure was possible only through external design, or with the presence of an internal control mechanism. Cillers offers a contrary anti-theological working definition of self-organisation; 'The capacity for self-organisation is a property of complex systems which enables them to develop or change internal structure spontaneously and adoptively in order to cope with, or manipulate, their environment' (Cillers 1998: 90).

This capacity for self-organisation is one of two which Cillers identifies as indespensible for complex systems, the second of which is *representation*, or the capacity of a system to 'store information concerning the environment for future use' (Cillers 1998: 10). This question is typically addressed in an atomistic manner by systems theorists, who seek to explicate system

structure, rather than explore the logic underlying its form of organisation, or who regard structural adjustment as a unilinear process by which the system simply reacts to external stress. What self-organisation implies, as suggested by the above criticisms of linear modeling, is that this is not a determinate one-way process;

> "Meaning is conferred not by a one-to-one correspondence of a symbol with some external concept or object, but by the relationships between the structural components of the system itself. This does not deny a causal relationship between the outside and inside of the system. It does, however, deny that the structure of a system is *determined* by the outside. Meaning is the result of a process, and this process is dialectical – involving elements from inside and outside – as well as historical in the sense that previous states of the system are vitally important. The process takes place in an active, open and complex system" (Cillers 1998: 11).

By this account, the question of system structure as self-organisation thus becomes comprehensible. A complex exchange of information, as a result of historically developing conditions and relations between system components, and between system and environment produces a necessity of institutional adjustment to cope with the systems entropic tendencies. Urry (2005) describes the process of self-organising autopoiesis as a '…network of production processes in which the function of each component is to participate in the production or transformation of other components in the network' (2005: 8). The autopoietic nature of social systems is here cited in explanation of urban segregation, a phenomenon by which individual's decide to live with those of similar ethnicity. This results in a configuration for which '…local, short-range interactions can create large-scale [self-organizing] structure' (Krugman 1996 cited in Urry 2005a: 8).

The role of iterative yet cumulative, small-scale disturbances,[41] could account for similar deviations, without resorting to a search for vitalist organising logic, collective mentalities or simple external causes – an example of which could include farmer's decisions to adopt ecologically sub-optimal subdivision and redistribution practices as will be observed within the forthcoming case study. The programme of complexity further avoids interpreting such patterns as a simple result of a teleological process of 'lock in' or 'path-dependence', and encourages reconstruction of the historical, local conditions within which such phenomena manifest, and the conditions under which differing configurations of system variant manifest.

[41] Waldrop (1994) recounts a fascinating preoccupation of Brian Arthur with searching for examples of technologies contradicting the economic law of negative feedback. Examples include clocks built to operate backwards, the modern QWERTY keyboard, designed to slow typists working on mechanical typewriters, and VHS tapes – inferior to their betamax contemporary. Arthur's search for simple principles contradicting economic assumptions of regression to an optimal state through positive feedback (i.e. contrary to his developing complexity account), demonstrated the strength of complexity's sensitivity to initial conditions, amplification of contradictions, and complex contingency whereby functionally sub-optimal technologies became 'locked in' to widespread use.

In specifying as much, it connects the concept of autopoietic organisation with contingent sensitivity to initial conditions and attractor states as specified by non-linear modeling (Kiel and Eliot 2004). It must hence be acknowledged that the concept of self-organisation in this sense has clear material roots, and must not be confused with the abstractions of earlier vitalist-mechanicists.

The relationship between social agents and such higher order structures in the process of self organisation is in turn offered by Sawyer's interpretation of emergence (2001, 2005) although this perspective is arguably of less *practical* concern for the forthcoming empirical exercise, and instead functions more an ontological endeavour. It should therefore be interpreted as a primer to elaborating the notion of a nested ontology in the following section, and for clarifying the position adopted within this work on the structure/agency dualism, as this question will emerge in subsequent chapters when discussing agent-based approaches to natural-social relations. Drawing upon empirical work in computer modeling, Sawyer (2005) presents 'emergence' as an analytical concept in systems theory, linking lower level interactions and processes (at the level of the individual agent), to higher-level system regularities;

> "…many sociological accounts of the micro-macro link use the term "emergence" to refer to collective phenomena that are collaboratively created by individuals, yet are not reducible to individual action…Emergence theories attempt to explain the nature of society as a complex system by accounting for how individuals and their relations give rise to global, macro social phenomena, such as markets, the educational system, cultural beliefs, and shared social practices (e.g., politeness and power dynamics)." (Sawyer 2005: 6)

Interestingly, Sawyer identifies 'emergence' as an ordering concept, and mode of thought evident within the works of numerous classical thinkers in sociology from Comte to Parsons. The concept also embodies an individualist-collectivist dichotomy whereby social order is variously, depending on the theorist in question, either reducible or irreducible to lower-level social interactions. According to Sawyers description above, the concept of 'emergence' is one which seeks to reconcile the ontological distinction between the primacies of the whole (system) vs. its constituent components in explanatory accounts of systemic regularity.

According to this concept, the problem of unpredictability in complex social systems is overcome through the ordering power of the concept of emergence; the idea that higher-order phenomena (i.e. institutions, cultural patterns and structure) are entities more complex than the constituents who produce them. The concept thus appears as a formalized theory of

structuration – albeit one with current close connections to computer simulation (Halpin, 1999) - which attempts to account for micro-level interaction (lower level) and resultant observed system regularities (higher level), that are irreducible to 'properties of the system components' (Sawyer, 2005: 4). It must be noted, that although Sawyer offers a compelling, empirically grounded account of emergence from multi-agent simulation models, this approach is, despite his criticisms of complexity, ultimately insensitive to the dynamics of history (such as are specified in the complexity account above) by relying solely on cross-sectional data.

The basic problematic of emergence, although not typically expressed as such in the literature, is familiar to all students of sociology through C. Wright Mills elaboration of the sociological imagination, such as it enables its possessor to grasp the complex embeddedness of the individual within broader social structures and institutions beyond his immediate control, but to which his social actions owe their constitution. The concept is here outlined for ontological clarity on the relationship between agent and structure, to add a further layer to the rejection of previous systems theorists' vitalisms of self-organisation, and to reaffirm the possibility of a realist approach to social measurement. It further offers a corrective to the prospect of psychological reductionisms, such as were advanced by early functionalists, and through the later methodological individualism of rational actor theorists. The concept of emergence thus fits with complexities suggestion of localism as essential to comprehending system dynamics. Heylighen et al (2006) have shown that agents typically interact with a comparatively limited number of individuals (in relation to the size of their overall collectives), and with intrinsically uncertain knowledge. As a further dismissive to predictive modeling and general structural models, the authors point out that the mere existence of such emergent properties, although unsurprising, indicates the impossibility of prediction. In this respect, many authors hold symbolic interactionism in high regard for its ability to systematically cope with such complexities of interaction at a local level (Sawyer 2005).

Classically, the problem of emergence is depicted as a question of the 'causation of the social' – (i.e. 'system effects that are different from their parts' Urry 2005a: 5) – or of the extent to which such irreducible higher-order social variables may be considered to impact on human action as objective entities independent of the techniques used to measure and describe them. Bhaskar's ontology of supervenience and critical realism thus corresponds with the approach here adopted (despite Sawyers objections), in his claims that '…societies are unilaterally, existentially dependent on the material world, such that any social change entails a natural change' (Bhaskar cited in Sawyer 2001: 568 see also Eliot and Reed, 2004 and Byrne 1998), although scepticism must be directed toward his consequent depiction of complete autonomy

of structure from the individual. Critical realism here defines a middle ground between modernism and postmodernism, by recognising scientific practice as socially conditioned, but distinguishing it from pure ideology by accepting the objectivity of its subject (Byrne 1998; Harvey & Reed 2004). This position was later reaffirmed and augmented by Margaret Archer in her rejection of Gidden's inseparability of structure and action; 'Archer's emphasis on time and her claim that current structural conditions were not created by the current actors, but by actors in the past, are foundational to her emergentist accounts of morphogenesis' (Sawyer 2001: 569). Her position thus offers a conciliatory account of emergence whereby structural contexts are produced and conditioned by social actions of the past.

Clearly, these questions are ones of ontological clarification, and it appears sufficient to merely supplement present accounts of self-organisation here with the precision of an 'emergence' concept of social order, which grasps the complexity of the structure-agency relation, but which ultimately accepts the potential *analytical* autonomy of structural variables. In the language of the complexity account, the myriad interactions of individuals give rise to emergent structural conditions, changes in which must be understood as a complex dialectic between local behaviour, and the recursive, but ultimately *causative* effects of structure. As will be addressed in chapter 2 in criticisms of actor-network theory, this offers a crucial route for the introduction of assessments of qualitatively differing states, outcome and system configurations - without resorting to excessive localism-inductivism - whilst retaining the analytical-generalisable capacities of structural regularity, and permitting the introduction of middle-range heuristics.

This epistemological-ontological position is itself compatible with Ciller's (1998) view of self-organisation as a result of interaction between system and environment, and a systems' consequent dynamic adaptation of structure conditioned by quality of feedback[42]. Such a conception of self organisation is reaffirmed by Alhadeff-Jones, who states that such interpretations of self-organisation '…help…to redefine complex organised phenomena as

[42] Given this consequent necessity of information management, *collective memory* may offer a conceptual link between these questions of emergent properties, and adaptive self-organisation; '…if a certain state of affairs regularly causes harm to the system, the system will associate that condition with harm *without having to know beforehand that the condition is harmful*. As the system encounters different conditions in the environment, it will generate new structures to 'represent' those conditions, within the constraints determined by the amount of memory available to the system' (Cillers 1998: 93). Collective memory (i.e. custom) may in turn be conceptualised as a repository of information conditioning practices of structural elaboration in accordance with accumulated experience. By this systemic logic, i.e. by conceptualizing system dynamics as a process of feedback oriented toward the production of negentropy, the assigning of autonomy to culture and memory may be avoided in observations of practice. Byrne (2005) further states '…a crucial corollary of complexity theory is that knowledge is inherently local rather than universal' (Byrne 2005: 97).

emergences, produced not only from their constituting order, but also from the disorder (noise or fluctuation) characterizing the relations among their own components (Alhadeff-Jones 2008: 69). This perspective will shortly be revealed as immanent in post-Hegelian (i.e. non-idealist) reconstructions of dialectical reasoning as forwarded by Marx.

1.2.4. The hierarchical ontology of social systems as a route to methodological pluralism

There is a further dimension to the complexity approach which attempts to break down singular concepts, and dichotomies of 'the social / natural' through a stratification of ontologies levels, informed by the founders of general systems theory - specifically Boulding's hierarchies of complexity – augmented with the work of Roy Bhaskar (Harvey and Reed 2004). It speaks specifically to the question of complex, non-linear interactions amongst system variables as outlined in the preceding section, and offers a potential 'complexity corrective' to the ontological formalisms of general systems' structural models. It is presented here as an essential precursor to outlining the concept of dissipative structures. Bhaskar's implicit 'nested ontology' derives from his critical realist account of scientific knowledge as the accumulation of discoveries of progressively deeper layers to physical reality (i.e. genetics and particle physics). Bhaskar thus accords reality itself with a similar hierarchical ontological structure (Harvey and Reed 2004), and his critical realism was here instrumental in carving a middle ground between constructivism and positivism;

> "It regards the objects of knowledge as the structures and mechanisms that generate phenomena; and the knowledge as produced in the social activity of science. These objects are neither phenomena (empiricism) nor human con-structs imposed upon the phenomena (idealism), but real structures which endure and operate independently of our knowledge, our experience and the conditions which allow us access to them" (Bhaskar [1975] 2008: 15).

Accordingly, Harvey and Reed outline a 'hierarchy of ontological complexity in social system[s]' (2004: 307). The concept of 'hierarchical' is preferable to that of nested, according to Cillers (2001) in that the former recognizes the complex, rather than linear constitution of such systems, and their potential as dynamic entities to transform relations between components and levels in their historical development. Harvey and Reed's original model contains fourteen ontological levels (vertical axis), against which modeling strategies are mapped (horizontal axis) according to their respective levels of determinism and abstraction;

Figure 1.3

Hierarchy of Ontological Complexity in Social System	Modeling Strategies for Studying Chaotic Social Systems: Arrayed by Decreasing Determinist Presuppositions (horzontal axis) and by Levels of System Specificity (vertical axis)					
Process II: Societal evolution via historical modes of production						
Process I: Class struggle. Conflict over cultural hegemony						
12. Values II: Hegemonic culture & subcultural bases of resistance						
11. Values I: Struggle of hegemonic vs. subterranean world views						
10. Norms II: Allocation of relative power among social institutions						
9. Norms I: Personal conformity to general hegemonic standards						
8. Roles II: Intraorganization allocation of roles & resources						
7. Roles I: Distribution of material rewards & esteem						
6. Facilities II: Technical division of labor in productive sphere						
5. Facilities I: Sociotechnical infrastructure of organization						
4. Ecological organization of institutional time & space						
3. Ecological organization of local biotic community						
2. Biological evolution as a series of assisted bifurcations						
1. Determinant regularities of the physical universe						
	Predictive Modeling	Statistical Modeling	Iconological Modeling	Structural Modeling	Ideal Type Modeling	Historical Narratives
	Levels of Modeling Abstraction					

Reprinted from Harvey and Reed (2004: 307)

According to the above table, constructed of a combination of Neil Smelser's extension of Parson's abstract system levels, and Kenneth Boulding's general systems hierarchy of organizational complexity (Skyttner 2005), each ascending level of ontological complexity possesses mediating properties vis-a-vis its predecessor. The implications for an integrative natural/social framework are evident, but, as is observed above, this model offers little in the way of reconciliation. Furthermore, the above model represents merely the possibility of such an approach to ontology – it is not to be taken as immanently transferable for the objectives of this study. It does however; offer a framework through which methodological abstraction may be assessed according to the amenability of the various ontological levels to specific techniques of modeling, by varying degrees of precision. It retains the possibility of conducting statistical

modeling at the level of 'ecological organisation of institutional time and space' (4), or of population dynamics for example, which despite its success within such established modeling programmes is not specifically included[43].

The promise of this stratified ontology in representing multilevel systemic complexity is further affirmed by Byrne (1998);

> "When we are thinking of real complex systems it is important to consider that these are likely to be nested...What this means here is that the attractor space, the subdomain of the phase or condition space represented by the strange attractor, constitutes the phase or condition space within which sub-systems of the whole system are located. Social and socio-spatial entities which are internally systemic, for example localities or households, can be considered to be located within the phase or condition space constituted by the higher order social system of which they are a part. It seems at least possible that we may have different kinds of bifurcation processes at different levels in the hierarchy. The butterfly attractor has great appeal as a description of the trajectories of individuals and households, whereas simple catastrophe might describe the evolution of the whole social order or of localities" (Byrne 1998: 28-29)

Byrne suggests here that various sub-systems (i.e. levels of Harvey and Reed's hierarchy above) may exhibit various states of chaotic behaviour, on a scale of magnitude, which may impact differentially on lower-order levels. Byrne here offers the epidemiology of T.B. as an example for which the nested hierarchy of individual, household, community and nation state illustrate various levels within which divergent outcomes at an individual system level (i.e. household) may combine to impact in unpredictable ways on macro-outcomes of morbidity and mortality (Byrne 1998: 111). The implications of this stratified ontology, and its consequent hierarchy of complexity for the general systems programme is that its efforts to develop predictive models (Snooks 2008) have failed to consider the susceptibility of social forms, and their consequent complexities, to the form of quantitative measurement implied by its proponents. This epistemological shortcoming of measurement is evident still in the recent work of J.G. Millers' ardent defendant, Kenneth Bailey. Although Bailey points out that systems theorists have typically focused on explicating structural objects and relations rather than suggesting component attribute measures, his corrective of *social entropy theory*, and its concomitant EPILOTS (acronym) measures are equally limiting. Although variables in Bailey's framework such as population (P) are doubtless critical to assessing systemic entropy, it is unclear for example how technology (T) could be operationalised (Bailey 2006). Furthermore, it is unclear how this approach is reconcilable with complexities' contention that such models are inherently flawed by remaining within the classical paradigm of predictive

[43] It further omits the analysis of trans-national interactions, (i.e. the effects of global economic configurations and contexts) such as are considered by world systems theorists (Wallerstein 2006).

modeling alone. The solution perhaps rests on the opposite extreme of Harvey and Reed's horizontal axis of methodological abstraction with the strategy of ideal-typical model;

> "Ideal typical modeling constitutes the mirror image of structuralist analysis. Scientists who employ ideal typical modeling in their research are not interested in structural commonalities…they are interested in the singularities that create deviations from homogeneous patterns… [they] also gather as many different empirical examples as possible…they seek commonalities among the class of objects surveyed and, like the structuralists, construct from those commonalities a logically pure type that captures the essence of the class of entities under study" (Harvey and Reed 2004: 312-313)

This suggestion must be set against the structuralism of existing systems theorists' models and methodologies, and appropriated as a possible means of overcoming limitations to historical data and generalization. The ideal-typical model is thus particularly amenable to current research objectives;

> "…after the ideal type model is constructed it is "discarded"…as the scientist turns his or her attention to the *deviant elements* that cannot be subsumed under the logically pure type. Using the ideal type to identify these singularities, the scientist focuses upon the *nonlogical* elements that set each instance off from the logical pattern. In these nonlogical exceptions, the scientist discovers what is historically and developmentally unique in each instance. The ideal typical modeling strategy, in sum, produces a variety of ideographic knowledge that can serve as the basis for a comparative history of social science" (Harvey and Reed 2004: 313)

This position is particularly compatible with Byrne's (2005) insistence on the comparative method as a basis for a unified research programme within the implicit episteme of complexity. It is a method which inherently seeks to grasp causation, and when considered within the context of the critical realist stratified ontology, offers no limitations to exploring case and level-specific system parameters such as population with techniques from the more concrete extreme of the methodological axis such as statistical modeling. This does not imply uncritical adoption of natural science methods and concepts, as evidenced by recent writings in complexity which appear to acknowledge the effects such emulated 'scientism' has had for social theory[44]. Urry suggests as much in characterizing the current complexity approach as 'one that combines system and process thinking' (Urry 2005a: 3). Furthermore, denial of the possibility of objective hierarchies merely reduces social science to the study of the politics of mental constructs; it leaves us incapable of generalization, and reduces our analytical capacity to descriptive empiricism.

[44] See Urry (2005a: 2) for a bibliography of recent work

Cillers (2001) remarks that any approach to representation must remain mindful of the distinction between descriptive and ontological complexity; the former representing the trap into which many previous systems theorists have fallen;

> '…models attempt to grasp the structure of complex systems [which are] neither homogeneous nor chaotic. They have structure, embodied in the patterns of interactions between the components. Some of these structures can be stable and long-lived (and therefore easier to catch in or model), whilst others can be volatile and ephemeral. These structures are also intertwined in a complex way. We find structure on all scales. In order to see how difficult it is to grasp these structures, it is necessary to look at the boundaries of complex systems and to the role of hierarchies within them" (Cillers 2001: 140).

A number of authors have given consideration to this question of system boundaries, and have suggested that their definition must remain mindful of reduction to the spatial (Cillers 2001; Heylighen et al 2006). It is here suggested that the preceding approach to representation of 'stratified ontology' overcomes such a difficulty. Bailey (2008) conceptualises a boundary as something separating the system from its environment, and in turn identifies a number of mechanisms regulating information and matter-energy flows within systems. Citing Luhmann's conceptualisation of social systems as simultaneously closed (organizationally) and open (exchanging across system boundaries), Bailey (2008) identifies optimal entropy maintenance as a critical function of social systems. Boundaries here act as a security against external incursions, and loss of internal resources; such boundaries may be immaterial (i.e. political territorial boundaries) or physical (i.e. fences and walls), and Bailey (2008) presents an ordinal typology of boundary flow processes for both information and matter-energy. This approach, based on living systems and social entropy theory clearly introduces a number of objectivist limitations.

Cillers (2001) offers an alternative interpretation of system boundaries as both material and immaterial. The concept of autopoietic organisation suggests that boundaries function in terms of 'operational closure', a process necessary for systems to maintain identities, and consequently, their own reproductive capacities (Cillers 2001: 140). In this sense, boundaries are self-constituted, emergent properties of reproducing systems, which 'emerge' as a result of the interaction of the systems' constituent components in the process of reproduction. The 'boundary' must be recognized, in the context of this ontological approach, as;

> "…simultaneously a function of the activity of the system itself, and a product of the strategy of description involved…we frame the system by describing it in a certain way…but we are constrained in where the frame can be drawn. The boundary of the system is therefore neither purely a function of our description, nor is it a purely natural thing. We can never be sure that we have "found" or "defined" it clearly, and therefore

> the closure of the system is not something that can be described objectively. An overemphasis on closure will also lead to an understanding of the system that may underplay the role of the environment" (Cillers 2001: 141).

This approach to boundary identification will presently become essential in dealing with systems subject to constraint and influence by factors beyond their spatial confines. Clearly there are objective properties to the boundaries of concrete agricultural systems, and these will be given due consideration. The problem when dealing with 'systems in general', or an ideal-typical process-based model of a socioecological system is that spatial limits are not forthcoming – we are dealing with properties, processes and relations, and as such, boundaries must be seen as *constitutive* of that which is 'bounded' (Cillers 2001).

Conceptualising boundaries as 'closed' restricts understanding of the complex ecological interactions of such systems; consequently, '…boundaries do not separate but immediately connect the system with its environment. They do not have to be physical or topological, but are primarily functional, behavioural and communicational. They are not "perimeters" but functional constitutive components of a given system' (Zelany cited in Cillers 2001: 141). The hierarchical nature of such systems' composition, as here outlined, further complicates the notion of objective boundaries according to the degree of abstraction to which a system component or property corresponds. Heylighen et al (2006) have argued that it is a matter of theoretical choice, in that the mutual constitution of context and system must be appropriately conceptualised. A stratified ontology does not offer to reduce, but merely to represent such complexity.

It is with this potentiality of 'combining system and process', and recognition of the interplay of multilevel systems with their environments, that discussion returns to Prigogine's concept of dissipative structures. The foregoing problematic of bounding is a theme which will be returned to at many points throughout this thesis, and is ultimately resolved by situating the question of bounding within Ragin's methodological pronouncements on 'casing' in chapter 6. It is thus essential that such a foregrounding of the empirical research of subsequent chapters with this ontological clarity has been offered, in order to avoid presenting the objectives of this work as a simple search for appropriate techniques of data reduction. Systems theory, as here observed, has provided a structural model of systems as hierarchically organised metabolic entities. Complexity theory has in turn confronted these limitations by complicating accepted notions of interaction in linear systems through the introduction of historical sensitivity. The concept of dissipative structures as here outlined, is offered as a resolution to the functionalist question of equilibrium, one which orients analysis toward a fundamental, albeit highly

abstract theorisation of social-ecological systems as metabolic entities, and their consequent production of structural regularity within conditions of varying entropic dynamics.

1.2.5. Dissipative structures: resolving the functionalist dichotomy

In their introduction to *Modern Thermodynamics*, Kondepudi and Prigogine (1998) remark upon the diversity of phenomena 'from astrophysics up to human sciences and economy', to which the concept of *dissipative structure* corresponds. Porush offers the following remarks on their ubiquity;

> "[Dissipative structures] represent the spontaneous emergence of order out of disorder – 'a self-organising system'...[these] are ubiquitous in the biosphere or the macroscopic world. Indeed the very fact of the biosphere – with its seething complexity and diversity and apparent tendency to evolve in the direction of increased differentiation and complexity is explained by Prigogine's theory of dissipative structures" (Porush 1991: 56 cited in Smith and Jenks 2006: 83).

The appearant prevalence of such structures, and their explanatory potential as a bridging concept between the natural and social sciences is cited by numerous authors from both sides of the scientific divide (Byrne 1998; Kondepudi and Prigogine 1998; Harvey and Reed 2004; Byrne 2005; Capra 2005; Urry 2005b, Smith and Jenks 2006; Wallerstein 2006; Manuel-Navarette 2008; Castellani and Hafferty 2009). Whereas the 'attractor' represents a descriptive outcome state of a system described with a particular set of variables, and the concept of self-organisation demonstrates how feedback-conditioned perturbations produce higher-order structural properties, the concept of 'dissipative structure' accounts for the evolutionary tendencies of such systems, thus uniting these aspects. It describes the phenomenon by which disorder (i.e. dissipation of energy) '...is able to regress...and the ways in which circumstantial fluctuations can amplify themselves (bifurcation) to bring the system into a new state characterised by stability (Alhadeff-Jones 2008: 69). Consequently, systems interpreted as interacting dissipatively with their environment (Urry 2005b) are variously described in the literature as 'islands in a sea of chaos' (Harvey and Reed 2004). The use of the term 'stability' in this context is fundamentally different to its misuse by functionalist and general systems theorists, in that it accounts for development as evolutionary, but ultimately not homeostatic.

Drawing upon non-linear dynamics, as discussed in the previous overview of linear modelling techniques and attractors, Ilya Prigogine initially explored the phenomenon through which living organisms were able to sustain metabolic states under conditions of non-equilibrium (Kondepudi and Prigogine 1998; Capra 2005). According to Capra, by connecting this

grounding approach of non-linearity with a concept of systems as ultimately 'far from equilibrium' (Byrne 1998), Prigogine discovered within open systems; '...[a] close interplay between structure on the one hand and flow and change (or dissipation) on the other. The farther a dissipative structure is from equilibrium, the greater is its complexity and the higher is the degree of nonlinearity in the mathematical equations describing it' (Capra 2005: 37).

This conclusion represents the thrust of the complexity approach thus far; that systems (including social systems) in their development inevitably confront the necessity of metabolic exchange with their environments both internally (i.e. between members) and externally, (i.e. ecologically). So fundamental is this dissipative interplay, according to Prigogine, 'that we cannot describe Nature around us without an appeal to nonequilibrium situations' (Kondepudi and Prigogine 1998: xii). Quoting the Commission of European Communities' report on *Self-organization in the Physico-Chemical and Life Sciences*, Biebricher et al offer the following connecting remarks;

> "The maintenance of the organization in nature is not – and cannot be – achieved by central management; order can only be maintained be self-organization. Self-organizing systems allow adaptation to the prevailing environment, i.e., they react to changes in the environment with a thermodynamic response which makes the systems extraordinarily flexible and robust against perturbations of the outer conditions." (Biebricher et al cited in Prigogine and Kondepudi 1998: xvi)

Ultimately this thermodynamic response can lead to change, and the emergence of new forms of order (i.e. attractor states) through changes in energy flows throughout the system (Capra 2005). This conceptualisation of social systems as dynamic and evolutionary overcomes such traditional dichotomies of stability / collapse[45] which are typically associated with functionalism and general systems theory; '...order and chaos are often in a kind of balance where the components are neither fully locked into place but yet do not dissolve into anarchy...they are 'on the edge of chaos' (Urry 2005b: 238). The possibility of a quantification of variance is thus offered by the concept of 'attractor states' as positions of multiple equilibria; such a suggestion was previously raised by C.S. Holling (Costanza et al 1997). Consequently, a complex dissipative structure exhibits a multitude of such self-organising tendencies;

> '...Thus, over time, there are not only negative feedback mechanisms, that were the basis of earlier cybernetic systems theory. There are also positive feedback loops that drive change and set up 'self-reinforcing systems' through positive feedback...There

[45] As discussed under the previous heading '*Discarding equilibrium*', Bailey (1984) has drawn attention to problems associated with such dichotomous measures of stability, in that they are unable to represent variance.

> can be increasing returns and different patterns of path-dependent development...What is important in this analysis is the ordering of events or processes since 'history matters' and different paths could have been taken' (Urry 2005b: 239).

Despite such conditions of non-equilibrium, the system self-organises to produce structures and institutions to counteract its entropic tendencies; it is far from equilibrium, yet maintains an attractor state of relative stability. Perturbations and alterations in the flow and exchange of energy in turn give rise to emergent properties, and the system encounters bifurcation points, at which 'attractors' define configurations of potential parameter values to which the system may tend. The systems' behaviour is non-linear, yet determinate; dynamic yet evolutionary; it is a dissipative structure. The explanatory possibility of such an approach is summarised by Capra; 'The theory of dissipative structures explains not only the spontaneous emergence of order, but also helps us to define complexity. Whereas traditionally the study of complexity has been a study of complex structures, the focus is now shifting from the structures to the processes of their emergence' (Capra 2005: 37).

According to Smith and Jenks, Prigogine's conceptual significance '...lies precisely in thermodynamics...in an ontology grounded in the actions of energy, whose products include human organisations...the process is driven by available energy, is itself structural and completely without moral motivation, surpluses, worldviews, judgement. It is auto-eco-organisational' (2006: 81-83). As thermodynamically open systems, social-ecological systems are thus able to 'fend off' a state of thermodynamic equilibrium; '...scientists refer to the ability of dissipative systems to transfer their positive entropy (i.e. the build up of internally generated disorder) to their immediate surroundings at a faster rate than they produced them...' (Harvey and Reed 1992 cited in Smith and Jenks 2006: 84)

By contrast, near to equilibrium systems display different tendencies. They are capable of maintaining consistency and stasis, without significant structural elaboration, by a process of damping through negative feedback (a staple of classical cybernetics and neoclassical economics). If the alleged homology of the concept of dissipative structures with social systems is truly ubiquitous (current consensus appears to reflect as much) then it is clear that recent general systems theorists and earlier functionalists have forwarded flawed accounts of social systems as both near to equilibrium, and tending toward homeostasis. The distinction is best summarised by Reed and Harvey;

> Far from equilibrium systems differ from their near-to-equilibrium counterparts by being evolving entities. In addition to preserving a state of minimal entropy production, they can also increase in complexity, and, hence, increase their negative

> entropy production. Instead of being homeostatically constrained, their evolution is irreversible in time. As such they move naturally from one equilibrated state to another, often radically different, reference point. Furthermore, unlike conservative, far-from-equilibrium configurations are subject to spontaneous internal fluctuations. The fluctuations constantly probe and push the system beyond its boundaries [mostly] for naught: In the absence of sufficient inputs of environmental energy, the systems falls back to its original dynamic state (Reed and Harvey 1992: 363 cited in Smith and Jenks 2006: 86-87).

According to Smith and Jenks (2006), the 'eco-dimension' thus becomes an essential component in understanding such tendencies as outlined by Reed and Harvey. Harvey and Reed (2004) subsequently elaborated upon this perspective by discussing the ecological processes underpinning such tendencies - specifically negentropic production - and their role in sustaining such far from equilibrium systems;

> "...their internal structuration and development, as well as the processes by which they are born, evolve, and die, are regulated by transfers of energy from their immediate environment. The most important feature of the thermodynamic composition of dissipative systems is their negentropic potentiality. Negentropy, or negative entropy, and its opposite, positive entropy, are irreversible thermodynamic processes. Positive entropy refers to the universal tendency of thermodynamic structures to evolve irreversibly toward a stage of maximum disorder called thermodynamic equilibrium. The most effective measure of this increasing disorder is the progressive degradation of the system's internal structure. Thus, by the time thermal equilibrium is reached, the energy making up the system has been smoothly and equiprobably distributed throughout its boundaries" (Harvey and Reed 2004: 302).

Such is the 'ideal typical' process of energy distribution, and the inevitable outcome of thermal equilibrium as specified by the second law of thermodynamics. In outlining this process, the authors reference a state of 'structural degradation' as a measure of disorder; it is thus through the analysis of energy exchange that such early complexity theorists came to conceptualise states of order. The analytical unit is a process; that of *circulation*, and the reification of 'system dynamics' to a prime mover in this context is restricted. The problem is that such a measure of disorder as entropy is still both highly abstract (for social systems at least), difficult to operationalise, and quite close to classical mechanicist-reductionism. Its operationalisation by Claude Shannon as a measure of the information content of messages is one of few such explicit successes cited by Cillers (1998) within the social sciences. The introduction of human factors as mediating agents, through an elaboration of the concept of metabolism is thus offered by Harvey and Reed, taking discussion closer to a broader consideration of the social form;

> "...research into systems ordered by negentropic processes has changed our ideas about irreversible thermodynamic processes and the role they play in a wide range of

> evolutionary phenomena. Negentropy, unlike positive entropy, occurs in a limited set of circumstances, but when it does occur its ramifications are profound. As the name implies, negentropy represents a tendency that runs counter to that of positive entropy, in that systems in which it is produced are capable of forestalling their descent toward thermal equilibrium. Negentropic processes are, therefore, the material foundations for the growth and evolution of thermodynamic systems. They enable dissipative systems, via *internal metabolic mechanisms*, to transform free environmental energy into increasingly more complex structuration" [emphasis added] (Harvey and Reed 2004: 303).

The metabolic process is thus central to understanding the conditions under which such systems manage their exchanges, and in assessing the emergence of conditions under which imbalances are introduced. It is the analytical concept from which an understanding of subsequent internal system dynamics (i.e. structural and institutional), and contextual constraining variables must be drawn. The reproduction of such systems is thus dependent upon the successful functioning of this metabolic process;

> "...for dissipative systems to sustain their growth, they must not only increase their negentropic potential, they must also eliminate the positive entropy that naturally accumulates over time and that degrades the system's internal structuring. That is, as dissipative systems grow and become more complex internally, the price of their increasing structural complexity is measured in terms of their rising levels of positive entropy. The latter is a natural waste by-product of the process by which dissipative systems develop. If allowed to accumulate over time, positive entropy will eventually nullify the system's tendency toward increasing differentiation and will move the system toward thermal equilibrium. Negentropic systems must, therefore, develop a means of eliminating their accumulated positive entropy. This is usually achieved by the system transporting its waste energy to its immediate environment" (Harvey and Reed 2004: 303).

This approach thus permits the conceptualisation of such systems, once represented through a stratified ontology, as metabolic entities. The analytical capacities offered by the 'complex holism' of such a multidimensional concept of social systems as dissipative structures depends not on a dichotomous measure of system health, nor vitalist determining logics, or reductionisms of economy, law or psychology. Its immediate utility as a framework for the study of social-ecological systems – particularly agricultural systems – is evident.

Byrne (1998) elaborates on the concept of environment in such an approach, identifying it as a source of external perturbation engendered by social-environmental interaction, set against 'internal perturbations' (1998: 31). Byrne is wrong however to suggest that external perturbation alone should be identified as the determining cause of systemic collapse; as will be shown throughout subsequent case work, such a loss of ecological resilience occurred due to a complex interplay of natural conditions, demography, productive relations, legal constraints

and culture (the terms 'natural conditions' will itself be demonstrated to operate under conditioning by social forms). The systems of interest in this study are constituted of multiple levels to which particular analytical techniques are better suited due to their respective levels of abstraction, and the role of these multiple determinants, forces, processes and factors must be subject to a system of reasoning that is suitably integrative. The metabolism of these *dissipative structures* provides the crucial conceptual link.

Smith and Jenks are cautious however, about ascribing a similar status of metanarrative to such a concept, a risk which appears unheeded in light of recent metaphorical applications of complexity (Urry 2005b, Walby 2007). The dominant sense from Urry's work in particular, despite its insightful connections between such concepts as emergentism and Marxism, is that these concepts assume a level of generality beyond their intended specificity; the 'global' of Urry's study is thus subsumed within the totalising metaphor of complexity, and the concept of dissipative structures becomes unfalsifiable. Conversely, its application within world-systems theory assumes a self-presentation of analytical units such as nation-states, or a '...proposal of structures that sit across system/environment distinctions, as a proposal of a class of large-scale attractors' (Smith and Jenks 2006: 20). Wallerstein's application differs by its empirical specificity, for which economic crises are taken as evidence of emergent bifurcation points (Wallerstein 2006: 76).

According to Smith and Jenks, these social science adoptions tend to push the concept toward the realm of the 'grandest of grand theories' (2006: 91). Nowothy (2005) offers the following comments in her argument for a cross-disciplinary complexity approach, with reference to Aristotle's concept of phronesis, or practical wisdom; '...this is an argument for the priority of the particular, focusing on what cannot easily be encapsulated by universal rules. Phronesis requires interaction between the general and the concrete; it requires consideration, judgement and choice' (Nowothy 2005: 27). It will presently be argued that such a system of reasoning is inherent within a 'mode of production' approach, and its concomitant dialectical approach to reconstruction. These comments are a worthwhile caution against tendencies such as the totalising structuralism of preceding systems theorists. The position of the complexity approach, as one which sits both between such determinisms and in opposition to humanist ontology is emphasised further by Smith and Jenks;

> "Something of the scale of ambition that eco-auto-organisation represents is glimpsed here. Determinism literally expects causality to flow from precedent to consequent: the latter 'has no choice'. Deviations have to be accounted for in terms of modifications to what should be expected. God and the Devil, Newton and sublunar variants, Marx and

> the bourgeoisie, Parsons and deviance, globalisation and fundamentalism. Given the failure of reality to live up to what ought to happen, the post-modern response pitifully offers 'conventionality' and relegates the durable, repetitive or robust elements of Being to metanarrative. Neither confront self-organisation: they comment on a paradoxical 'already there' finally devoid of reason or cause, except: God, language, human authorship. This is the meagre level of humanism's self-reflexivity" (Smith and Jenks 2006: 93).

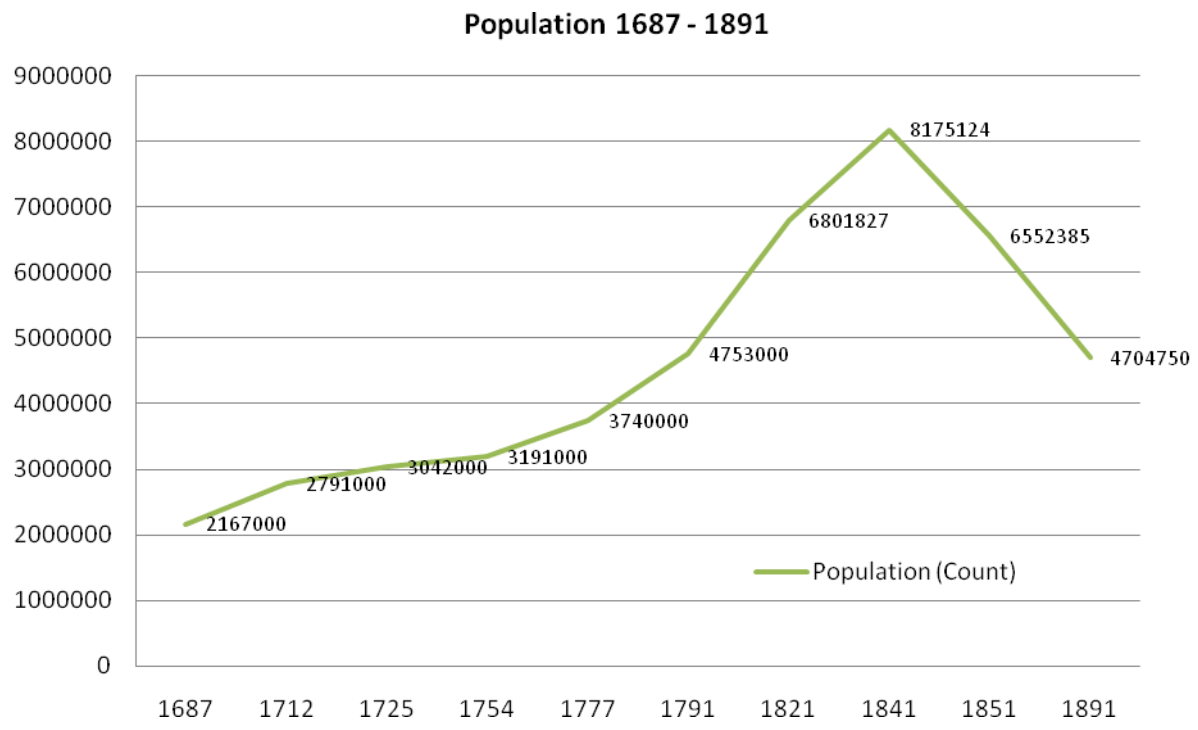
Again, the potential of critical realist ontological stratification and case-oriented methodology in avoiding such reductionist/idealist pitfalls is evident through Byrne's comments that such an approach represents a corrective to the 'sterility of structuralism...and the disengagement of relativist poststructuralism as the meta theory of postmodernity from any practical engagement at all of social science with the process of social transformation' (Byrne 2005: 99). The application of complexity thus proposes 'a dialogical engagement with human agents rather than the decomposition of the complex social through analysis based on the reification of variables' (ibid). In this sense, it would appear that modern extensions of living systems theory to macro-structural attribute measures are equally untenable (i.e. Bailey 2006). Self-organised criticality does not therefore imply reification of human agency, but rather suggests that '...for human societies we confront the possibility that the locus of perturbations in certain instances may be internal to society itself...human systems differ radically from nature on this point...in social systems perturbations of far-from-equilibrium conditions can originate in the values and actions of humans themselves' (Reed and Harvey 1992: 370 cited in Byrne 1998: 50). The concepts of higher-order emergentism and stratified ontology reconcile the potential paradox of accepting biologically motivated self-organisation at the cost of reifying human agency. The structuralist-humanist problematic is thus resolved.

In this sense, the complexity approach has merely pointed toward a process-based, non-reductionist view of system dynamics as metabolic exchange. Furthermore, it has provided powerful techniques for grasping the role of history, and for modelling complex constitution through methodological pluralism. This in itself should not be taken as a resolution of the problem of reductionism, as clearly much detail is lost in any exercise of conceptual modelling, including that of complexity; '...our models have to reduce this complexity in order to generate some understanding...' (Cillers 2001: 137). According to Cillers, the problem of reduction is manageable if consideration is given to the distinction between descriptive and ontological complexity; the trap previous systems theorists appear to have fallen into is that of interpreting their project as one of representing *descriptive* complexity with their conceptual models.

Returning briefly to the case of nineteenth-century Ireland for empirical grounding, a number of macro-systemic properties that suggest the necessity of such a metabolic approach to understanding social systems may be observed with a simple descriptive exercise. As observed below in figure 1.4., the rate of population increase across Ireland, particularly in the accelerated period of 1791-1841, and concomitant subdivision observed amongst the peripheral 'western' counties of interest to the forthcoming case study, suggests a fundamental shift in the metabolic order of individual farming systems. The classical narrative accounting for such changes in the population parameter identifies the removal of barriers to fertility such as marriage age, access to land, and prolific subsistence crop production.

Throughout the early nineteenth century, subdivision advanced at such a pace that by 1841, 45% of all holdings in Ireland were of less than five acres (Connell, 1950: 284). Parcellisation was recorded as most acute in the province of Connaught, where 64% of holdings, according to the abstracts of the Census of Ireland, 1841, were between one and five acres (Connell 1950). At this cursory level, Ireland appears to exhibit classical symptoms of self-organising criticality as specified by the concept of *dissipative structure*; the system, through multiple internal and external perturbations, increased in structural complexity. A cursory look at Ireland's demographic profile and associated trends of subdivision suggests movement toward conditions of non-equilibrium with differential consequences according to the social form under which the management of systemic entropy operated (i.e. at the level of individual farming systems). Furthermore, within such settlements as were cultivated under the rundale system, increasing organisational complexity was their structural hallmark. Understanding such systems as complex entities thus involves examining their strategies of productivity maximisation, without resorting to externally imposed criteria, or assessments of practices as either functional or rational. Complexity's concept of self-organising criticality has here directed consideration toward the metabolic process as the essential unit from which system dynamics must be understood.

Figure 1.4



Raw Population (Ireland), 1687-1891 (data from Vaughan and Fitzpatrick, 1978)

The ability of a system to cope with such increasing perturbations is conceptualised by Heylighen as its *adaptive capacity*, a social-ecological process through which the system, through the purposive actions of its constituent agents, adjusts to cope with such stresses; '...to balance itself at a critical point between rigid order and chaos' (Heylighen et al 2006). It does so by fulfilling two key metabolic requirements, the operation of which determines, in the abstract, the ability of the system to maintain its own reproduction;

> "...any long-lived dissipative system must fulfill two prerequisites if it is to persist: (1) it must be able to convert free environmental energy into ever more elaborate forms of internal structuration; and (2) it must transport thermal disorder into the environment. Dissipative systems are thus characterized by a dynamic tension between their ability to accumulate negentropy and their need to transfer their positive entropy into the environment. If they can sustain this tension, then under proper circumstances they can achieve a state of net negative entropy and persist. If they cannot, they will evolve to a state of thermodynamic equilibrium" (Harvey and Reed 2004: 303).

Since the manifest self-organising criticality of such dissipative structures has shifted consideration toward the metabolic process, and away from questions of structure and stability

alone, analysis must therefore focus on the question of metabolism, specifically how such complex, interdependent factors structure and condition nutrient circulation within specific farming systems in a complex dialectic. The application of this framework in part II focuses primarily on the rundale system in Ireland, between 1800 and 1860, the period of its accelerated demise, and the passage of Irish society through the economic and demographic watershed of the great famine. To fully integrate the study of natural and social processes, this approach must be able to move beyond questions of structure alone, and account both for the abstract social forms of productive relations, and the complex historical development of states of metabolic imbalance.

As yet, a number of specific informants are required in order to satisfy this objective. The preceding discussion has merely provided a general epistemology of systems as complex, metabolic entities. In order to operationalise these informants under a working methodology, a more precise means of conceptualising hierarchical systemic organisation is required, as well as more flexible measurement devices than the concepts endowed by energetic efficiency, and a narrative of social context which accounts both for the differentiation of historically variant forms of social organisation, and the contextual conditions under which inequalities in resource distribution manifest. Accordingly, consideration now turns toward the manner in which sociology has critically neglected the incorporation of nature into its paradigms of social organisation. Having undertaken this review, the derivation of a theoretical device which more adequately collapses this natural-social divide must be attempted. Such a device must in turn capture the dialectical mediation of society through nature, and nature through society, thereby opening a path toward more empirically grounded modes of explication.

2

Nature in social thought

Chapter 1 has advanced a number of propositions which propose to bridge the social and natural sciences by recognising abstract commonalities of constitution across both. This preceding discussion focused in particular upon epistemological similarities in the nature of both social and natural entities whilst devoting less attention to the ontological divisions between the social and the natural. A number of illustrative models, such as Boudling's hierarchy of ontological complexity considered in the previous chapter have made some attempts to integrate components more typically assigned to either the realm of 'nature' or 'society'; accordingly, such divisions have featured implicitly in the preceding account. Analogically, the complexity perspective emphasised the grounding concept of 'metabolism' as an essential process mediating both the natural and the social; the suggestion was made however, that what is lacking is a sense of the mechanisms structuring interrelations between natural and social elements in such complex systems, nor a developed theoretical grasp of the fundamental capacity of human societies to continually modify their ecological contexts.

Chapter 2 pays specific attention to the ways in which 'nature' has been conceptualised and deployed in social theory, in a manner which typically results in a separatist ontology, whereby the autonomy of the social or the natural is asserted at the expense of a recognition of the profound and intrinsic interrelations between both. Conversely, contributors from the materialist side of environmental-social theory have asserted the primacy of the concept of labour as an essential unit in any abstract typology of social-ecological systems, a concept with derives from a broader Marxist historical-materialist framework which proposes to grasp the intrinsic relation between both. Consequently, this chapter argues that a re-integration of nature within the social as mediated through the labour process offers a conceptual avenue toward developing a historical typology of social-ecological systems, and adaptive variability. Perspectives emphasising the over-determination of the social are therefore discarded in favour of a materialist-relational approach which offers dialogue between both trans-historical concepts, and the particulars of specific social forms. A context is therefore set for the development of more applicable analytical devices in chapter 3.

2.1. Contrasting conceptualisations of nature in social theory

Readers of environmental sociology will typically be struck by the consistency of the introductory remarks of its practitioners', many of whom begin by discussing the problem of dualistic conceptualisation in social theory, or the tendency to view nature and society as ontologically distinct entities. From all sides of the academic divide, contributions to the analysis of natural-social relations, it appears, cannot ignore the weight of preceding debate to which 'nature' is variously cast as external, internal, embedded, constructed, and networked. McNaughton and Urry offer a definition of nature which attempts to represent the complexity and diversity of this debate[46];

> "...the very idea of nature has been analyzed as having multiple and even oppositional meanings: it can refer to the essential quality or character of something; the underlying force which lies behind events in the world; the entirety of animate and inanimate objects, and especially those which are threatened; the primitive or original condition existing prior to human society; the physical as opposed to the human environment and its particular ecology, and the rural or countryside (as opposed to the town or city) and its particular visual or recreational properties..." (McNaughton and Urry 1998: 8).

The dichotomies around which these definitions revolve are described by Soper as ones of constructionist vs. ecologistic views, where nature is interpreted as either a '...domain of intrinsic value' or a discursive construct existing only as a repository of meaning (Soper 1995 cited in Franklin 2002: 40). Such academic distinctions stem historically from what Frank refers to as the 'natural attitude', a perspective identified as existing from the time of Descartes until the latter half of the twentieth century where nature was conceived as '...separate from humans, to be used and enjoyed by them, and overall virtually indestructible – something that was just out there' (Frank 2010: 104).

From Latour's rejection of the 'modern constitution' which cast nature as autonomous in the legitimation of political power (Latour 1993; Braun, 2007), to environmental economists' persistent analytical separation of environment and society (Daly 2007), implicit ontologies of 'nature' are seen as key points of activist engagement for both policy realignment, and collective action. Modern Marxists have in turn drawn attention to capitalism's ecological crisis tendencies as a consequence of 'laws' of accumulation, and the modern green movement is founded on a need to recognise the social origins of environmental problems (Benton, 1994). Despite various position papers on the political necessity of rejecting dualisms of nature and

[46] See Swyngedouw 2010: 306 for a similar definition.

society (Dunlap 1980, 1997), the preceding chapter has shown that this conceptual problem remains unresolved within the social sciences, as evidenced by more recent contributions in complexity theory which refer still to the *possibility* of resolving the natural-social dichotomy. Given that the previous chapter has already made numerous references to a broad objective of grasping natural-social interaction within social-ecological systems, it seems appropriate to consider the ways in which these concepts have been treated by the social sciences.

Representing the complexities of such debates from across disciplines is beyond the scope of this chapter; what must be examined is the failure of current social theory to offer a useful resolution to such dualisms. The existing state of knowledge does, however, offer a number of useful concepts and heuristics to bring to bear on the forthcoming case study, and this chapter will focus on developing such possibilities. Environmental sociology, and arguably sociology in general, has been dominated by dichotomies of nature and society, which are interpreted by Dickens (1996) as a consequence of 'Durkheimian' separatism, a process through which sociology sought to establish itself and its subject matter as distinct from the natural sciences. MacNaghten and Urry (1998) suggest that this has produced multiple restrictive paradigms and theoretical bases since the foundation of the discipline, through which nature and society are understood. Their contribution outlines three such widespread views in the social sciences; *externality* whereby nature is perceived as a real and distinct entity with laws and tendencies separate from those of society; *environmental idealism* which emphasises the importance of the study of human values and subjective meaning, and *environmental instrumentalism* which stresses the determinants of human motivation to engage in sustainable practice (MacNaghten and Urry 1998).

In many respects, this is a useful categorisation of the current state of mainstream social-scientific debate, as responses to the dominance of the *externality* of nature have arguably set the precedent for much of the critical responses from environmental sociologists and philosophers of science which will presently be reviewed. The relative predominance of culturalist perspectives in the discipline of sociology in general has ensured that these responses, for much of the twentieth century, have gravitated toward the study of human values, social movements, discourses and representations, in turn producing and normalising constructivist ontologies of nature. The resultant persistence of various forms of this dichotomy in the social sciences has lead to a '...failure to understand how social processes as understood by the social sciences combine with ecological and natural systems as understood by the natural and physical sciences' (Dickens 1996: 31). Consequently, Benton (1994) has suggested that sociologists have tended to overemphasise either extreme of the natural-social dichotomy

in the form of natural reductionism (i.e. deep ecology), or constructivist reductionism, to the extent that current approaches to nature and society within mainstream sociology merely represent alternative forms of the same restrictive dualism.

The problem with current mainstream environmental sociology is not that it has failed to address itself to environmental concerns as such but rather, as Dickens (1996) suggests, that it has taken up this project largely within its own boundaries. As a result, prominent contributions such as Ulrich Beck's *Risk Society* (1992), Giddens' *Beyond Left and Right* (1994), and Latour's *Reassembling the Social* (2005) fail to develop interdisciplinary dialogue by remaining within their respective confines of sociology or philosophy. The problem, as Benton rightly identifies, is that these divisions between the 'natural' and 'social' are not merely superficial, but are '..organizing categories, both shaping sociological thought and research across the whole span of the discipline *and* structuring everyday non-scientific and common-sense contexts of thought' (Benton, 1994: 29). The currency of constructivism within gender studies is cited as one example of a sub-discipline of many within sociology that has benefitted from re-positioning and reinforcing the nature-culture divide, such as it has shifted emphasis toward the discursive, socially constructed frames in competing concepts of gender are deployed. The results of this transplanted constructivism have in turn been extensively criticised by numerous authors for failing to offer a sound explanatory basis from which to advance the materialist project of environmental sociology (Redclift and Woodgate 1997).

The context of these extant shortcomings must first be established, and Benton (1994) has suggested looking to the founding of sociology as a discipline to trace the trajectory of such dualisms. A brief contextual aside is required however. The emergence of reductionist scientific epistemology, as discussed briefly in the preceding chapter, displays clear, inseparable connections to philosophy in its historical development. At a more abstract level, such classical philosophy, as a precursor to the foundation of sociology, has had much to say regarding nature. Human mastery of nature and a faith in the ability of technology to transcend restrictions imposed by nature is often illustrated metaphorically by reference to the tale of the Greek hero Prometheus, whose name lends itself to a form of technological optimism commonly abbreviated to 'Prometheanism' in both general environmental, and Marxist literature. Barry (2007) identifies this perspective as an antecedent of the Judaeo-Christian view of the environment as oppositional, and as a force requiring taming and management through intensive labour, a view owing its origins to god's instructions to 'dominate and subdue' as depicted in genesis (Barry 2007: 37). Such a view is further corroborated by Harvey;

> "Philosophical arguments favouring the domination, "mastery", control, or "humanization" of nature, though they may have had ideological taproots in the Christian doctrine of dominion...came strongly into their own during the seventeenth and eighteenth centuries. Francis Bacon vigorously propounded such views and in a celebrated passage in the *Discourse on Method* Descartes argued that the "general good of all mankind" could best be pursued not by resort to speculative philosophy but by the attainment of "knowledge that is useful in life" so as to "render ourselves the masters and possessors of nature". Such views were implicated in the rise of distinctively instrumental and capitalistic values with respect to the human use of the "natural" world" (Harvey 1996: 121).

In this sense, similar epistemologies to those that relegated qualitative methodologies to a position beyond the scientific method also solidified in the wake of the industrial revolution, as did scientific reductionism as a response to theology and teleology. With the evident material successes of the industrial revolution brought about though the application of science and technology, the parallel development of political economy into its mathematical strong programme, coupled with post-revolutionary emphases on economic growth as positive, have in turn proven powerful incentives to view nature instrumentally. The subsequent dominance of growth-centred approaches to economic development, along with 'fetishized' bourgeois views of external nature over the past century is thus cited by David Harvey as politically and theoretically problematic, insofar as it reduces ecological externalities to a technological problem, and inhibits conceptions of society as existing within nature (Braun 2007).

Writing in 1993, Bruno Latour described 'modernity' as a benchmark in time characterised by conflict. A key dimension of his suggested political conflict of representation involves what Latour refers to as 'purification', a process through which two distinct ontological zones of 'human' and 'non-human' are defined (Latour 1993: 10), a division he refers to as the *modern constitution*. Such divisions, according to Latour, function within the social sciences as ontological reference points; those who attempt to combine both are seen as alternating between the symbolic and the natural (Latour 1993: 85), a position which questions the validity of a linear continuum to which all entities may be cast as either social or natural. As a consequence of the 'modern constitution', this perceived binarism reflects much of the divisions encountered in the preceding chapter, by which object and subject were separated in the pursuit of scientific rigor.

Political philosophy, in the pursuit of this modern constitution, had long before grappled with its own contested definitions of nature, definitions which would have profound implications for interpretations of social order, depending on their view of humans' 'natural tendencies'.

Thomas Hobbes was openly critical of thinkers who had 'read off' cooperative tendencies from nature and transplanted them onto humanity. In defence of centralised, authoritative government, Hobbes famously argued instead that life in a primitive state of nature was '...solitary, poore, nasty, brutish and short' (Barry 2007: 53). Premised on his observations throughout the English civil war, Hobbes argued that private property was itself a '...natural right of the individual, and society existed to help secure it in a context of scarce resources and human conflict...natural right was a reflection of the naturally possessive instinct of the human individual' (Redclift 2006: 29-30). With Locke's pronouncements on private property as a necessary intermediary between humans and nature, such classical political philosophy offered powerful justification of a 'naturalist' view of the dominant institutions of emergent capitalism (Redclift 2006). Contrary to this dominant libertarian interpretation, Rousseau instead argued that such 'natural states' represented model societies based on equity, rather than exploitation and competition; '...Rousseau, from his earliest writings notes that alienation from nature is a chief source of human misery' (Biro, 2005: 60 cited in Barry 2007). The legacy of such classical divisions is evident today in the division between deep ecologists' views of the positive natural state, in contrast to the dominant neo-classical and modernist view of nature as external and hostile.

Chapter 1 has also referenced a number of important thinkers who subsequently established the context of debate on the relationship between nature and society, specifically Thomas Malthus and Herbert Spencer, who adopted various forms of natural determinism, which in turn gave rise to damaging policy applications. As pillars of classical liberalism, both offered analogical, 'scientific' legitimation of individualistic competition through appeals to evolution as naturally competitive. Earl Gammon (2010) has argued that post-classical political economy was governed by such an adversarial view of nature as competitive, the antecedents of which were briefly encountered in chapter 1 in the form of the physiocrats. The implications of such a post-enlightenment move from 'nature as inherently moral' to 'nature as adversarial' (Gammon 2010: 219) resonate today in the methods and implicit ontologies of marginalist environmental economists[47]. The consequences of this post-classical legacy and its retention by neo-classical environmental-economists will be discussed further in chapters 3 and 5 - specifically their market oriented methodologies, and strongly anthropocentric view of environmental problems,

[47] Gammon also suggests that the distinction between environmental and ecological economists is not as clear cut, as both subscribe to marginal utility as a '…sound basis for economic theory' (Daly 1994 cited in Gammon 2010). This commonality is not as important as the latter's clear rejection of 'growth as positive' (Daly 2007), and in this respect their differences are profound. It appears Gammon may have overstated the significance of residual post-classical ontologies of nature in neo-classical thought. It will presently be argued that the significance of contemporary ecological economics rests instead in its methodologies, and in its openness to alternative theories of value.

whereby the creation of markets by assigning property rights to environmental entities is viewed as ecologically efficient (Jacobs 1994). Emissions' trading, for example, represents a more recent form of this particular combination of neoclassical market-orientated valuation methodology and broader ontology of human exemption.

Gammon uses the example of Francis Bacon to illustrate the pre-Enlightenment connection between theology, science and nature. According to Gammons' brief history, which mirrors the supplanting of theology outlined in chapter 1, Bacon exemplified the pre-Enlightenment merging of theology and natural philosophy, by prescribing a dominion of nature through accumulated knowledge. The methods of this 'new organ of science' (Gammon 2010: 221) offered to corroborate what Bacon referred to as the 'two books of wisdom', those of scripture and nature so that '...the latter book will certify to us that nothing which the first teacheth shall be thought impossible' (Bacon, 1859: 221 cited in Gammon 2010). The post-classical shift, to which Thomas Malthus, J.S. Mill and Stanley Jevons contributed, ushered an ontology of improvident nature, one which 'required material domination to preserve the moral sphere of life', advanced by the Victorian reconstitution of social order, and the rejection of theological notions of a natural, moral economy (Gammon 2010: 240).

Gammons discussion is replete with names from the classical canon who purportedly viewed natural phenomena as a consequence of intelligent design, thinkers such as Robert Boyle, Adam Smith, Quesnay, Francis Bacon and William Paley. According to this classical unity of theology and science, the project of knowledge-accumulation (i.e. dominion of nature) was inseparable from the objective of establishing a moral or 'Edenic' state (Gammon 2010: 221). In contrast, the post-classical dominance of an instrumental, exceptionalist view of nature as a category distinct from society has persisted far longer, and left a profound imprint on contemporary social thought. Redclift and Woodgate (1994) discuss the legacy of the founding fathers' ontologies of nature, and suggest that Durkheim viewed nature as a precondition for society, but ultimately as a separate entity, contrary to constructivist accounts of nature as socially produced. Their interpretation runs contrary to other accounts of Durkheim's legacy however, such as Franklin (2006), who interprets Durkheim's analysis of totemism as one of the cultural construction of nature. According to Franklin's interpretation, Durkheim's 'totem' represented '...nothing other than a projection and representation of the clan itself' (Franklin 2002: 26). Subsequent orthodox responses to the environment-society question, such as Beck's *Risk Society* are cited by Franklin as an essentially Durkheimian response rooted in the analysis of discourse, in contrast to its contemporary of neo-Marxian realism. Of the classical canon, Weberian humanism and Durkheimian structuralism are thus described by Benton (1994) as

establishing clear natural-social dichotomies. Despite a number of concrete studies of natural resource conflict (i.e. irrigation systems; Hannigan 2006: 7), the legacy of Weber's work has not been the continuation of such concrete investigations, but of the application of the concept of formal rationalisation to ecological management.

Regardless of the multitude of ways in which these classical authors may be interpreted – the volume and diversity of their work suggests such restrictive characterisations are unrepresentative - Catton and Dunlap (1980) are emphatic on their role in providing a context for later dualistic thinking. Durkheim in particular is singled out, as was discussed in chapter 1, for rejecting psychological (i.e. natural) reductionism, and positing the 'social fact' as an emergent phenomenon with causative properties. It is therefore curious that he should appear in Franklin's defence of constructivism despite his repeated citation as a classical positivist. This is an important point, as it will presently be argued that the rejection of such classical contributions often rests on narrow readings and the reduction of their complex bodies of work to 'core principles' which are often grossly simplified, and consequently easier to argue against and deploy in debate than their more complex theoretical apparatus. Recovering such complexities and contradictions is thus essential for overcoming some of the more prevalent objections to the classical thinkers.

Sociology's subsequent and ironic exacerbation of the natural-social dichotomy is thus somewhat understandable when placed in the context of Kuhn's model of the development of normal science. Instrumental mastery of nature throughout the industrial revolution set a context whereby sociology carved its own niche in the academic division of labour throughout a time when concerns now considered commonplace such as 'limits to growth' or sustainability were absent. According to world-systems theorists, this dominant western view of human exemptionalim was assisted greatly by colonial expansion and mentality, whereby coerced cash-crop production (i.e. sugar in Hispanic America) supplied seemingly limitless food for export to core European markets (Friedmann 2000: 486). The resultant ecological simplification brought about through such coercive monoculture in the peripheries and contrasting specialisations in the core regions produced a diversity of ecologies, and complex divisions of labour. Such a dominance of the natural cycle by human innovation doubtless offered strong corroboration to a broader view of humans as dominant, and nature as their subject.

The industrial revolution, according to Mayumi (1991), provided 'emancipation' from land, by shifting fuel dependence from land-based materials to fossil fuels and minerals, a change which

was to prove essential for the subsequent growth of industrial economies and agribusiness. Mayumi remarks on historical periods of intense fluctuation in both agricultural productivity and the extent of area under cultivation throughout the lands of Western Europe from the Roman expansions, to the fertility recuperations of the dark ages. The 11th and 13th centuries are thus identified as a period of rapid expansion in areas under cultivation across Europe as feudalism took hold and production tripled. Population expansion prior to the industrial revolution gave rise to a demand for land-based resources prior to the exploitation of fossil fuels, which threatened to push the productive capacity of land to its limits;

> "The supply of food and drink depended on agricultural land, clothing came from the wool of sheep on English pasture, and large areas of land were needed for extensive forest: almost all domestic and industrial fuel was firewood, and timber was one of the most important import construction materials for houses, ships, mills, farms, farm implements etc. In addition, the transport system depended on horses and thus required large areas of land to be devoted to grazing and the production of feed. Even lighting used tallow candles which depended ultimately on the land supply" (Wilkinson, 1973 cited in Mayumi 1991: 41).

The first 'freedom' from natural constraint thus emerged as a consequence of increased productivity through the application of technologies and techniques such as rotation and fertilisation, the provision of winter fodder crops, inclusion of clover in rotation, and the movement of grazing sheep for manure deposits from uncultivated areas (Friedmann 2000).

This success of productivity is exemplified by English 'high farming', which despite its disastrous social consequences in the form of exacerbated inequality through enclosure and enforced low-wage labour, produced yields comparable to those of Asian rice cultivators (Friedmann 2000). Prior to such developments, European seed-plant ratios had averaged between 4:1 and 5:1, compared to the 100:1 ratios of the labour intensive irrigation systems of the Asian rice producers (Friedmann 2000: 489, footnote 6; Fischer-Kowalski and Haberl 1998 cited in Mancus 2007: 274). The substitution of coal for timber as a fuel source represented a move 'beyond the colonization of other organisms to include the drawdown of stores of *past* biological productivity' (Mancus 2007: 275), and is identified by Mayumi (1991) as critical in overcoming the looming Malthusian crisis of population density and productivity. Increased unit-area productivity therefore allowed for surplus production and the movement of peoples into emerging urban centres supported by rural food production and export creating the classical town-country antagonism which has arguably framed much development discourse throughout subsequent centuries. Urbanisation in turn created a consequent degradation in soil fertility, resulting in an ever-increasing search for alternative sources of fertilizer, which for European nations involved 'appropriating other lands and the labor of those who lived on

them' (Moore 2000 cited in Mancus 2007: 278). The exploitation of mineral and fossil fuels and the later development of synthetic ammonia allowed for industrial fertiliser production on a scale impossible under previous systems of organic manure importing, where agriculture depended upon alternative organic sources of fertiliser for its continued productivity, such as crop residues, manure, human wastes, bone, lime, ash or kelp.

Throughout the 19th century therefore, at a time when agriculture revolutionised its productive strategies, where industry developed synthetic fertiliser substitutes and where nation states developed global export markets external to their ecosystem boundaries, the world emerged into a twentieth century where science promised a technological solution to the problem of 'geometric' organic reproduction. Modern human progress was reckoned by the extent of our domination of nature (McNaughton and Urry 1998). It is therefore crucial that discussions concerning the marginality of nature in social thought pay some attention to such material conditions; the history of ideas alone cannot be considered the sole determinant of subsequent perspectives on nature, although numerous authors appear content to conclude as much (ibid). Adherences to ideas and ideals such as deep ecology risk neglecting research demonstrating that some societies external to global trade and the market economy have also engaged in unsustainable practice. Sirén's (2007) research, for example, demonstrates that societies exhibiting a classical 'Rousseauian' unity with nature (in this case, indigenous Ecuadorian Amazonians) have produced their own Malthusian conundrum as their population growth rate of 1.6% per year outstripped their collective rates of deforestation of 0.015% per year. Care must therefore be emphasised with all recourses to abstractions such as 'capitalism' or 'collectivism' as models of exploitation or sustainability; they can be no substitute for empirical dialogue. As will be observed, there is much of value in the respective concepts of capitalism and collectivism, provided an abstract view is taken concerning the manner in which ecological outcomes are conditioned by local forms of social organisation.

The curious irony of sociology's contributions to environmental studies resides in the fact that later strains of environmental sociology (American strains of the 1970's and 1980's) reproduced the same classical divisions between the natural and social sciences as were established throughout its foundation in the form of psychological-social, and objectivist-constructivist binarisms (McNaughton and Urry 1998). Dickens (1996: 40), for example, discusses Raymond Murphy's study of the rationalisation of nature, a study which examines the historical process by which humanity came to impose order upon nature by dispelling elements of mysticism and magic. Murphy's example represents one of many constrained to operate within the confines of existing 'socialised' practice wrought through an historical and

intellectual context of material conquest, colonial expansion and disciplinary exceptionalism. Consequently, the post-classical period to which Gammon refers provided the disciplinary foundations of 'human exemptionalim' for the social sciences such as were encountered in chapter 1.

As discussed in the previous chapter, Parsons largely ignored the level of the organism in his analytical scheme, and structuralist anthropology adopted its own highly contextual, yet broadly generalised approach to symbolic constructs and functions associated with nature. Some such modernist assumptions held that humanity was essentially exempt from ecological constraint, due to the ability of human institutions to compensate, either through policy or technology, for ecological adjustment (Dunlap 1980, Catton and Dunlap 1980). The appearant corroboration of this technological optimism with cross-national data (the Kuznets curve outlined in chapter 1), and the proscriptions of ecological modernisation (Mol 1997, Bradshaw et al 2010) lent much credence to the positive role of economic growth, and ensured that the burden of evidence fell to the agitators (i.e. ecological economists, climatologists and sociologists). That sociologists have consistently advanced critiques of growth-centred approaches to social justice and policy should thus require little qualification.

In this sense, it is not difficult to comprehend the marginality of nature in social thought for the greater part of the twentieth century, and the strength of the exceptionalist model given a comparative absence of visible environmental impact in the Western world[48]. The problem, according to Benton (1994) and Castree (2002) is that the niche sociology has carved itself for the study of the environment is not one that has moved toward a materialist understanding of natural-social interaction, but one which has emphasised the symbolic dimension of nature, and the assignment of meaning. Despite the significant presence and output of the sub-disciplines of Marxian eco-socialism and environmental sociology, their conceptions of nature have not become paradigmatic in the context of the overall discipline (Foster 1999). This core problematic is best illustrated through a discussion of the constructivist-realist debate, and is one which must be evaluated and discarded, along with actor network theory, before proceeding to develop a materialist alternative.

[48] This, of course, is not to suggest that such impacts are a mere product of the past fifty years. Foster (2000) refers to the writings of Lucretius (*De Rerum Natura*) who discusses environmental issues and as will be seen, Marx paid much attention to developments in chemistry and soil science. The lack of visibility is perhaps due to publicity and public awareness, or a consequence of the normalized 'natural attitude' (Frank, 2010) rather than an absence of real or imminent damage.

2.1.1. The constructivist-realist debate

The essence of the constructivist-realist debate has been outlined in the preceding section; what follows is a more focused discussion its key features and implications. The debate itself has rightly been identified as trivial and sterile, and largely inconsequential for the environmental movement in general by a number of authors (Murdoch 2001, Hannigan 2006). In a similar vein of criticism, the potential shortcomings of excessively theoretical exercises are well summarised by Noel Castree in his review of Eric Swyngedouw's (2004) *Social Power and the Urbanization of Water* (although as will be shown, he is perhaps wrong to direct this criticism against Swyngedouw). In his summary of Castree's comments, Hannigan (2006) draws attention to the questionable contribution excessively theoretical constructs can make to empirical understanding and the tenuous connections that often exist between such theoretical frameworks (in Castree's example, 'socionature') and their proponents' limited empirical application. This current section suggests that the largely-dominant approach of constructivism within recent environmental sociology is worthy of similar assessment.

Despite its apparent triviality the constructivist-realist debate has, however, drawn responses from the materialist-realist side of the divide which offers some useful insights into the nature-society problematic, and provides a contextual backdrop for subsequent debates examined later in this chapter. The debate itself represents a far less critical distinction than that implied by Harvey's famous statement that there was 'nothing unnatural about New York' (Braun 2007), which raises the alternative question of the validity of natural-social boundaries, and by extension, the dialectical unity of nature-society. Harvey's position, as with those of other left-leaning theorists, clearly rejects the classical separatism of nature-society, and speaks to an issue of broader, practical concern than that of the constructivist-realists; these debates will be examined in subsequent sections. Constructivism, as a perspective concerned with the ontological validity of 'nature', critically evaluates the extent to which such a category may be considered a self-referential, objective entity, existing independent of the linguistic constructs used in its identification. By this account, nature and society represent not distinct, objective phenomena, but a select number amongst innumerable other categories of human construction with no stable, self-evident meaning or relevance independent of human thought.

According to Raymond Murphy (1995), a key consequence of the discarding of sociology based on conservative systems theories (such as the Parsonian approach discussed in chapter 1) was the adoption of assumptions of plasticity in human relationships as the defining

characteristic of social life, rather than normative socialisation. This epistemic turn is illustrated by reference to Berger and Luckmann's *The Social Construction of Reality* (1967), in which the following claim is made; '...while it is possible to say that man has a nature, it is more significant to say that man constructs his own nature, or more simply, that man produces himself...all non-human animals as species and individuals, live in closed worlds whose structures are predetermined by the biological equipment of the several animal species' (Berger and Luckmann 1967 cited in Murphy 1995: 689).

Some years prior to Berger and Luckmann, Howard Becker published *Outsiders: Studies in the Sociology of Deviance* (1963), in which his theory of the construction and reinforcement of 'deviant' statuses was outlined. Based upon a case study of marihuana users, chapter 3 of Becker's seminal publication argued that the origins of criminality could not be located in the properties of specific substances, but rather through an analysis of the ways in which such substances were invested with meaning. As a challenge to individualistic-pathological theories of deviance, Becker further argued that users' enjoyment of marihuana depended upon their socialisation within a peer group conveying positive interpretations of the feelings of being high. Constructivism had thus emerged from the conservative restrictions of functionalist role assignment, with a renewed emphasis on human agency, contingency of meaning, and the autonomy of the social from the biological. The result of this widespread adoption of an epistemology of knowledge construction was, according to Murphy, the reinforcement of a conceptual discontinuity between human and non-human. As a result, Murphy claims '...most contemporary studies in the sociology of science have focused solely on how scientific knowledge is socially constructed and neglected the role of nature as a source of that knowledge' (1995: 690). The state of science studies, to which Murphy refers, reflects a broader tendency within sociology - as with the example of Becker's deviance studies - to discard questions of nature as biologically determinist, in order to depict such phenomena as exclusively social.

A more extreme form of such constructivist-relativism is typically depicted in the literature, and Benton (1994) offers one such example from the work of Keith Tester, who claimed '...a fish is only a fish if it is socially classified as one...the very word 'fish' is a product of the imposition of socially produced categories on nature...animals are indeed a blank paper which can be inscribed with any message, and symbolic meaning that the social wishes' (Tester 1991: 46 cited in Benton 1994). Such 'blank canvas' constructivist approaches to animals (Franklin 2006) have been criticised by Hilary Tovey (2003), who draws attention to the diversity of functions animals play in human societies (i.e. domestic, service, functional and experimental),

and their consequent capacity for character, subjectivity and experience (Tovey 2003: 196). Relativist perspectives such as Tester's, albeit in a less provocative form, appear to have proven somewhat more useful to anthropologists according to Phillippe Descola (1995). Descola remarks that the epistemic critiques of Rosset and Latour, and their consequent scepticism of metanarratives of nature, have proven instrumental in avoiding the ethnocentric projection of western dualistic thinking onto non-western cultural practice. Anthropologists have in turn come to reject the natural-social dichotomy and its assumed pre-existence of such divisions, which ignored the processes through which such boundaries could be transcended; '...by ignoring native classificatory criteria, they simply restricted the conceptualisation of beings to the classes of objects that we expect to find in the western category of nature' (Descola 1995: 82-83).

In defence of Tester, Burningham and Cooper (1999 cited in Franklin 2006) suggest that the realist critique has unfairly represented the evident limitations of constructivist accounts. In their comments, the authors point out that the analysis of categorisation does not amount to a relativist denial of physicality, but instead represents nothing more than an alternative area of research. If this conclusion is to be accepted, then it appears such over-socialised accounts of nature presented in such a way are to be criticised for little more than academic indulgence. A number of papers of this time however, attempted to move beyond the constructivist-realist divide such as Woodgate and Redclift (1998) and Gerber (1997), the former citing a need for an 'integrated body of theory that acknowledges the importance of both social and natural influences in conditioning the character and dynamics of socioenvironmental relations' (1998: 22). Gerber suggests that such debates have conflated the concrete and abstract, and that abstract categories of nature and society - rather than the concrete at which no such distinctions exist – are the source of such restrictive dualisms. Freudenberg et al (1995) also suggest that constructivism offers a resolution to the analytical separation of the natural and the social by examining the social shaping of 'physical facts' as separate from questions of aesthetics, whilst stopping short of the material agency thesis associated with actor network theory, the specifics of which will be examined in the following section. Castree (2002) has further suggested that such dichotomies have proven useful for developments in human geography, as the maintenance of such 'separatisms' of nature and society, upon which sociology itself has for so long depended, have allowed geographers to resist '...the hegemonic positivist tendencies of the natural science' (Murdoch 1997b: 732 cited in Castree 2002: 117). This conclusion is understandable given the history of geography's strong programme of spatial science, and geographer's sustained attempts to discard environmental determinism. On this point, Derek

Gregory (2007) provides an insightful discussion of geography's paradigmatic struggles through a biography of pre-Marxian David Harvey.

The stakes of the constructivist-realist debate are more than mere indulgence, and the appearant denial of the significance of external, causal mechanisms underpinning the social serves only to undermine the environmental movement in its attempts to grasp the complex interconnection of nature and society (Dickens 1996). Consequently, Hannigan cites Michael Soulé and Eileen Crist's remarks on the ecological destruction justified by constructivism, with Crist characterising is as '...zestless agnosticism and non-committal metadiscourse' (Crist 2004: 16 cited in Hannigan 2006: 29). On review however, it appears that such 'strong programme', linguistic constructivism is very much in the minority, and Dickens (1996) acknowledges as much by suggesting the continuum of strong-weak constructivism renders the constructivist-realist dichotomy itself invalid. Dickens' resolution of the debate involves viewing the perspectives of constructivism and realism as of equal epistemological merit, without conflating one into the other in the form of over-determination;

> "...mechanisms and structures established can still be real, causal and extra-discursive, even though they have been established in social contexts...it is important to note here that realists do not rely solely on constructions of such phenomena to explain concrete events. As we have seen, they typically look to the *combination* of such mechanisms with other information derived from the particularities and contingencies within which such mechanisms are operating" (Dickens 1996: 74).

As will presently be discussed, this position is quite close to the critical-realist take on the object-construct dualism. Overall, the debate thus far appears markedly similar to the aforementioned 'science wars' (Ashman and Baringer 2001), the net outcome of which also offered little practical benefit beyond academic prestige. It is also worth noting, based on the criticisms quoted above, that these debates have merely served to draw critical responses from the natural sciences rather than foster useful connections.

The unfortunate state of research at the peak of this debate is best illustrated by Redclift and Woodgates' (1997) responses to McNaughton and Urry's (1995) paper *Towards a Sociology of Nature*, the precursor to their 1998 publication *Contested Natures*. Redclift and Woodgate (1997, 1998) are critical in both instances of the author's insistence that '...there are other contributions sociology can provide to current "environmental" debates. These also arise from how the "social" and the "natural" are being reconstructed in contemporary societies' (McNaughton and Urry 1995: 208 cited in Woodgate and Redclift 1997: 59). McNaughton and Urry may well be criticised for failing to revise the orthodox constructivist programme –

indeed the contents of their 1998 publication serve to illustrate the extent to which such a discursive recommendation was carried through. Urry's development of the concept of the gaze (Urry 1991), and McNaughton and Urry's claim that '...a major task for the social sciences will be to decipher the social implications of what has always been the case, namely, a nature elaborately entangled and fundamentally bound up with social practices and their characteristic modes of cultural representation' has lent much subsequent support to repositioning constructivism in the separatist terrain of the social sciences.

Despite the authors' claims to the contrary, emphasising cultural constructs clearly does not collapse the natural-social divide; positing the inseparability of nature from culture in this way clearly prioritises the social in their analysis. Furthermore, this field of environmental history (Woodgate and Redclift 1997) is one which historical geographers have long contributed to productively without succumbing to excessive constructivism. Such geographers have focused on the connection between spatial forms and human actions, and more recent 'symbolic geographers' (Seymour 1999) have discussed the processes through which landscape ideals, ideologies and aesthetics have structured space. Anthropologists have also devoted much effort to integrating the study of culture and environment in a way that avoids restrictive separatisms; Emilio Moran, for example, has drawn attention to a set of research methods developed by Julian Seward that '...paid careful attention to empirical details and causally linked the *cognized environment*, social organization, and the behavioural expressions of human resource use' (Moran 2006). In the process, as Moran outlines in his review, anthropologists have repeatedly confronted questions of energetics, boundary definition, and the dialectic of ecologically embedded cultural forms.

The natural sciences have not been immune to this renewed sensitivity toward human-mediated ecological contexts, as discussed by Swetnam et al (1999). According to these authors, effective ecosystem management stands to benefit from the study of both the past influence of humans, as well as more conventional sources of historical climatological, biological and geological data. It seems curious that such a prospect of productive dialogue would be sidestepped for the sake of academic territory, and such relativist questioning of discourse-validity appears all the more tenuous in light of the growing weight of evidence that human action is contributing directly to climate change. For the forthcoming case study, it seems worthwhile to retain some insights (if not the grounding ontology) of the constructivist approach however; as will be demonstrated, a number of documentary sources display clear ethnocentrism in their assessment of Irish agriculture which calls for a particular consideration of the influential role of ideas. The ideological and political context in which such comments

were made doubtless conditioned later approaches to agricultural restructuring however, which in turn wrought significant change in local ecosystems. Discourse in this instance cannot be examined in isolation from its material consequences, nor the clear material basis constitutive of prevailing property relations.

Although some have claimed that the constructivist-realist debate has largely simmered (Hannigan 2006), the result for the social sciences has not been a general resolution or synthesis of insights. A recently published reader edited by King and McCarthy (2009) designates a specific section to papers dealing with 'the social construction of nature', and numerous other articles deal in what might be termed an evolved constructivism, albeit with evident influences of Ulrich Beck. Their topics include the social construction of cancer, the use of science in environmental conflicts, and representations of risk in popular culture (King and McCarthy 2009: VII). The field of science studies has arguably enjoyed more success with the constructivist emphasis on discourse, and its stability is reflected in the current composition of the field's output. Steven Yearley is typically identified as a model of the 'social problems' approach which has arguably dominated mainstream environmental sociology (Benton 1991, 1994; Dunlap 1997). Its dominance is doubtless assisted by its familiar sociological terrain of power relations, contested knowledges, discourse and social movements. In chapter 8 of his publication *Cultures of Environmentalism,* Yearley, outlines his scepticism toward the use of science by environmental movements such as Greenpeace. Citing science and technology as the origin of numerous environmental problems, and further confusions regarding the contested nature of scientific claims, Yearley concludes that; '...scientific evidence, far from being an impartial resource for resolving a dispute, may become part of a pressure group's campaign armoury leads us towards the 'social construction of social problems' approach...the correctness of social problem claims may be comparatively unimportant in determining their public impact' (Yearley 2005: 115).

Clearly the example of science studies is surplus to the requirements of this thesis. It does however reveal a worrying, and lasting tendency within sociology to emphasise the social at the expense of its material preconditions, contrary to the mode of ontological compromise prescribed by critical realism. It may be instructive to interpret Yearley's particular strain of environmental studies as a symptom of postmaterialism, which is often singled out as a key factor by political scientists in determining the emergence of green party politics, a factor with close correlations to economic growth and rising standards of living. The luxury of discursive exchange on environmental issues could in turn be seen as a condition of the continued strength of such cultural studies approaches in environmental sociology. In this sense,

constructivism is merely reacting to the real presence in the developed world of post-materialist environmental discourse based largely on threats to quality of life rather than survivability. Statistics from Mazoyer and Roudart on agricultural modernisation puts such postmaterialist research into perspective, and speak also to its geographical specificity;

> "Around 80 percent of the farmers of Africa, and 40 to 60 percent in Latin America and Asia, continue to work exclusively with manual tools, while 15 to 30 percent of them use animal traction, and less than 5 percent use motorized traction. Modern agriculture is thus far from having conquered the world. Other forms of agriculture remain predominant and these continue to employ the majority of the active population in the developing countries" (Mazoyer and Roudart 2006: 20).

This may also account for the comparative theoretical success anthropology has experienced in the field of ecosystem ecology; it is far easier to operationalise a realist 'dialectic of culture and ecology' when the manifest analytical units are themselves dependent on visible, localised, and bounded ecological exchange. Recent publications such as Armitage and Plummer (eds, 2010), and Lichtfouse et al (eds, 2011) contain a wealth of articles structured around the concept of adaptive capacity, which the authors note derives from researches in anthropology, ecology, geography and biology. Such a concept, according to the authors, allows for comfortable dialogue between natural scientists' analyses of organic adaptive capacity, with social scientists' insights into the role of institutions and culture as moderators[49]. Questions of ontology within these multidisciplinary papers are conspicuously absent.

In many respects, the constructivist-realist debate mirrors other prominent, divisory debates within the social sciences such as those of methodology, in the sense that both are essentially questions of ontology and epistemology contextualising questions of empirical investigation. Correspondingly, the typical terrain of the social constructivist approach is that which lends itself to the qualitative approach, and its associated epistemology of social reality as essentially constructed and actively negotiated. There are two instances in which the concept of 'construct' is here employed, which speak respectively to ontology and epistemology. In questions of methodology, the assumption of 'reality as construct', and its consequent focus on subjective meaning is one typically associated with epistemologies of constructivism. In the nature-society debate, 'constructivism' denotes reference to the ways in which humans actively construct nature as a category, which is in turn deployed as an ontological device against realist accounts of nature as objective, or meaning as immanent within objects.

[49] These concepts are detailed further in chapter 3.

Consequently, constructivism, as observed above, has enjoyed some success as an approach critical of objectivist notions of nature in social policy, which it claims denies the relevance of issues such as the situatedness of concepts of ecology and environment, the validity of tacit and indigenous knowledges, and the ways in which conceptions of nature as an object of specialist expertise are deployed in public debate for political gain. The core problematic sustaining such divisions, according to Roy Bhaskar (2010) is an implicit 'epistemic fallacy' involving the 'reduction of being to knowledge of being' (Bhaskar 2010: 1). His summation of the critical realist position on the relationship between ontology and epistemology is worth noting as a potential means through which to critique the extremes of various natural-social reductionisms;

> "...outside experimentally established and a few naturally occurring 'closed' contexts, invariant empirical regularities do not occur. The need in general to artificially generate them means that they cannot be identified with the causal laws and other objects of scientific knowledge that they ground, but must be seen as our mode of empirical access to them; and that the causal laws, etc. must be analysed as objects which exist and act independently of our access to them, including transfactually (i.e. outside the context of their establishment). They must therefore be conceived as the operation of structures and mechanisms which exist and act independently of our human (experimental) access to them." (Bhaskar 2010: 2).

Interpretation of the process of scientific knowledge production is characterised by Bhaskar as an activity which cannot proceed without recognising the pre-existence of structures and process which are *independent* of human access. Addressing questions of ontology and epistemology in this way highlights the futility of the constructivist-realist debate, in that both objectives are necessarily immanent in the critical realist disambiguation. Neither approach is any less valid; the processes of meaning-assignment and the independent, causative role of nature are merely moments in the dialectical unity of the natural and the social.

Discussions of critical realism in chapter 1 provided an abstract framework with which to think through such natural-social analytical levels, as represented through Harvey and Reed's (2004) hierarchical ontology. Its abstraction is, as yet, its weakness and as with the previous chapters consideration of the development of scientific epistemology, it has here proven essential to outline the concrete history of natural-social dualisms in academic social science. As will be demonstrated, overcoming such restrictions involves working toward an understanding of the mechanisms that structure such interactions between ontological levels in the natural-social hierarchy, and in many respects, discussions of critical realism in chapter 1 prefigured this critique of 'over-socialised' conceptions of nature from within the social sciences. Critical realism has, however, merely pointed out that objective conditions exist independent of such mental conceptions of nature and, more importantly (by rejecting ecological reductionism), that

there exists a complex interplay between 'natural' and 'social' tendencies to the extent that such ontological separatisms are untenable. The mechanism connecting such levels, it will soon be argued, was previously suggested by Marx through his concept of abstract labour, and the labour process. Consequently, an appropriate framework is required to understand both the unity of nature and society *vis-a-vis* human labour, and the conditions under which such labour operates.

It must also be acknowledged that the 'social constructionism' which materialists have often co-opted in their criticisms, is wilfully ignorant of the sub-disciplines recognition of its own limitations (Hannigan 2006). Evidence of such self-reflection is seldom evident in the reviews of its numerous critics however (Benton 1994, Freudenberg et al 1995, Dickens 1996, Gerber 1997, Redclift and Woodgate 1997, Demeritt 2001, Murdoch 2001, Franklin 2002), and the debate must be recognised as considerably more nuanced than has typically been suggested in these widely cited works. Furthermore, little stands to be gained from simply arguing against reduced misrepresentations of such ideas which stand to contribute, if only tangentially, to broader socioecological frameworks. The prospect of constructionism can no sooner be discarded than that of the biophysical basis of social life. All too often, such statements are taken out of context in evidence of particular extremes of idealised natural-social reductionism; the problem, as Dickens suggests, is perhaps more a communicational impasse rather than a real incompatibility. As a potential solution to this impasse, the concept of 'co-construction' has been suggested by a body of work collectively known as actor network theory.

2.1.2. Actor-network theory and its critics

Against such aforementioned dualisms, actor-network theory (ANT) depicts a world of porous ontology populated by hybrid entities embodying both natural and social properties (Akrich 1992; Swyngedouw 2004; Latour 2005; Law 2009). Murdoch (2001) describes ANT as approximating a co-constructionist ecological sociology, in that it attempts to '...identify how relations and entities come into being together' (2001: 111). It is co-constructionist, in that it '...treat[s] everything in the social and natural worlds as a continuously generated effect of the webs of relations in which they are located' (Law 2009: 141). By Law's (2009) account, ANT draws much influence from previous philosophers of science, albeit with reference to metaphors of disordered relations reminiscent of more narrative accounts of complexity (i.e. Urry 2005a). The difference, according to Law, is that ANT is viewed by its proponents as '...an empirical version of poststructuralism' (Law 2009: 145), insofar as it avoids imparting notions of structure onto social regularity, opting instead for the qualitative explanatory

generalizability of a 'network' epistemology, as will presently be discussed. Murdoch cites Latour's study of Louis Pasteur as a case in which the co-construction thesis tends neither toward naturalist nor constructivist determinism. According to Latour, Pasteur's discovery of the anthrax bacillus resulted of a process in which the natural and the social were '...co-constructed to the extent that both Pasteur and the anthrax bacillus are modified by the experimental event...they mutually exchange and enhance their properties' (Murdoch 2001: 118). This ontological position proposes a bridge between constructivist-realism by viewing the natural object as constituted in emergent socio-technical networks.

In the process of theorising such connections, ANT has drawn much criticism for its ascription of agency to non-human entities, referred to in such accounts as 'actants'. Such hybrid actants are conceptually produced by actor-network theorists by collapsing the natural-social dichotomy, and by rejecting the idea that humans are the sole bearers of agency (i.e. purposive action). Agency in the ANT account, according to Hannigan (2006), becomes not the exclusive preserve of humans, but the outcome of '...networks composed of 'hybrids' of people, nature and technologies' (2006: 34). ANT has consequently enjoyed success in the field of technology studies, where its proponents have used it to question exceptionalist narratives of technological development and diffusion, whereby technology is seen as the product of isolated innovation and diffusion through negative feedback (i.e. an inherently logical process). Such an approach is similar to Brian Arthur's discussion of positive feedback as a justification for the complexity account, and the empirical accounts of actor-network researchers tend to proceed on the basis of similar exceptionalist case studies.

Contrary to systems theory which employed particular base assumptions regarding macro-structural parameters, ANT was born of a search for a 'neutral vocabularly' (Bijker and Law 1992: 13) in which networks of both human and non-human were seen as simultaneously constituted and shaped. ANT thus raises questions regarding the constitution of such network boundaries, and the (non-natural) sources of the categories of artefact and human – a tendency demonstrating the close associations of many of its practitioners with linguistic poststructuralism. This research programme is best summarised by Madeline Akrich (1992) who argues;

> "...technical objects participate in building heterogeneous networks that bring together actants of all types whether human or non-human...they build, maintain and stabilise a structure of links between diverse actants...thus technological determinism pays no attention to what is brought together, and ultimately replaced, by the structural effects of a networks. By contrast social constructivism denies the obduracy of objects and assumes that only people can have the status of actors" (Akrich 1992: 206)

Here, the term 'technological determinism' may be substituted with 'environmental determinism' to understand ANT's approach to natural-social relations; both are coterminous in that they identify respective forms of 'intrinsic property' reductionism. Natural-social categories are collapsed in the sense that such networks of complex interaction and causation render it impossible to distinguish agent from object, and consequently cause from effect. Given that objects in the ANT account possess the ability to restructure human relations and actions, they are consequently viewed as active entities (actants). Michel Callon (1992) employs such concepts of the actor-network similarly to Akrich in his analysis of the introduction of the electric car to France. Callon here attempts to bridge the natural-social divide by viewing the electric cars' by-product of poisonous catalysts as an 'actant' structuring both the network, and user preferences. This results in a modification of actor-orientations toward the object, and consequently a fundamental restructuring of the fluid actor-network, which itself is both socially and naturally constituted. Examples such as this which demonstrate the fluidity of network boundaries, variable orientations and causative properties of both object and human actor are often cited as evidence of the limits to structuralist interpretations; if such networks are conceptualised as emergent in the complexities of interaction, it becomes difficult to impose abstract structural properties on any case of interaction. Such structuralist devices are in turn questioned along with their concomitant authoritative (often 'scientific') discourses.

This perspective raises a number of further questions of concern for the nature-society connection, specifically with regard to the study of agrarian systems. The first, arguably of lesser significance concerns the theoretical role of technology in cultivation. Given that technology (i.e. implements or synthetic additives) and their diffusion play a significant role in mediating the form of human engagement with the environment, ANT raises the question as to how natural-social separatisms are tenable in presence of such 'hybrid' entities. The intellectual origins of this approach in critiques of the 'technological imperative' account are instructive in this regard (Williams and Edge, 1996), which concerns ANT's reluctance to resort to path-dependence or diffusion as explanatory metanarratives; ANT accounts are thus highly contextual, with generalisation at the level of epistemology rather than process, mechanism or structure. Agricultural technology has doubtless played a significant role in re-configuring and restructuring at many levels, from the structure of the global food circulation system, to local geographies, class structures and divisions of labour. However, it hardly seems appropriate to single out technical objects in these accounts as the focal point with which to collapse the natural-social divide. Beneath the surface there appears little of explanatory

benefit beyond the ontology of the 'hybrid', and less that cannot be accounted for (in terms of the transformations outlined above) by established disciplines. In short, given the questionable practical contribution such perspectives have made; the defining motive of such theorisations appears purely academic. It is unclear, for example, what practical benefits may have resulted from reconceptualising Callon's (1986) scallops as actants, or for the feminist movement to adopt more forcefully Donna Haraway's concept of the cyborg.

ANT has thus been criticised on a number of grounds, due both to its questionable empirical utility, and its broader epistemological foundations – the latter of which has arguably fostered less than conducive relations between sociology and the natural sciences. Furthermore, Murdoch (2001) identifies problems with language at the centre of many of ANT's critics concerns. Bloor's (1999) critique is instructive in this respect, but ultimately amounts to a defence of 'strong programme' sociologies of knowledge, which Latour had consistently criticised as insufficiently radical. Murdoch summarises Bloor's concerns as follows; '...that simply reducing everything to a set of simplified analytical categories – such as 'relations' or 'networks' - does an inevitable injustice to the causes of scientific belief and action' (2001: 122). In this sense, Bloor has merely echoed (or prefigured in the case of later accounts) the position of critical realists; that of the reality of external (natural) entities and the identification of the conflation of epistemology with ontology as the essential problem in normative accounts of natural-social separatism. Bloor himself acknowledges the necessity of such an interpretation of knowledge by criticising Latour's suggested rejection of the 'schema of subject and object'; '...knowledge is to be understood in terms of an interaction between an independent reality, the 'object' of knowledge, and a knowing 'subject', embodying its own principles of receptivity' (Bloor 1999: 82).

Castree's critique is more substantive on the issue of natural-social relations, and his comments proceed on the claim of a false characterisation by actor-network theorists of orthodox Marxist approaches to nature as essentially normative. Castree acknowledges that ANT has provided a powerful incentive to overcome traditional geographical dualisms, albeit one that comes at the cost of materialism's staple explanatory devices;

> "Where dichotomous thinking ultimately resorts to one pole or another-society or nature-as explanatory, ANT refuses to look for causes lying *outside* socionatural networks...Moreover, it refuses the presumption that different networks are driven by the same general processes or factors, be they "capital" of "class interests", for example. Instead, the processes determining the constituents, stability and reach of a particular network are deemed to be *internal* to it and, at some level, to involve all the network entities....Far from appealing to causal forces separate from and prior to networks, which

> explain but do not themselves need explaining, it is only *after* each network has been carefully described that explanation can emerge" (Castree 2002: 118-119).

Castree (2002), and Castree and MacMillan (2001) have thus suggested a 'weak' version of ANT may be required as opposed to the 'strong' alternative which has drawn the bulk of criticism. Across both cited contributions, the authors have remained cautiously receptive of actor-network theory however. Their claims as to the potential of ANT rest on a perceived reproduction of natural-social binarisms by both social constructivists and natural realists, to the extent that neither is capable of depicting the nature-society relation in a non-dichotomous manner. Their endorsement of the ANT approach runs counter to much of the systems frameworks discussed in chapter 1, by refusing to begin with any notions of structural regularity or trans-historical generalisation, instead opting for a strong inductivism in their approach to case study data (Castree and MacMillan 2001: 212). Again, this level of particularism poses a significant challenge to generalisation beyond the existence of abstract 'networks' themselves. In this way, ANT characterises the natural-social dichotomy as a post-hoc attempt by researchers to impose conceptual order on complex phenomena. This account is unfortunately (and characteristically) light on the practical consequences of sustaining such a degree of natural-social separatism aside from the usual charges of anthropomorphism / centrism associated with many critiques of constructivism, and the ethics of western green movements.

The authors' 'weak' ANT alternative thus proposes remaining mindful of possible abstract similarities of process across multiple cases, which moves us somewhat closer to generalizability, and avoids discarding (as with more extreme postmodernist positions) notions of process and structure. Castree has in this regard attempted to defend Marxist approaches to nature in the context of his endorsements of ANT on a number of occasions (2001, 2002). The superficial incommensurability of ANT and structure-based theories may be attributed to their respective positions on the very nature of theory itself; Law (2009) states that ANT in the first instance is not a theory as such, but rather a set of general propositions (as discussed above – its rejection of meta-categories is its critical weakness), whereas Castree identifies Marxism as an '...irredeemably totalising and rigid...theoretical architecture' (Castree 2002: 114). Castree however, suggests that there is a fundamental commensurability between ANT and Marxism through mutual information in the 'weak alternative' as outlined above.

The specifics of such Marxist approaches to nature will be discussed in detail in the following subsection; for now, it is sufficient to point out that Castree categorises existing research into a

brand of dualism-sustaining 'dialectical' Marxism (Ted Benton, James O' Connor) against a 'relational' variant' (David Harvey, Neil Smith, Eric Swyngedouw) which supposedly retains the possibility of dialogue with ANT propositions[50]. He further (and usefully) suggests that ANT would benefit from remaining mindful of the need to identify '...structured and consequential modes by which multiple socionatural networks are ordered' (2002: 141). It appears Castree has staged an inaccurate confrontation in his rendering of 'dialectical' Marxism however, as Ted Benton had, eight years previously, outlined much of this necessity programmatically (1991), and with reference to a general methodology (1994);

> "What is required is the recognition that each form of social/economic life has *its own* specific mode and dynamic of inter-relation with its *own* specific contextual conditions, resource materials, energy sources and naturally mediated unintended consequences...The ecological problems of any form of social and economic life would have to be theorised as the outcome of this specific structure of natural/social *articulation*...Each form of social and economic life is understood in terms of its own specific contextual conditions and limits. These conditions and limits have real causal importance in enabling a range of social practices and human purposes which would not otherwise occur, and also in setting boundaries and limits to their sustainability" (Benton 1989 cited in Castree 2000: 22-23)

Consequently, it appears a far more productive mode of inquiry to retain the possibility of generalisation through process and abstract structural characteristics, rather than excessive particularism. What Benton is suggesting here, is that such totalities of 'conditions and limits' may be grasped (in the abstract) as various modes of production - a concept which, as will presently be observed, is inherently ecological yet sufficiently abstract to permit particularism and generalizability.

The problem with Castree and MacMillan's (2001), as with Bloor's (1999) critique of 'strong' ANT is their clear insistence on the separatism of the social as a field of research. Accounting for co-construction, as Bloor suggests, within the boundaries of sociology (i.e. knowledge and discursive context) is clearly limiting; in this sense, it would be instructive to consider existing literature on collaborative ecosystem research and management which has comfortably proceeded – to significant practical gain – with its own multicausal take on natural-social divisions (Moran and Ostrom (eds) 2005; Berkes et al (eds) 2003; Young et al (eds) 2008). As Bloor and Murdoch rightly identify, remaining exclusively and excessively within the boundaries of sociology can only push the debate so far. The problem with Bloor's critique unfortunately, is that it emphasises the separatism of sociology (specifically the sociology of

[50] Given that Castree is a geographer, it is understandable - if not entirely representative - that his lines of separation follow those of discipline. His distinction forms the basis of sub-headings for forthcoming sections of this chapter.

knowledge), and arguably reinforces the classical 'Durkheimian separatist' foundations identified above as problematic.

A number of authors have attempted to substantially rework the abstractions of ANT. In his introductory defence of Latour, Eric Swyngedouw (2004a) points out numerous practical examples of limits to binarism, such as the interplay between disinvestment and climate in the physical and economic decline of the city of Jakarta, and later the provision of water in the city of Guayaquil. Endorsing Latour's argument that the post-Enlightenment binarization of nature and society permitted accelerated scientific achievements removed from reflexive consideration of their social embeddedness, Swyngedouw attempts to collapse the natural-social impasse through the concept of hybridity; 'There is nothing 'purely' social or natural about them, even less asocial or a-natural: these 'things' are natural *and* social, real *and* fictional. Society and nature, representation and being, are inseparable, integral to each other, infinitely bound up. Simultaneously, these hybrid socionatural 'things' are full of contradictions, tensions and conflicts' (Swyngedouw 2004a: 14).

Swyngedouw's development of the concept of hybridity does much to modify the co-constructionist account however. In a manner similar to Bhaskar's separation of ontology from epistemology, Swyngedouw argues that the concept of 'hybrid', forces recognition that the natural-social binarisms sustained by modernist science are merely discursive. The implied problematic is similar to that outlined by critical realists, in that both illustrate how such discursive binarisms translate into ontological assumptions, whereby the world comes to be perceived by social actors as actually corresponding (in ontological terms) to such discursive natural-social divisions[51]. The strength of Swyngedouw's contribution is that he advances the concept of 'hybrid' beyond the usual particularistic-contextual or metaphorical accounts of actor-network theorists by suggesting that the real, material connections between the natural and social are hidden by the commodity form. By locating such concealment within the commodity form, Swyngedouw thus permits the discarding of binarisms of representation-being and discourse-materiality (and also constructivism-realism, 2004a: 14). By tracing their metabolic unity, the material and abstract conditions underpinning the reproduction and

[51] As suggested numerous times throughout chapter 1, similar problems remain in current methodology, whereby alliances to epistemological traditions have sustained deep divisions between research methods – typically centered on disagreements concerning their explanatory validity. There are visible echoes of this conflation of epistemology and ontology in such debates, whereby quantitative research is viewed as reproducing natural-scientific reductionism; the charge is frequently levelled against statisticians that they mistakenly interpret the social world as corresponding ontologically to reductionist theoretical models (i.e. rational actor theory). Such debates typically ignore the epistemological reflexivity of many quantitative programmes, and their willingness to pursue mixed-method models of explanation. For examples of this current of debate, see Arjas (2001), and for a misinterpretation of the nature of statistical inference and its relation to theory in general see Esser (1996).

circulation of the commodity form are thus revealed; '...the dialectic of the environment and urbanization consolidates a particular set of social relations through 'an ecological transformation which requires the reproduction of those relations in order to sustain it' (Harvey 1996: 94 cited in Swyngedouw 2004a: 9). The 'hybrid', in this instance permits the simultaneous understanding of the reproduction of abstract relations, concrete networks and representational forms, and, it might be suggested, rightly pushes the concepts of ANT beyond the limitations of socio-technical case studies.

This level of generality appears preferable to the level at which ANT accounts are typically pitched, and the object of Swyngedouw's case studies (the metabolic entity of the city and the circulation of water) clearly benefits from such a materialist re-working. In this sense, it is preferable in practical terms to trace the material conditions of political forms and circulation networks rather than to trace the co-constructive webs of natural-social hybrids merely for the sake of epistemic critique. In this critical-geographical vein, David Harvey has previously drawn attention to the foundations of such a materialist approach to the study of technology available in the work of Marx, which has in turn informed both his, and Swyngedouw's work. Citing an important footnote in which Marx equates his general approach with Darwin's as the study of the 'development of the economic formation of society from the standpoint of natural history' (Marx 1976 cited in Harvey 2010: 189), Marx outlines the necessity of a critical history of technology to any theory of social change. The dialectic of human/nonhuman (the missing dimension of Darwin's account) is therefore imminent in such a critical history which '...reveals the active relation of man to nature, the direct process of the production of his life and thereby it also lays bare the process of the production of the social relations of his life and of the mental conceptions that flow from those relations' (Marx 1976 cited in Harvey 2010: 190). In such a way, Marx had already taken up a non-reductionist (i.e. process based) account of the development of technology in pursuit of a theoretical account of social change. Various technologies are thus depicted in Marx's note within a matrix of organizational forms, mental conceptions, social relations and relations to nature (ibid). The social, as is often singled out in ANT critiques of sociological approaches to technology (Latour 2005) is afforded neither primary nor determining status in relation to the others.

In assessing ANT overall, if the only generality that may be established is that the categories of natural and social dissolve in such socio-technical networks, how may generalisations be made concerning mechanism and process? Such networks may well intertwine nature and society, and the 'modern constitution' may produce and sustain the ontologically divisive categories of nature and society discursively, but this is not a central concern of this work. The capacity to

speak in terms of material contexts, processes and structures at a general level, and with a methodology that does not resort to exhaustive empiricism must be retained. In this sense, ANT tends closer toward the constructivist account by viewing action, and the categories of nature and society with its own brand of social 'emergentism'; they are viewed as dependent on human subjectivity and collective definition. This is clearly too high a level of abstraction, and also reveals the irony of the Bloor-Latour exchange in that Latour's version of an 'ecologised' sociology itself remains firmly within the domain of the conventional social-sciences, albeit with a sheen of deceptive terminology.

As detailed above, the hostilities engendered throughout the 'science wars' have served only to stunt disciplinary dialogue precisely at a time when sociology should be working toward overcoming excessively philosophical indulgences. Furthermore, a degree of scepticism should be directed toward Murdoch's conclusion that ANT's '...focus on action within the heterogeneous networks that comprise 'nature-cultures' thereby qualifies it as an ecological perspective and perhaps indicates how sociology might embrace some central aspects of the ecological world-view' (Murdoch 2001: 126). The inevitable conclusion is that both actor-network theory *and* a number of its critics have misconstrued the concept of 'ecology' within social theory. The criteria by which ANT judges its ecological engagements are too limiting, and the terms of an ecological social theory suggested by many of its critics are too narrow. The inherently (and necessarily) materialist role of ecology within social theory must, as in Swyngedouw's account, be developed. It is now suggested that the work of Marx be taken as a starting point in assembling this alternative human ecology, specifically the central role of human labour as mediator in any typology of natural-social relations. This exercise provides a crucial context for subsequent chapters, beginning with an outline of the current state of Marxian approaches to environment and nature.

2.2. Contributions from the sociological and geographical left

Although many of the contributions cited in the preceding section are clearly sourced from the academic left (e.g. Harvey, Swyngedouw, Castree, Benton), the preceding debates have focused on theoretical approaches developed within the academic mainstream (or various postmodern alternatives, insofar as such a categorisation is tenable), and their critical respondents. There exists a substantial body of theoretical and empirical work on nature and ecology with a particular orientation such that it may be considered apart from the preceding approaches – indeed, Marxist environmental sociology is arguably a prominent sub-discipline in itself. What follows is an examination of contributions from theorists identified as Marxist

(or of particular 'left' orientation), who have variously attempted to develop Marx's insights for the sociological analyses of environmental phenomena, or who have attempted to recover Marx's ecological contributions from his diverse writings through various 'archaeologies of knowledge' – although this strain of more recent work is largely reserved for chapter 5.

This collective of contributions from the left is for now considered apart from studies in Marx's concept of 'metabolic rift' which will be given substantial attention in chapter 5. There is some semblance of chronology as well as logic to this separation; metabolic rift did not come to the academic fore until 1999-2000 (Foster 2000), although as will be shown, the concept of metabolism was previously much discussed in the social sciences (Fischer-Kowalski 1997). Consequently, this post-2000 period arguably marks a theoretical watershed in Marxian environmental sociology. This current discussion thus prefigures chapters 3 and 5, which deal with the somewhat less critical, though no less significant body of 'political economy' approaches to social-ecological systems analysis and interdisciplinary human ecology. The reader must, for now, trust that this separation is required, as 'metabolic rift' will be considered separately; the following discussion focuses instead on attempts to conceptually collapse the natural-social divide, whereas recent work in the concept of metabolic rift represents a more pointed formalisation of a coherent research programme, and a broader theoretical frame.

Since chapter 5 marks the penultimate theoretical position upon which this thesis is based, the material presented prior should be considered cumulative. A great number of contributions within these more prominent Marxist debates focus specifically on issues relevant to contemporary capitalism (i.e. Burkett's discussion of value-form and the working day, 1999). Where appropriate, detailed discussions are avoided as later chapters will examine in greater detail Marx's writings on pre-capitalism, which are considered more relevant to the empirical focus of this work. The emphasis throughout is on extracting what is analytically useful for the forthcoming case study, and indeed for developing a more generally applicable methodology; certain insights and concepts developed herein through the analysis of capitalist production are therefore considered relevant to other, precapitalist modes of production, or to human ecology in general.

2.2.1. 'Promethean' Marx and the labour process

The divide between geographical and sociological contributions from the left appears pronounced in the following discussion, and there is much to distinguish in the character of

their debates and interpretations[52]. Clearly, an obvious distinction of subject matter makes such compartmentalisation easier; David Harvey, for example has applied his readings of Marx to inequalities of spatial and urban development, and Neil Smith's complementary work has forwarded an alternative version of co-production, in which nature and society are viewed as mutually constitutive and produced. There are two prominent sociological debates in which Marxian approaches to environmental matters have been criticised, the first of which centres on the notion of an implicit 'Prometheanism' in Marx's pronouncements on the environment (Benton 1989, Foster 1995, Burkett 1999), a view more commonly identified in development and economic literature as 'technological optimism'. According to this position, a fundamental incompatibility exists between ecology and Marxian political economy, on the grounds that the former remains sceptical of economic growth – a staple, and necessity of the historical-materialist succession of modes of production. Such an impasse, as will be shown, has been usefully recast by ecological economists (Mayumi 2001; Daly 2007) in their analysis of post-industrial revolution natural resource depletion. For example, numerous comments by Marx on the works of Justus Von Liebig are cited by Mayumi (2001) as offering a succinct analysis of the contradictions of modern agriculture, namely the relationship between natural resource depletion (fertility) and the various social forms under which it is experienced (in contemporary studies, mainly capitalist).

The second dimension of popular mistrust of Marxian treatment of the environment concerns Marx and Engel's rejection of Sergei Podolinsky's integration of the first law of thermodynamics with Marx's theory of value (Burkett 2006), which will be given substantive treatment in chapters 3 and 5. Consequently, although there are numerous sub-debates within Marxian environmental sociology, the 'Promethean' debate draws attention to a number of important grounding assumptions within Marxist historical materialism, specifically Marx's use of labour and surplus appropriation as essential orienting components in his typology of modes of production. The utility of these grounding areas of concern to socioecological analysis must therefore be examined – although, as previously mentioned, this is a question that will need to be addressed and enriched throughout subsequent chapters. Although there is much to operationalise from these contributions, the forthcoming emphasis, in order to remain consistent with the broad objectives of this chapter, will be to discuss how these elements offer a useful conceptual bridge between the aforementioned impasses of nature-society dualisms.

[52] It is important (and somewhat unfortunate) to note that many discussions of ecology and Marxism (as with the many of the 'productivist debate' contributions here considered) are primarily concerned with defending the historical-materialist apparatus, in a manner reminiscent of Schumpeter's prophetic dogmatism (2008 [1942]). There are many fortunate exceptions to this rule however, such as Burkett (1999, 2006) who despite his sustained defence of eco-socialism uncovers much of both practical and theoretical value in the journey.

The purpose of considering these debates here is thus to prepare discussion to move beyond implicit conceptualisations of nature-society, toward the development of working concepts for social-ecological analysis.

The suggested, implicit Prometheanism in Marx's work is summarised by John Clark as follows;

> "Marx's Promethean..."man" is a being who is not at home in nature, who does not see the earth as the "household" of ecology. He is an indomitable spirit who must subject nature in his quest for self-realization...For such a being, the forces of nature, whether in the form of his own unmastered internal nature or the menacing powers of external nature, must be subdued" (Clark 1989 cited in Foster 2007: 29-30).

Burkett (1999) identifies such a 'Promethean' outlook (i.e. the necessary subjugation of nature to human dominance under both capitalism and socialism) as a post-Enlightenment residual – indeed, a number of authors previously cited have drawn attention to the role of post-industrial revolution exuberance in sustaining such human-exceptionalist views (Catton & Dunlap 1980). Benton concurs with this reading, and identifies worrying parallels in modern conservative development theory which he claims operates under the '...assumption of an intrinsic antagonism between the fulfilment of human purposes, on the one hand, and the forces of nature, on the other' (Benton 1996: 172).

Benton characterises this Prometheanism as a grounding assumption in Marx and Engel's work – a view arguably consistent with their nineteenth century peers in the context of available knowledge;

> "Although there were...moments when Marx and Engels criticized this idea, it remains as a presupposition of their view of the relationship between the historical development of the forces of production and the ultimate achievement of human emancipation. Natural conditions and limits tend to be regarded as a primary source of human heteronomy, the progressive function of the development of the forces of production consisting in the *transcendence* of limits by incorporating natural conditions within the sphere of human intentionality: a domination or control of nature" (Benton 1996: 172).

This conclusion, as with those of other commentators, suggests that Marx consistently privileged the ability of technology to transcend limits to human development, and therefore limited the ability of his theoretical apparatus to cope with limits to natural resource appropriation. By implication, this results in an incompatibility between historical materialism and modern ecology, the latter of which remains critical of unmitigated economic growth. Benton's (1989) paper locates the origins of this Prometheanism within a crucial hiatus in

Marx's thought, centred on a perceived 'utopian over-reaction' to Malthusian determinism (1989: 58), and an uncritical adherence to Ricardian disregard of resource limitations[53]. Marxian Prometheanism is therefore interpreted as a consequence of its rejection of Malthus' notion of natural limits; Malthus consistently excluded historically contingent social relations from consideration in his population-food supply model[54]. Marx's familiar enthusiasm for the development of the forces of production under capitalism, and its consequent production of class divisions' essential for revolutionary action further augment this rejection. Emphasis for now should not be on reassembling or arguing what Marx's specific statements or interpretations may have been (a wealth of contradictory excerpts are available in Parsons (1977)), but in abstracting from concrete questions of 'natural limits' to examine more broadly the role of social forms in structuring such heterogeneous ecological conditions. It is in the pursuit of such abstractions the excessive particularism of previously criticised approaches to nature and society (i.e. ANT) may be avoided, which in turn permits retention of the possibility of applying general explanatory concepts. A brief passage in an earlier publication by John Bellamy Foster, and Benton's own afterthoughts to the natural limits debate offers a useful starting point.

John Bellamy Foster's work has proven essential to advancing debate on Marx's pronouncements on the environment (Foster 1999, 2000, 2002, 2008). In an earlier publication, prior to taking up fully the question of Marx's ecology, Foster (1994) provides a brief discussion of ecological relations within pre-capitalist modes of production which offers a complementary insight to the natural limits debate. Importantly, Foster outlines how ecologically tenuous relations are evident across all antecedent modes of production, illustrating that the phenomenon of 'ecological limits' is therefore not unique to the social form of capitalism. There has been much debate concerning typologies of precapitalist modes of production which will be given greater consideration in chapter 4 (for illustrative material, see Hobsbawm 1964; Hindess and Hirst 1975; Foster-Carter 1978; O' Leary 1989; Anderson 2010; Browne 2010). For present purposes, it is sufficient merely to state that a central tenet of such historical materialist typologies is the centrality of abstract 'social relations of production which correspond to a definite stage of development of the material forces of production' (Hobsbawm 1964: 11). Although this level of abstraction has attracted much criticism (particularly the form espoused by Hindess and Hirst, 1975, strongly criticised by Diptendra, 1985), its empirical utility resides in its ability to broadly typify societies according to their

[53] Discussed further in chapters 3 and 5 in the context of the works of Georgescu-Roegen.

[54] See Foster (2000: 105), *The Critique of Malthus and the Origins of Historical Materialism.*

dominant modes of appropriation of surplus labour (i.e. either collectively as with primitive communism, or by a non-labouring class as with feudalism). Such an approach is a grounding assumption of much Marxist work in the social sciences.

Foster's discussion of pre-capitalist modes of production identifies various confrontations of limits to reproduction in the context of such dominant relations of production; '...these early societies were especially vulnerable to those regional environmental changes that did take place-often as a result of human interventions designed to extract a larger surplus product-because they raised the specter of ecological collapse whenever the extremely narrow limits of sustainable production were crossed' (Foster 1994: 36)

According to Foster (1994, 1995), the difference under capitalism is merely that stressors such as the accumulation imperative, scale of production, and town-country antagonism have shifted the boundaries of environmental degradation from regional to global scales. Acknowledging that various precapitalist modes of production have engendered their own particular dynamics of ecological destruction adds further credence to rejecting both technological determinism (the assumption that post-industrial revolution technological development is the sole cause of ecological imbalance), and deep-green idealism, whereby precapitalist production is viewed as existing in sustainable harmony with nature (Foster 1994). Numerous examples are offered by Foster, such as population growth and the extraction of tribute within the Roman Empire and its consequent exhaustion of vast tracts of soil. Consequently, if abstraction from such specific historical examples is employed, the analytical focus shifts to the relationship between the social form of surplus appropriation, and its contextual ecological conditions (i.e. the dynamics of specific modes of production). It is therefore redundant to attempt to define an ideal social-ecological state with reference to general historical examples; although environmental exploitation has accelerated exponentially under capitalism, the gains (albeit unevenly distributed) in population health as evidenced in the demographic transition are doubtless an immensely positive consequence of human 'subjugations' of nature (see Livi-Bacci 2005: 26, table 1.2). Simplistic blame cannot therefore be assigned to 'capitalism' without qualifying the dynamics which produce such resource imbalances. In the process of doing so, a form of generalisation is invoked through abstraction, by conceptualising social-ecological relations as intrinsically bound within distinct modes of production. The question is not singular (i.e. 'why is capitalism inherently ecologically exploitative'), but rather comparative; (i.e. 'what variations in the dynamics of resource degradation might be observed in different types of society, and what general concepts might be derived to permit an alternative form of comparative human ecology?'). This possibility of analysis through comparative abstraction

comes, in the first instance, from locating the labour process (abstract labour) as the essential unit from which such typologies derive.

The centrality of labour in typologies of modes of production, including capitalism, is emphasised by Burkett, who reproduces Marx's abstract model of the historical development of relations of production;

> "Relations of personal dependence...are the first social forms, in which human productive capacity develops only to a slight extent and at isolated points. Personal independence founded on *objective* dependence is the second great form, in which a system of general social metabolism, of universal relations, of all-round needs and universal capacities is formed for the first time" (Marx, 1973: 158 cited in Burkett 1999: 153).

What is most important to observe in the above quotation is how this scheme categorises such developmental stages in terms of relations to nature (the development of productive capacity) as mediated through the social organisation of human labour. Engagement with nature is an indespensible precondition of human reproduction which is present in all forms of society, yet this simple necessity produces multiple forms of ecological exchange corresponding to particular configurations of social relations. Such relations are ultimately dialectical, with no single factor determining the social form (i.e. nature, technology, law or economy) - they are the result of a complex interaction between multiple spheres. The substantive aspects of this 'mode of production' framework will be examined more closely in chapter 4; for the moment, it is sufficient merely to point out that it is labour (in the abstract) which proposes to capture the embryonic unity of the natural and social. There are evident homologies between this view of structural differentiation and the general narrative of systemic complexity outlined in chapter 1, as both attempt to impose summary conceptual order on the complexities of human organisational differentiation.

Continuing at this level of abstraction, Benton (1989) presents an outline of deficiencies in the concept of the labour process which he claims restricted Marx's ability to grasp the social exploitation of nature as essentially limited. This shortcoming, according to Benton, originates in Marx's under-representation of '...the significance of non-manipulable natural conditions of labour processes' and his over-representation of '...the role of human intentional transformative powers vis-á-vis nature' (Benton 1989: 64)[55]. The centrality of the labour process to the Marxian framework has been cited by numerous authors (Schmidt 1971, Grundmann 1991, Foster 1995, Harvey 2010). As alluded to above, it constitutes a trans-historical category (the

[55] Fischer-Kowalski (1997) endorses this distinction in her history of the concept of metabolism in the social sciences

category of value being specific to bourgeois society), independent of specific forms of society, which expresses the intrinsic ecology of social organisation; '...labour is a condition of human existence which is independent of all forms of society; it is an eternal natural necessity which mediates the metabolism between man and nature, and therefore human life itself' (Marx 1867: 133 cited in Harvey 2010: 111). From this embryonic unity, according to Marx, emerged myriad forms of cooperation, social organisation and divisions of labour (Hobsbawm 2007 [1964]).

According to Benton (1989) a critical ecological deficiency emerges once this concept is applied to the agricultural labour process; assuming that the intentional structure of the abstract labour process is essentially transformative, this concept becomes insufficient when applied to the agricultural, which Benton characterises as regulative rather than transformative; 'There *is* a transformative moment in these labour processes, but the transformations are brought about by naturally given organic mechanisms, not by the application of human labour. Agriculture, and other 'eco-regulatory' labour-processes thus share an intentional structure which is quite different from that of productive, transformative labour-processes' (Benton 1989: 67).

Marx has thus purportedly reduced labour to a productivist model by conceptualising abstract labour as inherently transformative. The agricultural labour process, according to Benton, consists merely of the maintenance of contextual conditions of organic transformation; a process which itself is exempt from human mediation. This is a highly subjective criticism once the concept of *transformative action* is closer examined. Chapter 1 closed with the suggestion that the hallmark of social order was merely the transitory stability of dissipative structures (itself a highly abstract proposition, operating at multiple scales of natural and social organisation). The complexity model - as yet subject to further elaboration - identified energetic metabolism as a fundamental of all social systems, and the preceding critique of preceding Parsonian systems theory also identified critical shortcomings in stability metrics as a key factor in its rejection by sociology. It is unclear in Benton's account (acknowledging its level of abstraction) by what criteria particular modifications, such as applications of labour in agricultural production, may be judged as transformative.

Benton rightly suggests that agricultural labour processes may be viewed as 'optimising the efficiency of its capture' (1989: 68), but the question of scale - raised in a limited capacity in his paper - introduces further problems. For example, the application of fertilising agents to alter the chemical composition of soil raises the question as to which side of the ontological divide the labourer has operated – has he merely produced a transformation in contextual

conditions or intervened in the realm of natural conditions? As will be shown, multiple strategies existed in nineteenth century Ireland to modify contextual conditions, such as the selective application of fertiliser through ridge cultivation, and modification of the spatial layout of ridges - even entire villages - with respect to relief, to control wind shear and sunlight capture. When questions of scale are introduced, the discussion moves dangerously close to the conceptual redundancy of the 'actant', once such interventions produce alterations with causative capacities beyond their local boundaries – or when systems themselves expand in physical size. Again, Benton is correct to introduce a distinction between technologies of natural limit transcendence and adaptability. This measure, however, still falls short of moving toward a reliable metric of ecosystem health; it incorporates and theorises the role of labour in ecological exchange, but ultimately, does not work toward operationalising a model of socioecological 'stability'. This comment should not be read as a statement of priority – neither abstraction nor empiricism may be ranked on a theoretical hierarchy; both objectives must be pursued simultaneously.

This distinction is reflected further in the literature; certain other contributions have 'mined' Marx's writings extensively either through deep philosophical engagement (such as with Schmidt 1971), or more concretely, as with some recent engagements with newly translated source materials (Parsons 1977, Shanin 1984, Foster 2000, Smith 2007, Anderson 2010). Schmidt's (1971) contribution to the labour process debate is particularly weighty in theoretical terms, and contains a number of insightful comments addressing the mechanicist reduction of materialism to the analysis of discrete moments primarily of the physical world (a process reminiscent of mechanistic-reductionism outlined in chapter 1). Interestingly, Schmidt (1971) problemtises binarist ontology through his discussion of the labour process, by observing how Marx depicts man as simultaneously natural and social (i.e. how man as a natural being must also be comprehended as an 'externality' such as with natural objects). Such a statement makes previously-cited forms of constructivism appear all the more limited; as Schmidt elaborates, labour, either in its abstract form as the determinant of commodity exchange value, or concrete form as the 'material of nature transformed into human form' (Schmidt 1971: 65), is always dependent upon a '...substratum which cannot be reduced to labour alone' (ibid). In essence, the materialist position asserts the pre-existence of a property (i.e. nature) irreducible to categories of either human social organisation or conceptualisation (i.e. labour). Again, it is remarkable to note how succinctly critical realism accounts for this natural category in a non-deterministic manner. Schmidt affirms as much in his summary of the tendencies of humans, and arguably social scientists in particular, to over-determine;

> "As against Engels's assertion that 'the world is not to be comprehended as a complex of ready-made *things*, but as a complex of *processes*', Marx did not make the idea of the dialectical process an abstract alternative to reified consciousness. One cannot, without falling into error, conceive of things in a metaphysically rigid way as finished and unchangeable. Equally however, one cannot dissolve things completely into moments of the social process which mediates them, for this would amount to the same metaphysical error with reversed premises. It is a matter rather of unfolding the concrete dialectic of the immediacy and mediacy of objective being in its appropriate forms" (Schmidt 1971: 67).

An important tension is again revealed in this quotation; that the over-determination of the natural in the social-natural equation obscures underlying configurations of social relations, and, equally, the over-determination of the social renders the analyst incapable of grasping the independent objectivity of the natural category. The labour process thus points in a direction of 'dialectical unfolding' which, it is suggested, is capable of overcoming both tendencies. Daniel Bensaid (2002) has since outlined how this dialectic of the abstract and the particular loomed large in Marx's general interpretation of the project of scientific explication; 'A disconcerting 'science', this science of Marx's. In a breathless quest for the living organism, where conceptual order constantly comes undone in carnal disorder, it continually mingles synchrony and diachrony, the universality of the structure and the singularity of history' (Bensaid 2002: 204).

The materialist critique of reductionism might thus validly be extended to the preceding examples from within sociology, as instances of this quest for fixed general principles of nature and society - whether from the Durkheimian base of the objectivity of the social, or the epistemic base of relativism - both have produced bodies of knowledge respectively un-dialectical. The implications of this 'disconcerting science' are reserved for subsequent chapters where the specific relation of structure to singularity are explored – as with all such niceties of the historical materialist apparatus, it has helpfully become a prolific sub-field in itself. Escaping the confines of conceptual order through abstraction was not unfamiliar to scientific practitioners either; indeed, Niels Bohr long ago suggested abandoning '...the need for intuitive representations with which our language is saturated' (Bensaid 2002: 204). It is again asserted that this, contrary to ANT's self-depiction as a set of principles free of a-priori assumption, provides the means with which to abandon such binarisms. The realm of ideas can no more be prioritised than that of 'natural' particulars.

Most promising of Schmidt's remarks are those which point in the direction of 'metabolism' as a concept expressing the dialectical unity of nature and society. In contemporary usage, the concept of metabolism (in its 'socialised' appropriation) is employed to express the

relationship between forms of social organisation and their ecological consequences (Fischer-Kowalski 1997). According to 'later' Marx (by the publication of *Capital* a 'post-humanist', according to Schmidt), 'labour' constitutes a purposive action which in turn mobilises *latent* forces of nature in the labour process. In contrast to Marx's earlier humanist view of nature as '...a process which coincided with the naturalisation of man' (Schmidt 1971: 76), Marx's metabolic perspective viewed the human-nature relation as something which could not be abolished, but ultimately could alter in form. In the process of metabolic interaction, '...nature is humanized while men are naturalized...its form is in each case historically determined' (Schmidt 1971: 78). This is a crucial (albeit apparently simplistic) observation, but one which offers much to explain and transcend the ontological divisions here encountered. Schmidt continues with a succinct summation of historical materialism's grasp of the nature-society dialectic;

> "The whole of nature is socially mediated and, inversely, society is mediated through nature as a component of total reality. The hidden nature-speculation in Marx characterizes this side of the connection. The different economic formations of society which have succeeded each other historically have been so many modes of nature's self-mediation. Sundered into two parts, man and material to be worked on, nature is always present to itself in this division. Nature attains self-consciousness in men, and amalgamates with itself by virtue of their theoretical-practical activity. Human participation in something alien and external to them appears at first to be something equally alien and external to nature; but in fact proves to be a 'natural condition of human existence', which is itself a part of nature, and it therefore constitutes natures self-movement" (Schmidt 1971: 79).

In this way, materialism reveals how conceptions of nature come to dominate as a consequence of prevailing relations and forces of production – forces which include dominant technologies. This accounts neither for social relations, nor conceptions of nature in a technologically determinist manner, but rather examines the dialectical unity of multiple factors in historical motion; ideas emerge in the context of practical activity, and the production process renders the internalised nature-society interaction invisible in the process of commodity circulation (i.e. a qualitative transformation obscuring social relations underpinning objectified labour and its organisation). In many respects, Benton's commentary on deficiencies in the concept of the labour process has prefigured an important development in Marxian environmental sociology which will be examined further in chapter 5; by drawing attention to the need to address contextual conditions as a non-transformative subject in the agricultural labour process, emphasis is placed on the historically specific dynamics under which such labour operates (i.e. the forms of surplus appropriation internalised within specific modes of production). According to a number of authors, by addressing disruptions in social-ecological metabolism engendered by specific forms of surplus appropriation, Marx offered a means with which to

understand the relationship between such social relations and declining soil fertility, a relation expressed through the concept of 'metabolic rift' (Bellamy Foster 1999; Moore 2000; York 2003; Clauson and Clark 2005; Wittman 2009; McMichael 2010).

It is important that environmental sociology (and arguably social theory in general) acknowledges the inherent flexibility of this materialist approach. Howard Parsons (1977) had previously suggested as much in remarking on its sensitivity to contextual conditions;

> "...The position of Marx and Engels on ecology embraces their position on technology, for they understood man as a natural being in dialectical interpenetration with the rest of nature by means of his perceptions, his reflections, his manipulator practice with tools, machines, and techniques, his consuming, and his enjoyments. As nature and the practice of man reciprocally call out and influence each other, so the concepts pertinent to nature and human techniques - i.e., the sciences of ecology and technology – must be reciprocally advanced" (Parsons 1977: 3).

The 'productivist' debate, unfortunately, appears somewhat ecologically short-sighted in its ambitions, partly as a consequence of its implicit defence of historical materialism as a transformative socialist project (for now, distinct from the 'scientific' justifications of analytical Marxists - i.e. Cohen), and its allusions to ecological ethics (Grundmann 1991). Foster, for example, has consistently rejected the charge of 'Prometheanism' as an anti-modernist proposition rooted in deep green theory, which '...demands nothing less than the rejection of modernity itself' (Foster 2000: 135 cited in Barry 2006: 157). As discussed above, Foster had long before rejected this position on empirical grounds as naive idealism by outlining numerous examples of pre-capitalist (pre-modern) contradictory relations with nature. Others still have attempted to expand debate both within and beyond the niceties of the historical materialist apparatus, such as Adorno's critical materialist (humanist) reading of Marx, Grundmann's (1991) extension of the concept of ecological problems in response to Benton, O' Connors (1996) concept of the second contradiction of capitalism, and Burkett's (2006) engagements with ecological economics. In the context of Parsons' comments above, it is therefore critical that Marxian dogmatism does not inhibit conceptual advancement, nor stunt its sorely needed empirical application; as both he and Schmidt have pointed out, change and motion are the hallmarks of this dialectical unity – approaches to theory must in turn reflect this dynamism.

Neither can excessive naturalism take hold in social-ecological alternatives - the preceding account has emphasised throughout, the inadequacies of both technological determinism and naturalistic reductionism. On this point, Barry's (2007) rendering of the environmental debate,

as with many proponents of the 'Prometheanism' thesis rests on a number of restrictive interpretations; Marx's opposition to 'naturalism' is clearly directed at forms of naturalistic reductionism that fail to account for the role of humanity in the modification of ecological conditions (see Harvey 2010: 198 for comments on Darwin). Such appeals to naturalism drew consistent criticism from Marx – both for their ideological appeal and reductionist methodologies - and his endorsement of the materialist alternative is consistently critical of explanations that fail to proceed from a thorough analysis of *given* relations. In this manner, much subsequent Marxist work on environmental sociology has attempted to bring the consideration of social form to bear on the limitations of naturalism. It is to the field of geography that discussion now turns, in order to examine how this materialist-analytical approach has been applied - under the broad rubric of spatial theory – before offering some concluding comments. Marxist geographers have offered a number of complementary, albeit apparently contradictory contributions to the nature-society debate which must be appropriately considered and integrated with foregoing derivations of the centrality of labour.

2.2.2. Geographies of capital and nature

Social and geographical theories have enjoyed long associations, and much common correspondence throughout their brief formal histories, to the extent that Swyngedouw cites a plethora of mixed-discipline practitioners as a general 'historical-materialist' revival in the social sciences (Swyngedouw 2004a)[56]. The 'cultural turn' may in part be responsible for a broader amenability to intellectual exchange, as arguably the theoretical confines of both disciplines have become considerably more porous since the mid-twentieth century (Johnston and Sidaway 2004)[57]. For scholars of the left, historical materialism has been a mainstay of numerous sociologists since its putative emergence from the works of Marx; geography has since experienced its own drastic paradigmatic shifts in recent decades, within which David Harvey's materialist contributions have proven highly influential – an influence which has extended beyond the boundaries of geography into both cognate disciplines and popular

[56] This 'juxtaposed' mix includes Ted Benton, Noel Castree, Reiner Grundmann, and Neil Smith.

[57] The reader is again directed to Johnston and Sidaway (2004), Chapter 6, *'Radical' Geographies* for an appreciation of the development of this important strand. Acknowledging its complex development and numerous proponents is beyond the scope of this chapter; it is referenced here for posterity, lest the author should misconstrue the broader implications of Harvey's work. It is the opinion of this author that Harvey's work constitutes a most productive avenue for this thesis, yet he is far from the sole instigator of this important theoretical turn.

discourse (Harvey 2011)[58]. In one of his earliest publications, in which he explored applications of Marxism to geographical analysis, Harvey (1973) drew particular attention to the broad compatibility of the 'sociological and geographical imaginations' as a route to both conceptual and methodological advancement. These comments bear further examination, particularly for the historical sociologist of agriculture, who is evidently dealing with both spatial and social processes and their interactions[59].

A theoretical examination of the social-spatial nexus as developed within geography also offers a critical missing link in any dualistic conceptualisation of human ecology; clearly any process of labour – either transformative or eco-regulative – operates within spatial boundaries. However, as geography has long since demonstrated, this does not amount to a simplistic specification of spatial case-study boundaries; world-systems theorists, for example, have shown how localised sites of production are themselves implicated in broader networks of commodity exchange, which in turn structure flows of resources at both local, and trans-national scales (Friedmann 2000). The specific ecological character of any defined spatial area is therefore subject to the influence of social processes which interact dialectically with other elements (i.e. spatial, physical or economic). Consequently, any summary remarks on the natural-social dualism are likely to be severely deficient if they fail to acknowledge the critical dimension of space, and the necessity of abstraction.

To recast Bruce Braun's characterisation, what is forthcoming within Harvey's geography is a '...dialectical method...relational ontology' and an insistence that '...the production of space cannot be thought *independently* from the productions of nature' (Braun 2007: 192). The strength of such a materialist approach is its ability to integrate such multiple determinants within a theoretical model which emphasises relational totality, rather than discrete compartmentalisation. Although some illustrative examples are here offered, emphasis will be less on the ways in which the forthcoming authors have applied their ideas to spatial analysis, but rather on their particular pronouncements on the relationship between nature and society, such as they inform and enrich the tentative perspectives developed toward the end of the preceding section.

[58] The author's reading of Marx's *Capital* has been greatly assisted by the publication of Harvey's *Reading Marx's Capital* course in a series of online lectures (www.davidharvey.org), and the recent publication of a companion volume, *A Companion to Marx's Capital* (Harvey 2010).

[59] Such relations are visibly manifest in pre-capitalist modes of production – i.e. this is not to suggest that questions of space only present in this current research context; as Harvey (1973) – and common sense - points out, all human action is irrevocably bound by the necessities of place. There is however, a 'scale of association' as alluded to by Schmidt (1977) which suggests a more immediate and visible form of natural-social interaction within peasant agriculture.

Harvey's embryonic remarks on the necessity of integrating social and spatial thought arrive initially in the context of a broader analysis of urban development and inequality, conducted under the aegis of a thoroughly Marxian 'mode of production' approach. Harvey's (1973) tome is thus laden with bridging concepts drawn from the Marxian canon. Accordingly, Harvey is concerned with synthesising a perspective which is mindful of the multi-directional influence of both space and social process – each of which are implicated in the analysis of the other (Harvey 1973: 24). Such dialogue would subsequently prove forthcoming in a manner more recognisable to sociologists in the nineteen-eighties, when a number of human geographers seized upon Gidden's structuration theory as a possible avenue toward spatial-social dialogue (see Johnston and Sidaway 2004: 220). For Harvey – a noted critic of Giddens (Harvey 1989: 102), any such configuration of factors was irrevocably relational;

> "Since spaces, times, and places are relationally defined by *processes*, they are contingent upon the attributes of processes that simultaneously define and shape what is customarily referred to as 'environment'. . . [T]he idea that spatio-temporality can be examined independently of those processes evoked in environmental and ecological work cannot be sustained. From this perspective the traditional dichotomies to be found within the geographical tradition between spatial science and environmental issues, between systematic and regional (place - bound) geographies appear totally false precisely because space - time, place, and environment are all embedded in substantial processes whose attributes cannot be examined independently of the diverse spatio-temporalities such processes contain" (Harvey 1996a: 263-264 cited in Braun 2007: 192).

Such a conceptualisation confronts many limitations encountered within chapter 1 concerning the 'compartmentalisation' of analytical issues according to disciplinary boundaries. Although this does not simplify the task for the analyst, it nonetheless points out the summary complexities of any such case study, the fragility of any rigid, binarist conceptualisations of environment or nature as ontologically distinct entities, and the deficiencies of approaches which mount territorial defences of their respective subject matters – often to the defence of one particular aspect of the above-outlined totality (i.e. discursive representations of nature in constructivist accounts). This perspective arguably constitutes the foundation of geographical critical materialism; the metabolic transformation of nature, as both an indespensible human necessity and ontological principle, assumes historically specific forms under which human collectives exploit, and thus transform both nature, space and themselves (Swyngedouw 2004: 130). The process is thus sociophysical; "...the transformation of nature is embedded in a series of social, political, cultural and economic constellations and procedures (i.e., social relations) that operate within a nested articulation of significant, but intrinsically unstable, geographical scales" (Swyngedouw 2004: 130).

Harvey's early foray into Marxism provided numerous such dialectical concepts which in turn were brought to bear on the study of the city in a non-deterministic manner. Traces of this implicit notion of dialectical totality are evident in his discussion of conceptualisations of rent, which initially derives from a close examination of the internalised duality of use and exchange value in Marx's concept of the commodity - Harvey extends this concept by applying it to land as commodity. By examining more closely the academic tendency to dissociate the study of use value from exchange value (and therefore the configurations of social relations implicated in their relation to one another), Harvey articulates a criticism of respective bodies of research which have focused either on spatial configuration alone (i.e. theories of land-use patterning) or market exchange systems (the latter of which has been much implicated in recent engagements between ecology and the social sciences) (Harvey 1973: 160).

In his presentation of theories of rent, Harvey's discussion draws attention to the hidden historical processes underlying manifest rental values, such as the appropriation of land as private property. The particular form of natural-social mediation (rent), operating through the mechanism of the competitive market, therefore demands scrutiny beyond marginalist price allocation; the very existence of the institution of private property points to a set of antecedent historical processes whereby particular relations to nature become reconstituted under the institutions of market and private property. The existence of rent itself presupposes a 'class monopoly over land use', a category which is subject to variation depending on the prevailing mode of production (Harvey 1973: 178). This materialist approach to critique was later pursued by Harvey in *The Condition of Postmodernity* (1989), in which emergent cultural forms and modes of representation are linked to systemic changes in the operation of capitalism in the late twentieth century. The preceding debate might well be analysed in much the same way – chapter 1 has already attempted to sketch something of a material context for the emergence of dominant conceptualisations of science where appropriate (i.e. industrial technology). In short, what Harvey and other such materialist geographers are demonstrating is the situatedness of concrete phenomena within broader configurations of social relations.

It is thus the *absence* of any consideration of such historically-specific configurations of social relations, along with persistent separatisms of use and exchange value considerations which impoverishes the study of land use dynamics – and arguably any such intersection of the social and the natural - according to Harvey. Amidst the historical churn of social change, land is thus variously subject to an 'exchange value vs. use-value' realisation imperative, as the institutions of private property and commoditisation place particular classes of individuals in unequal

relation to one another, and restructure the social and spatial contexts of metabolic exchange. As ever, attempts must be made to move beyond the specifics of this example; Swyngedouw (2004) thus extends and abstracts Harvey's critique within the context of the historical-materialist model by suggesting that a crucial missing dimension in any such natural-social problematic is a consideration of these dialectical relations as an historical process;

> "The world's historical geography can, consequently, be reconstructed from the vantage point of this perpetual socioecological transformation process. These social relations are always constituted through temporal and spatial relations of power with respect to the social and physical ecology that is being transformed. Indeed, these social relations are ''grounded'' in the sense that they regulate (but in highly contested or contestable ways) control over and access to transformed nature (place), but these relations also extend over a certain material/social space" (Swyngedouw 2004: 131).

'Historical variability' is here the key – but this inherent variability need not imply the rejection of meta-categories as alluded to in chapter 1, as endorsed by more relativist or constructivist accounts of nature in this chapter. In Swyngedouw's comments above, 'social and physical ecology' stand in relation to 'temporal and spatial relations of power'. For Swyngedouw – and arguably historical materialism in general - it is the inexorable ecological action of the collective which provides the conditions of power relations – although as observed above, this relationship is ultimately non-linear. Crucially, this characterisation points toward a number of trans-historical categories, or broad institutional regularities evident across all modes of production; metabolism, ecology, labour, spatial relations (the concrete evolutions of which are given substantive treatment by Hobsbawn, 1964), and, according to Elmar Altavar, entropy (cited in Braun 2007). In short, for such a model, in which ontological binarisms collapse within the concept of metabolism, certain abstract, relational properties emerge as relatively stable (i.e. the labour process, and the metabolism of human and nature) – it is the social forms under which such labour operates which as yet require further specification. Questions of historical context and the dynamics of modes of production as a route toward the reconciliation of the natural and the social are thus becoming all the more critical.

Such questions are of immediate relevance to the aims of this chapter, and broader research objectives of this work; what both Harvey and Swyngedouw are demonstrating is that any conceptualisation of nature as external to society becomes immediately problematic, due to its inability to grasp 'humanity's place within nature' (Braun 2007: 194). As Smith (1984) points out in his review of Alfred Schmidt (1977), '...the relation with nature is an historical product, and even to posit nature as external to society...is literally absurd, since the very act of positing

nature requires entering a certain relation *with* nature' (Smith 1984: 18). For both Benton (1989) and Harvey (2010), labour is therefore accorded primacy as a transhistorical necessity which unifies both nature and society in common, immutable metabolism. This appearant compatibility between sociological and geographical interpretations however, belies a perceived deeper incompatibility at the ontological level. Braun again identifies two distinct strands of ecology within Marxism which further underscores such sociological-geographical divisions, specifically; '...those who seek to extend the insights of historical materialism to questions of the environment, and thus understand 'nature' as itself an effect of historical forces (i.e. Harvey, Smith), and those who accept nature's externality and seek to 'renovate' Marxist theories of economic crises so as to take external nature (i.e. natural limits) into account' (Braun 2007: 197)

The roots of this suggested incompatibility may be located within their respective rejections, and reproductions of ontological binarisms of humanity and nature. The problem with Benton's eco-Marxism, according to Braun's reading of David Harvey and Neil Smith, is that it reproduces natural-social binarisms by positing nature as external through the concept of 'natural limits'. Such a perspective is ultimately problematic for Harvey and Smith as it reproduces an '...'Aristotelian' ontology of fixed forms...', a problem which requires '...a fully fledged historical-geographical materialism in which all things were understood in terms of their emergent properties, and in which nature was seen to be produced through specific material practices' (Braun 2007: 199-200). Consequently, Benton and others are accused of reproducing ontological binarism by identifying 'natural limits' as an externality apart from society.

Conversely, the 'production of nature' thesis, which finds its most developed expression in the works of Neil Smith, argues that such separatisms are logically untenable. Traces of this 'production of nature', according to Castree (2001), are immediately evident today in recent developments in genetic engineering and mapping, to the extent that such endeavours constitute an almost 'second nature', distinct from the 'first nature' of evolutionary succession. The possibility that nature could be conceived of as non-social (as certain aforementioned strains of eco-Marxism are accused) is therefore untenable once viewed in the context of capitalist development; '...It is capitalism which ardently defies the inherited separation of nature and society, and with pride rather than shame' (Smith 1984: xiv). It is the context, and reference point of capitalism in these arguments however, that simultaneously points out both a shortcoming, and benefit within this debate for this research.

Firstly, it is important to distinguish the 'production of nature' thesis from constructivist accounts of the social production of *conceptions* of nature. Smith's account proceeds with an acceptance of the centrality of the labour process, which implicates society and nature as '...an *internal* relation within a larger unity' (Braun 2007: 200). It appears another paradox has been reached however; the anthropocentrism of the 'production of nature' thesis may reasonably be accused of reproducing ontological binarisms itself by positing labour as the essential unit to which all else is subject; yet on the other hand, Marxist geographers such as Smith and Harvey cite this co-implication as precisely the required unifying alternative[60]. Engaging this line of thought - although much debated within the literature - ultimately amounts to theoretical hair-splitting[61]. There is much nuance within Smith's original work however, which contains a number of insightful remarks on existing interpretations of Marx on nature. Marx, according to Schmidt (as considered in Smith 1984), collapses Hegel's distinction between first and second nature by placing the latter within the boundaries of natural history. It is this which allows Schmidt to identify metabolism as the grounding concept which Marx uses to express the mediation of nature through society and society through nature. In terms of post-Enlightenment philosophy, it was not the concept of metabolism itself which was unique, but rather the identification of the '...labour process as the motive force of this metabolic interaction' (Smith 1984: 19) which was to prove revolutionary, providing as it did a materialist typology of successive modes of production.

Secondly, although this thesis holds up within the context of capitalism when examining technological manipulation, its utility for theorising pre-capitalist relations is less certain; it is here perhaps that the most critical question for the objectives of this work presents. The production of nature thesis deals well with interpreting progressive developments under accumulation imperatives (i.e. capitalist) which '...materially produce that which seemed beyond the power of humanity to alter: nature' (Castree 2001: 200). The dominant conclusion from the aforementioned authors (Smith 1984, Castree 2001, Braun 2007) is that the specific dynamics of capitalist accumulation are implicated in the modification of natural entities, to the

[60] This is politically important when certain conceptions of nature manifest implicitly in public policy or collective action.

[61] The 'anthropocentrism' of the production of nature thesis is interpreted by Castree (2001) as reproducing a promethean-productivist bias by failing to recognize nature as an object of intrinsic worth irrespective of human intentionality. Furthermore, Smith (1984) points out variability in Marx's conceptualisation of nature – which speaks to a point placed earlier in this chapter concerning restrictive characterizations. According to Smith, Marx depicts nature and society as intimately bound in his earlier work to, where he claims '…virtually no nature existed anymore which predated human history' (i.e. his 'materialization' of Hegel's notion of history as bound to dominant mental conceptions). Smith states that this concept fades somewhat with Marx's later works, within which conceptual dualisms begin to appear – where nature figures in the labour process as an object of labour (Smith 1984: 17).

extent that such a process constitutes a 'second nature'. It presumably remains for the researcher to explicate how such 'productions of nature' may have manifested under precapitalist forms, but this would appear to violate the implicit role of a particular concept of formal, capitalist-aligned, modern 'science' in the production of nature account.

Swyngedouw offers a resolution by pitching this thesis at a somewhat more abstract level, demonstrating the utility of a more 'micro-scale' conceptualisation of space as produced nature;

> "Everyday life is necessarily "placed" or "situated" by virtue of the need to transform and metabolize (produced) nature. The material and social conditioning of life and of the metabolic transformation of nature is constituted in and through temporal/spatial social relations that operate over a certain scalar extent. Engaging place as ''produced'' nature is essential for human existence" (Swyngedouw 2004a: 131).

For Swyngedouw, this perspective ultimately involves borrowing from Joseph Schumpeter the concept of 'creative destruction', whereby metabolic interaction necessarily modifies space to the production of new natures. Crucially, the spatial situatedness of such inherently social processes permits the manifestation within of relations of governance – or what Massey refers to as a '...geometry of power' (Massey 1993 cited in Swyngedouw 2004a: 131). Swyngedouw (2004b) as with Smith (1984) is thus jointly critical of any conceptualisation of nature removed from that of human intentionality (i.e. a 'first nature'). What is being advanced here is a potent argument against determinism, with a refusal to view space, in the classical Euclidian sense, as determined by 'prime movers'; the very concept of metabolism itself implicates multiple processes in the production of both space and nature. It is surely this recognition which leads Swyngedouw to comment; '...starting analysis from a given geographical scale seems to me, therefore, to be deeply antagonistic to apprehending the world in a dynamics, process-based manner' (Swyngedouw 2004a: 131-132). As with the excesses of structuralism and linear causality in chapter 1, so too are reductionist models which conflate the complexities of the multi-scalar nature of human environments to be criticised.

2.3. 'Historical specificity' as a route toward a systemic analytical framework

As yet, the preceding discussion of the nature-society debate remains at too high a level of philosophical abstraction. There are however, traces of a common compatibility across all aforementioned contributions at this level which point tentatively in the direction of a suitable methodological frame. Having identified the labour process as an abstract, trans-historical category, Schmidt elaborates how its concrete form is subject to historical change (Smith 1984:

21). This move toward a more concrete conceptualisation, paralleled in a distinction between 'earlier' and 'later' Marx, is signalled by his identification of the historical variability of relations to nature under certain conditions of production; 'Marx's statement that man is as yoked to his natural existence as to his body is not applied here to the labour-process in general, but only to its pre-bourgeois forms' (Schmidt 1977: 81). Under conditions of capitalism, the role of labourer as an 'accidental property of the material earth' is eliminated, and he therefore enters a 'real relationship with production' (Schmidt 1977: 82). Accordingly, Schmidt identifies two significant dialectics of nature, in which natural-social relations are expressed in their appropriate materialist terms;

> "As long as nature is appropriated through agriculture and is therefore absolutely independent of men, men are abstractly identical with nature. They lapse, so to speak, into natural existence. However, where men succeed in universally mastering nature technically, economically and scientifically by transforming it into a world of machines, nature congeals into an abstract in-itself external to men" (Schmidt 1977: 82).

The perceived paradox of the conflation of 'second' nature into 'first' appears here to be resolved; Schmidt is not identifying respective ontologies corresponding to particular historical epochs, but rather expressing the possible variability of natural-social relations as a consequence of objective conditions of labour. The ontology of humanity-nature as totality is thus intact, but, crucially, the opportunity appears for the introduction of historical variability in the social form. The relation between history and our very human physiology (Schmidt 1977: 84) is thus captured; 'Hunger is hunger. But the hunger which is satisfied with cooked meat eaten with knife and fork is another hunger than that which swallows raw meat with the aid of hands, nails and teeth. The mode of production produces, both objectively and subjectively, not only the object consumed but also the manner of its consumption' (Marx 1979 [1859]: 279).

Mindful of the need for a dialectical conception, Braun points out the inherent Malthusian dangers of collapsing humanity completely into the category of nature, thereby 'naturalising' dominant political systems and structures of inequality; '...the solution was not to fall back into the old dichotomy but to understand nature as a 'unity' that included human labour' (Braun 2007: 195). What is in question here is not the political deployment of concepts of nature, but rather the concepts and arguments employed by these aforementioned authors (i.e. Harvey, Swyngedouw and Smith) to demonstrate further how nature and society are related, and how such relations are inextricably bound with underlying social dynamics, as Marx alludes to in the above comment. Benton (1996) has already suggested some degree of analytical separatism is required for this task, as his critique has argued that Marx had perhaps over-emphasised the

transformative capacities of the labour process (Benton 1996: 166). This again offers a potent argument for historical specificity, and ironically brings it into close dialogue with the production of nature thesis, which asserts that it is precisely the historical form of developed capitalism which permits the production of alternative natures. The conclusion must therefore be forwarded, that the historical-materialist possibility of typology presents itself as the most potentially productive avenue of enquiry;

> "...the re-conceptualizations of labour-processes which I am advocating permit and explicit recognition of the ways in which naturally given processes, mechanisms and conditions make possible human need-meeting practices which otherwise could not occur. But in any realist or materialist approach, enabling conditions must be understood as simply the obverse side of the coin from limits or constraints. A power conferred on human agents by a specific social relation to a natural condition or mechanism, will also be bounded in its scope by that same self-relation" (Benton 1989: 78).

Again, there appears to be an emergent compatibility between this perspective, in which natural limits are viewed as historically variable and as a function of contextual social dynamics. This comes quite close to Braun's characterisation of David Harvey's relational ontology;

> "Marx's dialectical materialism, Harvey claimed, refused to understand things – 'resources', or even 'needs' – independently of the relations that constituted them. Resources had to be defined relationally, in terms of a mode of production or a social formation that continuously 'produced' them through the physical, mental and technological activities of people: 'There is, therefore, no such thing as a resource in abstract or a resource which exists as a "thing in itself"' (1974d: 168). For Harvey, what counted as a resource at any given moment, and the limits of such a resource, was something determined by the totality of the relations in which resources were materially and discursively constituted" (Braun 2007: 196-197).

The preceding, albeit highly abstract review of complexity theory, Prigogine's interpretation of thermodynamics, and the previous chapters 'derivation' of the trans-historicity of metabolic exchange vis-a-vis the labour process, have shown how intimately bound the natural and the social are. To analytically grasp their interrelation, therefore, is to acknowledge the intransigence of entropy, and that our capacities to forestall ecological degradation – either through transformative or eco-regulative labour – are bound up within, or constrained by historically-specific relations of production. Benton continues;

> "A second possible avenue for further theoretical work would be to reconceptualize the Marxian typology of modes of production, as articulated combinations of forces and relations of production. This would entail, *in each case*, not only specifying the social-relational aspects of each mode and the intentional structure of the labour process (in Marx's terms, the characteristic forces and relations of each mode), but also *complementing* this with a non-intentional characterization of the contextual sustaining

> conditions and liability to generate naturally-mediated unintended consequences. Each mode would, in other words, be thought of as instantiating a specific form of nature/society interaction, and as having its own distinctive ecological 'niche'. Each mode must be conceptualized in terms of its own peculiar limits and boundaries, and its own associated liabilities to generate environmental crises and environmentally related patterns of social conflict" (Benton 1996: 175).

There is clearly a fundamental compatibility evident across all such comments; Swyngedouw (2004a, 2004b) merges relativist notions of hybridity with the explanatory regularity of materialism, David Harvey and Neil Smith collapse ontological separatisms within the apparatus of capitalist development, and Benton has here demonstrated how the specification of particular configurations of 'limits and boundaries' provides a systematic, comparative means to join history, metabolism, human physiology and nature. Undoubtedly, as many of these authors have shown, the conflation of epistemology with ontology in political discourse has the potential to wreak damaging effects from its Malthusian extremes, to the ignorance of crucial factors of ecological variability such as, for example, local knowledges or indigenous property rights. The potential for damaging applications or errors of reasoning however, are hardly a default function of such a move – as Tony Smith (1993) discusses, such movement had been a mainstay of Marx's mode of reasoning for quite some time; responsibility for conflation or reductionism thus rests with the practitioner or appropriator. There hardly seems anything particularly damaging with *analytically* compartmentalising the natural and the social, as long as both are reassembled in the process of exposition. Although this sounds quite close to a variant of ANT co-constructive assemblage, the above has surely suggested that a more productive methodology presents by retaining elements of regularity both in terms of trans-historical categories, and of concrete relations.

Recent work, which has seized upon the centrality of metabolism in Marx's analyses (Foster 1999, 2000; Clauson and Clark 2005; Clauson 2007; Foster and Burkett 2008, Slater and Flaherty 2010a, 2010b), has surely revealed a semantic error in Smiths presentation; Smith (reading from Schmidt 1977) typifies metabolism as a 'logico-epistemological category', separate from historically contingent economic categories (Smith 1984: 21). Yet surely its successful operationalisation by the above authors demands that debate move beyond merely the ontological toward application; it has here been argued that this is precisely what is forthcoming in Benton's work (1989, 1996), implicit in Harvey (Harvey 1973, 1996; Braun 2007), and implemented with much effect by Swyngedouw (2004b). Perhaps the true 'analytical' Marxism is not the classical disregard of dialectics, but rather one based on recognition that successful analytical generalisations and empirical enrichment may be generated through transhistorical abstraction.

Daniel Bensaid's (2002) incisive commentary reveals the true contradictions of previous forms of 'analytical' Marxism, and in the process, suggests a path toward an alternative 'formalisation' of the project of systemic social science. A number of mainstream sociologists have offered some analogical acknowledgment of Marx's grappling with complexity (see Urry 2005a), but Bensaid reveals a considerably more complex compatibility of epistemologies than Urry, who merely suggests that Marx's derivation of the abstract category of capital marks him as a classical emergentist. Indeed, far from imposing such quintessentially postmodernist epistemologies upon Marx's corpus, Bensaid instead reveals an implicit 'complexity' mode of reasoning through a discussion of Marx's comments on the nature of science itself, and through an examination of the logical structure of his works. As remarked above, it is surely the process of pushing concepts closer to analytical utility that constitutes a viable 'analytical' Marxism; the rejection of such a dialectical approach surely results merely in the conflation of epistemology with ontology – through a failure to acknowledge both the need for particular methodological separations, and the necessity of structural models (i.e. 'testable' in the analytical Marxist language) as a heuristic to marshall complex, and ever-expanding data.

There is an inherent risk when attempting to extract specific conclusions and interpretations from so immense a body of writing; as Parson's (1971) work has demonstrated, there exists a wealth of quotations, asides and comments, any combination of which might appear contradictory, but perhaps make better sense in the context of their original pieces of writing. Consequently, despite the back-and-forthing of exchanges such as the productivist debate of the nineties, and the current metabolic rift debate, it becomes possible to contradict particular statements with ease (Grundmann's (1991) and Foster's (1995) responses to Benton serve as such example). The fortunate side-effect of the scale of this body of work (and its inherent nature as a theoretical apparatus) however, is that it becomes possible to extract a number of explanatory generalisations with some degree of consensus – presumably this would allow such theoretical models to be populated with case-study data, in the dialectical fashion touted on numerous occasions by David Harvey. That this is not the key mode of debate highlights another deficiency within Marxism in general; such debates have tended to remain at a high level of abstraction, with their theoretical pronouncements seldom operationalised (or arguably in a lesser proportion to other sociological sub-disciplines). Promisingly, as was briefly mentioned, recent developments in 'metabolic rift' have seen numerous empirical applications which have yielded substantial practical gains (Clauson and Clark 2005, Clauson 2007, Jorgenson and Rice 2007, Martinez-Alier 2007).

The latter portion of this chapter has emphasised Marxist materialism in particular as a route around the normative impasse of current sociology; this discussion thus arrives at the cusp of another important theoretical development in the Marxian vein which serves to bridge the general framework outlined toward the end of chapter 1 – that of metabolic rift. The preceding (and largely theoretical) discussion of the materialist centrality of labour in this chapter has derived a number of 'first principles' with which to criticise both excessive abstraction and empiricism, but this will only take us so far. This critique is materialist in that it asserts the theoretical primacy of the *specific* forms of natural engagement in any discussion of human ecology, but it is highly abstract. What it has shown, crucially, is that the construction of investigative frameworks cannot begin in the realm of ideas (i.e. by studying dominant modes of representation embodied in discourse), nor by isolating a single factor as determinant; forms of social order are undeniably a product of the complexities of our manifold relations to nature. This theme is taken up further in chapters 4 and 5, where this concept is expanded to produce typologies of social forms corresponding to forms of surplus appropriation and relations of production (i.e. modes of production).

At this point of conclusion, it is clear that 'Prometheanism' is clearly the wrong debate; Marx was already aware of how capitalist modernisation had modified stressors and natural limits, in turn impacting both on the nature and rate of resource depletion. At a more abstract level, the general propositions are now in place to allow such social-ecological dynamics to be conceptualised as totality. There are 'laws' of nature, just as there are trans-historical 'constants' of social order, each of which is implicated at all historical moments of collective human life. World-systems theorists have already suggested looking to factors and institutions external to specific bounded social systems to understand completely the complexities of trans-national influence (Moore 2000, 2001, 2003a, 2008, 2011)[62]. This is a most useful illustrative project but ultimately falls short of providing a workable metric of ecological integrity, and of an approach which grasps the general character of ecological instability engendered by various modes of surplus appropriation (i.e. it does not provide a means with which to quantify variance in ecological consequence). Swyngedouw (2010) expressing much scepticism in 'absolute' measures of quality however, by stating '...that there are a range of different natures, relations and environments that are subject to continuous, occasionally dramatic or catastrophic, and rarely, if ever, fully predictable changes and transformation' (Swyngedouw 2010: 303). Swyngedouw further emphasises how the inherent relationality of such social-

[62] Ireland offers a classic example of a case sorely in need of such a framework of complexity (see O' Hearn 2005 for a discussion of the complexities of the Irish economic development). Indeed, O' Hearn's discussion of sub-optimal lock in and path dependency appears to suggest a complexity perspective is required, rather than post-hoc conceptual labelling as discussed in chapter 1.

ecological totalities render any attempts at reductionism to a singular concept of ‘nature’ invalid (i.e. reduction to an unqualified state of ‘complexity’ (ibid: 303)).

Before advancing further into Marx’s conceptual frameworks, consideration must be given to contributions from the ‘concrete’ side of research practice in order to better understand both the general principles of current human ecology, and the significant conceptual and empirical gains yielded through applied systemic human ecology. The basic conceptual components which permit an introduction of commonalities of structure and process into analysis have here been developed (i.e. historical variants of metabolic interaction vis-a-vis the labour process), ones which avoid excessive structuralism, or various forms of reductionism outlined previously in this chapter. What must first be attempted in chapter 3, before proceeding to articulate a typology of historical specificity, is to analytically ‘compartmentalise’ the natural and the social in preparation for their reassembly, and to explore the possibility of a means of representing hierarchical complexity, and of quantifying systemic movement, integrity and change. Having established the centrality of labour in such any historical typology of natural-social relations, and examined the possibility of addressing variation in metabolic ‘function’ as a consequence of such, consideration must be given to the persistent question of implementing an empirically grounded, yet simultaneously non-normative metric of ecosystem health.

3

Ecological resilience as middle-range heuristic

Although a general epistemological template of social-ecological systemic constitution has been advanced in chapter 1, a chief limitation thus far is that discussion has remained at an inadequately high level of abstraction. Complexity theory, in the context of its largely metaphorical adoption within the social sciences, has proven difficult to operationalise alone; this chapter introduces an approach developed in close dialogue with developments and debates in complexity within a multidisciplinary field loosely identified as 'human ecology'. Under the rubric of 'resilience ecology', various researchers have attempted to operationalise the explanatory potential of complexity by developing a number of applicable heuristics for the analysis of combined social-ecological systems. Given that chapter 2 has now provided a necessary sensitivity to the implications of such separatisms and combinations, this discussion begin by providing a brief historical outline of the development of human ecology from its origins in early twentieth-century systems-theory debates, to more recent applications in energetic reductionism which have attempted to grasp both ecological and social dynamics within a common metric of energetic efficiency.

Having established an historical and conceptual context to contemporary human ecology, a number of key ecological principles are outlined, including a closer examination of the laws of thermodynamics, trophic interactions, and nutrient cycling. In doing so, a working vocabularly and context is established for further discussions of cross-disciplinary applications of resilience ecology, and subsequent empirical discussions of ecological functionality within the chapters of part 2. As an approach sensitive both to the complexities of social-ecological interrelation, and the inherent epistemological difficulties of representing such complex system dynamics, the concept of 'panarchy' is discussed, as a sister heuristic of resilience, which offers a welcome corrective to previous depictions of systems as linear hierarchies. This chapter concludes by suggesting that despite a number of outstanding limitations in its treatment of the social, the heuristics of resilience ecology offer a number of powerful, non-reductionist devices with which to assess social-ecological system function in a non-normative manner.

3.1. *Human ecology* as theory of the middle range

Situating human ecology as a distinct sub-discipline is decidedly problematic, due to its resilience to formalisation, and the diversity of its informants[63]. Furthermore, selecting and reviewing appropriate theories for the explanation of human-environment interaction is no straightforward task. Recent decades have seen significant expansions in cross-disciplinary literature under the broad rubric of 'human ecology', within which authors of diverse disciplinary origins have offered both empirical and theoretical contributions. Within these contributions, population and household composition often feature as key independent variables in both theoretical and statistical models of land use outcomes and resource consumption (Fratkin and Johnson 1990, Johnson 1990, Sick 1998, VanWey, Ostrom & Meretsky 2005). Comparable historical literature exists for the study of trends in Irish household structure and demography, although this is less often mapped onto broader theoretical debates in human ecology (Connell 1962, Carney 1980, Mokyr and O' Grada 1984, O' Neill 1984, Gray 2006). This diverse collective of existing approaches to modeling in contemporary human ecology may be further divided between those emphasising unidirectional relations between independent population variables and resource consumption outcomes, and those in which the agency of actors is asserted (VanWey et al 2005). Such a broad division mirrors that of the structure-agency problematic outlined in chapter 1, by which practitioners of human ecology may themselves be compartmentalised into either 'determinists' or 'agentists' – with the latter emphasising the reflexive capacity of humans to modify the circumstances of their ecological interaction, rather than viewing such actors as merely subject to macro-structural influence. There are identifiable disciplinary and methodological cleavages evident within this division also; the former tending to work within quantitative methodologies as with economics and demography, the latter within qualitative, such as anthropology and sociology - although agent-based simulation models, as mentioned in chapter 1, have attempted to bridge this divide from the quantitative side[64].

[63] Steiner and Nauser (1993) in their introduction to *Human Ecology: Fragments of Anti-Fragmentary Views of the World* provide a useful review of the various disciplines implicated in this mix; fragmentation is viewed as a necessary consequence of both the complexities of human-environmental relations and disciplinary specialisation (1993: 6). Its relative coherence is reflected in the establishment of the *Society for Human Ecology*, and various conferences such as the *International Conference on Human Ecology*.

[64] See Grimm and Calabrese 2011; Deffuant and Gilbert 2011

In 1935, Arthur Tansley articulated a definition of ecosystem as '...a biotic community or assemblage and its associated physical environment in a specific place' (Pickett and Cadenasso 2002), - a bounded system composed of biotic and abiotic components[65]. Conceptualised as a 'system', the concept thus oriented researchers to the study of interactions between both sets of components. Interestingly, Tansley's initial conceptualisation specified the inclusion of '...humans and human-generated processes and structures' in such ecosystem studies (ibid). In the context of twentieth century disciplinary specialisation as discussed in chapter 1, it would be some time before this unified objective found formal expression in academic practice. Costanza et al (1997) identify the emergence of dialogue between ecology and economics as appearing first in the 1980's, resulting of a common discontent with measures of economic growth which ignored rates of natural capital depletion. Although Tansley is often identified as the 'founding father' of ecology as a distinct sub-discipline, a number of pronouncements appeared some years previous mooting the possibilities of an integrated human-environmental science. Writing in 1923, Harlan Barrows singled out geography as the most likely candidate for the mantle of human ecology, amidst a sustained call for the 'humanization' of geographical research, which he claimed required a shift '...from the extreme physical side toward the human side, until geographers in increasing numbers define their subject as dealing solely with the mutual relations between man and his environment' (Barrows 1923: 3).

Whilst geography subsequently struggled with the early influence of the environmental determinist paradigm, and practitioners increasingly compartmentalised their disciplinary turf, it was 1972 before the editors of the first edition of human ecology would offer a coherent forum for such dialogue, suggesting '...professionals must stimulate greater understanding among their colleagues in such diverse fields as urban planning, psychology, geography, zoology, sociology, and anthropology' (editors of *Human Ecology* 1971: 1). By 2005, the sub-discipline of ecological economics had formalised to the point that Common and Stagl's (2005) introductory textbook *Ecological Economics*, suggested that the growing magnitude of human interaction with the environment over the past three centuries imposed upon the social sciences an immediate need to grapple with questions of the relationship between economy and ecology, relations which were rapidly producing profound trans-local consequences. The formality and

[65] The history of 'ecology' itself is decidedly more complex (see Schwarz and Jax 2011b). Although originating in 1866 in Ernst Haeckel's *Generelle Morphologie der Organismen*, the term did not pass into common usage until some twenty years later. This apparent lag reflects the purpose of its initial specification; Haeckel intended it merely to define a sub-field of zoology which as yet lacked a formal title. The concept, and its practice, thus experienced a period of formalization throughout the development of systems theory and the environmental movement; '…in the 1960's the concept broadened and ecology came to be described as a "super-science". "Ecology" in this sense served to blur the boundaries between scientific, philosophical and political knowledge, and at the methodological level there was a merging of facts and values, the epistemic and the social' (Schwarz and Jax 2011b: 147) See also Bergandi (2011: 36) for remarks on its early development.

depth of this publication (Common and Stagl 2005) suggests that a stable consensual basis of theory and method exists, at least within economics.

Throughout the intervening years since the publication of *Human Ecology*, there appeared the journal of ecological economics (Costanza 1989), works in the analysis of common-pool resource governance (Ostrom 1990, Ostrom, Gardner and Walker 2006) and volumes critically examining the theoretical foundations of ecology itself (Schwarz and Jax 2011a, 2011b). Throughout its development, the body of work here loosely circumscribed as *Human Ecology* has advanced many conceptual models which attempt to relate specific human-mediated contextual variables to objective resource consumption and organisation measures; an abstract commonality amongst its practitioners may therefore be identified at the level of theory.

Theories developed within human ecology and ecological economics may be roughly distinguished from those reviewed in chapters 1 and 2 due to the nature of the former as theories of the *middle range* - propositions which are generally more amenable to empirical testing than their more abstract counterparts. Such a distinction, as articulated within sociology, is often traced to Robert Merton, a contemporary and student of Talcott Parsons' whose work is often characterised as an attempt to push Parson's systemic abstractions toward empirical application. Consequently, Merton distinguished between theories of a high degree of abstraction, and those of the middle range whose propositions more readily point toward study parameters, causal mechanisms, and relevant variables; middle range theory is thus '....one of those theories...which consolidate otherwise segregated hypotheses and empirical regularities' (Merton 1957: 280 cited in Boudon 1991: 520). Its utility is best grasped through Boudon's 'negative' definition; '...it is hopeless and quixotic to try to determine the overarching independent variable that would operate in all social processes, or to determine the *essential* feature of the social structure, or to find out the two, three or four couples of concepts (e.g., *Gesselschaft/Gemeinschaft*) that would be sufficient to analyze all social phenomena' (Boudon 1991: 519). Such theories tend to be associated methodologically with a logical model of deductivism (often erroneously conflated with a positivist epistemology by critics), whereby initial predictions are populated with data from theory-derived metrics, in a process of falsification-validation. Middle-range theories are devices which attempt to marshall empirical generalities in a non-empiricist manner, whilst extracting statements sufficiently broad to permit further application and testing in other contexts.

This chapter thus represents a further stage in a progressive descent of levels of abstraction; as a review of a particular strain of the natural-social project, it may be distinguished from the

systems theory debates of the early-mid twentieth century examined in chapter 1 by recognising the former as pitched at a comparatively higher level of abstraction, with sporadic and rare empirical testing. Human ecology and ecological economics are, in contrast, markedly empirically oriented. Further commonalities and amenabilities to theoretical exchange between ecology and the social sciences are elaborated by Schwarz (2011a) who observes that unlike physics, which he claims may be reduced to a common language and set of pure concepts, ecology is inherently resistant to such formalisation due to the inherent localism of its conceptual application. As well as priming the social sciences and ecology for mutual exchange, this recognition also highlights the futility of dichotomies of ontology typically brought to bear on certain strains of social science methodology, which tend to gloss over the heterogeneity of scientific practice and epistemology. At the very least, it identifies a common debate of conflicting 'base assumptions' set against an earlier search for a unified theoretical model, a project which remains unresolved for both sociology and ecology, but which reveals a fascinating point of common origin as discussed in chapter 1.

Examining certain practical applications of studies in human ecology develops this point somewhat, and introduces further dialogue between the reviews of ontologies of nature and society examined in the previous chapter. Various authors draw attention to the immediate applicability of human ecology to policy analysis and formulation (Ostrom 1990, Common and Stagl 2005, Moran and Ostrom 2005), and the question which has arguably dominated research since the initial forewarnings of the Club of Rome (Meadows et al 1974) has been the ability of policies or regulatory frameworks to maintain long-term human sustainability, or to appropriately balance the Malthusian equation – analyses which are typically pitched in terms of population levels or economic growth confronting external limits to expansion or propagation, within which an analytical separation of 'natural' from 'social' variables is typically forwarded. Consequently, some form of 'modernist' hierarchy of outcomes is typically suggested which permits the analyst to distinguish 'sustainable' configurations of contextual factors from 'unsustainable'. Such a basic tenet is at the core of all of the forthcoming bodies of work; whether their methods remain within paradigms of neoclassical economics, or leftist political ecology; an abstract common concern with the possibility of sustainability motivates their research efforts (Ostrom 1990, Costanza et al 1997: 82, Costanza et al 2001b: 5, Gowdy 2011).

Swyngedouw, however, is sceptical that any definitive sustainability metrics are possible in light of the inherent plasticity of the concept of nature itself (Swyngedouw 2010)[66]. Depicting the concept of sustainability as an 'empty signifier', Swyngedouw discusses how it is invoked to render invisible social conflicts and exploitative capitalistic relations interwoven with ecological degradation;

> "While it is impossible to specify what exactly sustainability is all about (except in the most general or generic of terms), this void of meaning is captured by a multiplying series of fantasies, of stories and imaginations that try to bridge the constitutive gap between the indeterminacies of natures on the one hand (and the associated fear of the continuous return of the Real of nature in the guise of ecological disasters like droughts, hurricanes, floods etc...) and the always frustrated desire for some sort of harmonious and equitable socio-ecological living on the other, one that disavows the absence of a foundation for the social in a Nature that, after all, does not exist" (Swyngedouw 2010: 310).

Swyngedouw's discussion is a potent call for an examination of both the social basis and heterogeneity of 'nature', and a critical glance at its fetishized deployment in public policymaking discourse. The problem, according to Swyngedouw, is that scientific practice, intimately bound as it is with policymaking, privileges solutions that operate according to the market imperative – this will prove most important when consideration later turns toward the base assumptions of ecological economics. Swyngedouw may, however, have exaggerated the apparent restrictive consensus of agreed-upon definitions of sustainability; numerous authors have identified it as problematic, and drawn attention to similar issues of complexity and scale alluded to by Swyngedouw and others (Swyngedouw 2004 - see also contributors to Sheppard and McMaster 2004). Schwarz (2011) offers a useful perspective on such rejections, and suggests a contextualised, measured approach is perhaps preferable to wholesale rejection; '...a concept brings together the diverse array of historical experience and a summation of theoretical and practical factual references in a context which is only given and can only be truly experienced as such by means of the concept...each concept sets certain horizons as well as certain limits to possible experience and conceivable theory' (Schwarz 2011: 25). This is worth bearing in mind; aside from criticisms which may reasonably be levelled against certain strains which emphasise the importance of market-based mechanisms of eco-regulation (Mol 1997), there is a demonstrable cumulative-empirical basis of many of the forthcoming concepts and measures, such that any rejection of their analytical potential on purely political or ideological grounds is questionable.

[66] According to Rigby and Cáceres' audit, there exists '...at least 386 definitions of sustainable development' (2008: 34).

Of the tradition which Swyngedouw singles out for blame, Costanza et al (2001b) devote specific attention to a critical examination of the concept of sustainability which they define as '...the persistence of the integrity and structure of any system over time' (Costanza et al 2001b: 5). In recognition of critics of sustainability, the authors acknowledge that questions of scale and predictability often render precise definitions of sustainability problematic. In a publication some four years previous, Costanza et al (1997) drew specific attention to the question of measures of ecosystem health, many of which they claim have proven 'amazingly ineffective' (Costanza et al 1997: 82). Similarly, Ostrom et al (2006), and Van Wey et al (2005) point out that simplistic models relating a limited number of variables to variability in land use have often proven readily falsifiable[67]. As Costanza et al (2001a) discuss, the problem of predictability - as a function of ecosystem complexity - renders estimations of ecosystem health very much a post-hoc exercise: outcomes may only be judged as 'sustainable' if a particular system is deemed to have survived within appropriate parameters for a specified amount of time. Human factors render this predictability more problematic still, as human-natural interactions often produce delayed feedback responses - i.e. adjustments for a particular growing season may take some time before reductions in yield or fertility present (Costanza et al 2001a).

This does not, however, preclude the need to derive cumulative insights from multiple case studies, and the authors cite a plethora of literature which has identified sustainably exploited and managed ecosystems (Ostrom 1990, Bromley et al 1992, Lam 1998 cited in Costanza et al 2001b: 6), cases which have formed the basis of powerful theories and concepts bridging both social and ecological factors. As Foster (1994) has identified various examples of unsustainable pre-capitalist socioecological systems, so too does Ostrom (1990) identify numerous contemporary examples of resource governance in which stakeholders have devised regulatory institutions to sustainably manage common-pool resources[68]. Accordingly, Ostrom points out numerous examples such as the Turkish Alanya fishery (1990: 19) and the communal tenure systems of the Swiss Torbel peasants (1990: 61), as instances of management systems which

[67] Van Wey et al (2005) single out the IPAT model, which serves as a useful illustration of deterministic modeling strategies. It is worth illustrating, as an analogical form of this model has been much utilized in previous studies of Irish communal farming (Whelan 1995, 1999). In this model, '…population in one form or another plays the role of the villain' (Commoner 1972 and Ehrlich and Ehrlich 1991 cited in Van Wey et al 2005: 26), and takes the form ($I = P*A*T$), where I = impact on environment, P = population, A = affluence (consumption, per capita GDP, level of living) and T = technologies employed. Many of these variables have been encountered previously in chapter 1 in Miller's *Living Systems Theory*, and Bailey's *Social Entropy Theory*, neither of which suggest appropriate metrics.

[68] It may, for now, be worth adopting the loose definition of sustainability employed by Costanza et al; 'A sustainable system is a renewable system that survives for some specified (non-infinite) time' (Costanza et al 2001: 6).

apparently resolve the classical common-pool resource dilemmas of exclusion (difficulties of excluding individuals from benefitting), and subtractability (resources consumed by one individual not available for another, as opposed to relatively 'constant' commons such as wind) (Ostrom et al 2006: 6).

What counts in the assessment of various land use models therefore, is their ability to manage questions of scale. The literature is emphatic on the pitfalls of scale mismatches in devising appropriate policy initiatives, whereby solutions, or policy remedies deemed effective at local levels, prove ineffective at community, national or transnational levels (Ostrom 1990; Costanza et al 1997; Costanza et al 2001a; Van Wey et al 2005). Such issues were previously identified by Swyngedouw (2004a, 2004b) - with the crucial addendum that social life should be considered as essentially process-based - who drew further attention to the multi-scalar nature of power structures, and has repeatedly emphasised the need to abandon dualistic concepts in favour of metabolism and natural-social hybridity. Such a need is evident when issues of aggregation are considered in human ecological models, and Costanza et al (2001b) point out that such policy shortcomings typically occur as a result of data-scaling insufficiency (i.e. sample outcome measures taken on local eco-systems are aggregated up to national level, or aggregate national macro-economic measures are taken as representative of regional complexity). The intimacy of natural-social metabolic connection is purportedly lost within higher levels of aggregation, and the effects of emergent characteristics with downward-causative properties are invisible at micro-levels without appropriate contextualisation.

Clearly, questions of policy effectiveness are surplus to current requirements, but this does reveal an important tension within the literature, and a critical point of consideration for the development of theoretical models. The question thus arises as to the necessity and validity of such 'middle range' case-studies, their concomitant sustainability metrics, and their compatibility with a broader historical-materialist theoretical apparatus, the proponents of which typically criticise the conservatism of middle-range human ecology. Discussion has thus arrived at a critical 'bridging point'; in possession of a number of highly abstract trans-historical concepts, yet in need of a range of theories and measures for case-specific empirical application. Consideration of the latter thus brings discussion beyond consideration of a simple problematic of structure-agency (which may easily be assessed with a careful scepticism toward deterministic models), and into a territory of uncovering common epistemological foundations, and exploring the possibility of dialogue between bodies of theory pitched at respective levels of abstraction. The remainder of this chapter will attempt to develop this compatibility by demonstrating a common theoretical ground for both sociology and human ecology, and to

argue the immediate necessity of contextualised heuristics of ecosystem health and systemic representation.

3.2. Theoretical foundations of ecology and early dialogue with systems theory

Many of the above-cited authors maintain an explicit separation between social and ecological variables in their models. Van Wey et al (2005: 23)[69] present a review of influential theories and models in human ecology, many of which have featured both within broader sociology, and within literature relevant to the case study of nineteenth century agriculture (O' Neill 1984, for example, refers to Chayanov's theories of household composition and labour requirements in his historical demography of the parish of Killashandra, Co. Cavan). This separation is in part attributable to the requirements of quantification, as a consequence of the particular paradigms in which such authors work. Costanza and Ruth (2001: 22) depict this separation as a function of model precision requirements, with high-precision analytical models requiring greater specification, and consequently more precise quantification. The process of quantification inevitably involves a certain degree of reductionism; for example designating 'rates of deforestation' as an outcome variable, and relating a particular set of predictor variables inevitably restricts the analytical complexities achievable with conceptual modelling.

Decisions of model selection involve a number of related considerations; '...conceptual models describe usually qualitative relationships between a few important variables. They simplify relationships and / or reduce resolution, thereby gaining generality at the expense of realism and / or precision' (Costanza and Ruth 2001: 23). The net effect of such a trade-off is a greater amenability to cross-disciplinary communication (Heemskere, Wilson and Paveo-Zuckerman 2007). In contrast, high-precision and 'high-realism' models (typically quantitative) allow the researcher to tease out the relative impact of contributing factors, and their relations with each other, on particular outcomes (such as biotic stock models, short-run econometric models, and dynamic ecological simulation models – Costanza 1990, cited in Costanza and Ruth 2001: 24). Consequently, there can be no 'ideal' mode of representation per se, merely differences of utility, as a consequence of disciplinary and analytical requirements, and of a need for practical application.

[69] Such models include classical Malthusian models, IPAT and its sister PPE (Population, Poverty and Environmental conditions), Esther Boserup's theory of population density as a catalyst to technological innovation, Bilsborrow's model of multiphasic response, Von Thunen's agricultural location theory and demographic transition theory – which in its most simplistic form represents an empirical generalization based largely on European data (Kirk 1996). Although many of these reside on a more general side of the testability scale, their application has seen many studies produce models which posit their theorized factors as independently determinant.

What must therefore be attempted before delving further into this territory for explanatory metrics and concepts is the establishment of a common epistemological ground for both ecology and the social sciences as a means to unite their subject matter. Chapter 1 has already outlined the possibility of such dialogue with the theoretical informant of complexity, which identifies certain abstract similarities of structure and transformative dynamics between social and natural systems. Chapter 2 has in turn questioned the very concepts with which such authors posit the uniqueness of either the natural and social, and has further suggested an immediate need for careful historical contextualisation in any assessment of human-environmental relations. There are a number of decisions and trade-offs implicated in any study of such relations; whether one considers it a philosophical violation, or ideological legitimation to posit ontological separatisms, or whether ones disciplinary confines or study objectives render analytical and predictive precision more necessary than explanatory or structural generalisation. Once again, the common epistemological grounds of the early twentieth century systems theorists, and debates of the formative years of ecology are invoked in order to uncover the possibility of productive dialogue.

In a recent collection of interdisciplinary essays, a number of authors offered both a historical and critical evaluation of the origins of ecology, and of its linkages with other scientific and social-scientific disciplines throughout its formative years (Bergandi 2011, Becker and Breckling 2011, Haber 2011, Hard 2011, Taylor 2011, Trepl and Voight 2011, Voight 2011). As discussed in chapter 1, systems theory concerned itself with the abstract possibility of a unified model of natural and social organisation, in which any defined collective could be considered as a set of hierarchically organised levels, the components of which interact with each other in metabolic relation – such a proposition maps closely onto recent debates concerning the concept of ecosystem, with its antecedents in the classical holism-reductionism debates of systems theory (Bergandi 2011, Haber 2011, Trepl and Voight 2011). The historical connection between ecology and social science - given the importance of early vitalist-holist debates, and developments in cybernetics and systems theory to the formalisation of sociology - is thus extensive; ‘Ecology and systems theory thus form two research fields which are only partially separated and which display powerful internal dynamics and borders that are permeable from several sides’ (Becker and Breckling 2011: 385). As well as informing the early development of sociology, Voight (2011) depicts systems theory as an essential precursor to the development of the concept of ecosystem within ecology. The significance of the ecosystem as a unifying conceptual basis for the discipline of ecology is emphasised through the results of a series of interviews with 500 ecologists at the 75th anniversary of the British

Ecological Society, which revealed 'ecosystem', and associated community-level concepts as most influential amongst practitioners (Wieglib 2011: 106).

Early twentieth-century systems theory, as previously discussed, proposed to establish a common vocabulary with which to merge scientific discussion; '...developing unifying principles running 'vertically' through the universe of the individual sciences, this theory brings us nearer to the goal of the unity of science' (Von Bertalanffy 1968: 37 cited in Voight 2011: 184). Parsons' abstractions, coupled with Tansley's early distancing from the general systems programme through realist application of the ecosystem concept, thus established differing developmental trajectories for both disciplines. Subsequent empirical application of the concept of ecosystem by practitioners such as L. Lindemann permitted the quantification of productivity within systems themselves, enabling them to be described in thermodynamic terms (Bergandi 2011, Voight 2011: 186)[70]. Subsequently, mathematical notions of equilibrium became prominent in ecological debate, due in part to such earlier successes of quantification, as evidenced by the prominence of studies later advanced by Eugene P. and Howard T. Odum. H.T. Odum in particular, extended the energetic approach by mapping energy transfers within systems through flow diagrams, in a methodology which was to form the basis for the analysis of both natural and social systems (Moran 2006, Voight 2011: 187-188). Permitting the possibility of effective management and quantitative formalisation, ecosystems theory thus became paradigmatic.

Within this broad consensus of 'system' as a grounding concept, ecosystem realists and constructivists may further be identified, who trace their epistemological grievances to classical platonic debates of universals or archetypes, such that current orientations to the concept of 'ecosystem' correspond to a hierarchy of abstraction. Consequently, 'ecosystems' are interpreted as either reflections of natural entities (image naturalism), representations based on real-world data formed post-hoc into systemic hierarchies (analytical realism), and mental constructs (constructivist realism) (Becker and Breckling 2011: 388-389). Such an orientation to conceptual validity is similar to the constructivist-realist debate within the social sciences over the concept of 'nature'. The ontological dilemma confronting researchers therefore, is the nature of such described 'systems' as idealised abstractions, or actual reflections of concrete phenomena, a critical issue in practice which determines the intelligibility of researchers representations; 'If no ontological distinction is made between the real and the ideal world (for example, by interpreting the ideal world as a mere reflection of the real one – or vice versa),

[70] Bergandi (2011) states that the result of Lindeman's research was to 'render dynamic' Tansley's concept due to the formers 'energetic dynamics' approach

then the meaning of abstractions cannot be properly comprehended' (Becker and Breckling 2011: 391). The implication, given the perceived explanatory necessity of abstraction, is that successful analyses of interrelation and function inevitably depend upon some degree of *conceptual* model-building, or the population of loosely-defined categories with data. The simple fact that consensus has not been reached over this core concept surely suggests that this is the preferred strategy of human ecology also; to accept 'image naturalism' as a valid basis for the development of theory merely suggests a progressive specification of a single monolithic systems models, with its precision augmented progressively with the addition of new data. Such a model has not been forthcoming for either the social or natural sciences - sociology has all but proven that the complexities of human interaction and collective organisation cannot conform to such a model. For ecology to recognise the key role of 'humanity' as an active agent, and also considering the longevity of its epistemological debates, this surely sets it apart from other such sciences as one which is amenable to productive dialogue. The root of this epistemological exchange in earlier systems theory debates thus represents a point of critical early unity for both the social, and this particular strain of the natural sciences.

This should not imply a reversion to the general systems programme as a sounds basis for research however – complexity has all but dispelled the notion that the diversity of different living systems may be captured within a single structural model. Although it is generally acknowledged that the search for such a unified model has failed, an important legacy of systemically-oriented empirical research remains; '...*General* Systems *Theory* has dissolved into a multiplicity of *specialised* systems sciences, and it continues to exist in the form of a heterogeneous discourse with pronounced ontological and epistemological contradictions (Becker and Breckling 2011: 395). A positive consequence of the residual project of systemic generalisation appears to be a burgeoning amenability to exchange of *principles*, as opposed to the advancement of law and structure-based models across disciplines (i.e. the concept of 'resilience' in ecology – to be reviewed presently - which has seen much successful application in the social sciences; Holling 1973, Berkes, Colding and Folke 2003, Fraser 2003, Janssen et al 2006, Walker et al 2006, Walker and Salt 2006, Cumming 2011, Deffuant and Gilbert 2011).

In many respects, the core endeavours of systems theory mirror a core objective of the theoretical aims of this thesis; an attempt to combine sufficiently holistic conceptions of totality (through the derivation of trans-historical concepts such as labour and metabolism) with an immediate need to reduce complexity for analysis (reductionism), attempts which still confront the theoretical legacy of their practitioner's forbearers;

> "…a reductionist approach is obligatory in any investigation of highly complex phenomena, as complexity can only be mastered be breaking it down into its (presumably) principal components. This analytical procedure, however, has to be followed, and completed by a re-synthesis of the "why" of complexity. Such a combination of a reductionist with a holistic approach, often done iteratively, is essential for ecosystem investigations, but is neglected by researchers who shun the "holism trap"…this attitude goes back to the origins of science and the historical primacy of physics in the seventeenth and eighteenth century" (Haber 2011: 222)

The holism-reductionism debate permeates many disciplines which struggle between emphasising collectives or higher-order macro analytical units at the expense of micro-level interactions and dynamics. Recently, variants such as 'deep ecology' and 'political ecology' have asserted the need to reassemble collectives from the typically reductionist methodologies and fragmentary case-studies pursued by the natural sciences (Hughes 2000, Trepl and Voight 2011). Within the social sciences, as discussed in chapter 1, balancing holism-reductionism involves remaining attentive to the agency of individuals operating within structural constraint, whose collective actions produce emergent, higher-order characteristics not readily reducible to lower-order dynamics (Sawyer 2005, Bergandi 2011)[71]. Clearly, there can be no simple resolution of this dilemma – it is arguably indespensible for the advancement of knowledge, given the multi-layered nature of social life, and the necessity of specialist research. When considered in the context of Harvey and Reed's hierarchy of ontological complexity, the diversity of analytical levels implicated in such a totality becomes apparent, and the depth of knowledge required for the assessment of various levels such as ecological organisation (6), technical divisions of labour (6) and the analysis of norms. It is surely a considerable ask for individual analysts to fully assess each analytical level, but this does not exclude the necessity of recognising individual units and levels as embedded and interlinked within complex totalities – this falls as much to the sociologist as to the natural scientist. Furthermore, it is all but

[71] Bergandi (2011) suggests that a more precise re-casting of the 'holism-reductionism' debate would be the 'emergentism-reductionism' debate. The inclusion of the former term emphasises the naturalistic-materialist basis of the broader physical and human sciences, which maintains a fundamental reducibility of complexity to constituent units. This is a critical distinction for social scientists; our subject matter is defined by the acceptance of 'emergent properties' as a basis for a coherent research programme, and as such requires '...appropriate laws and theories that allow for an understanding of the specific properties of that particular level...reductionism denies the existence of emergent properties or else considers them an epiphenomenon strictly dependent on the state of our knowledge' (Bergandi 2011: 32). Bhaskar provides a useful corrective to methodological individualism (as a crude form of reductionism), and, in the process, clearly refutes the mapping of atomistic-reductionism onto the explanation of collective social behaviour;

> '...the real problem appears to be not so much that of how one could give an individualistic explanation of social behaviour, but that of how one could ever give a non-social (i.e., strictly individualistic) explanation of individual, at least characteristically human, behaviour! For the predicates designating properties special to persons all presuppose a social context for their employment. A tribesman implies a tribe, the cashing of a cheque a banking system. Explanation, whether by subsumption under general laws, advertion to motives and rules, or redescription (identification), always involves irreducibly social predicates' (Bhaskar 1998: 208-209)

accepted - with the exception of metaphysical outliers such as the 'Gaia' hypothesis perhaps - that vitalism is a tenuous basis for comprehending totality, and that a proper analysis of relations between ontological levels is required;

> "Vitalism, they say, sees in the living organism only a sum of so many parts that are complemented and monitored by a kind of soul in the role of engineer, rather than seeing the essence of life in the interactive structure of the whole...biological holism... is given when the key element of life is *not* seen to lie in an inner force inaccessible to scientific methods. Biological holism consists, instead, in the view that the characteristic of being alive can only be attributed to objects that are a whole, and that this whole exists in a special relationship to its parts that is not found in non-living objects. These wholes, so the theory goes, require an approach of their own that is different from that of physics" (Trepl and Voight 2011: 49)

Chapter 2 has hypothesised a mechanism unique to human societies which, it was suggested, sets in motion a metabolic relation between society and nature, which mediates relations between multiple levels in the natural-social hierarchy (i.e. the labour process), thereby dispensing with vitalist notions of inherent organisational logic. As well as offering a theoretical window into combining ontological elements of the social and natural, it has also offered the possibility of producing (as yet to be addressed) a historical typology of 'relations to nature' broadly defined as modes of production. Here, it has been observed that this social-scientific notion of metabolic totality maps quite well onto ecological notions of organicist-holism; that it is the dynamics of the 'interactive structure' that define the collective, rather than vitalist organising logic, or the accidental convergence of individually-produced homogeneous mentalities (i.e. theories invoking methodological reductionism – Bhaskar 1998). Given that the concepts now to be advanced from within human ecology may be located within these debates concerning holism-reductionism, it must hence be acknowledged that the above forms a sound epistemological and ontological basis for engagement with ecological concepts, given that organicist-holism conceptualises 'totality' as mutual relations of interdependence. Decomposition is therefore not mandated in a positivistic sense (i.e. by which statements of totality are reduced to metaphysical claims – Trepl and Voight 2011: 54); critical realism, emergentism, and historical materialism have all but dispelled this by offering a sounds logical basis for interpreting such collectives and properties as 'real' entities. Such abstractions have already been much qualified and elaborated over preceding chapters; these implicit assumptions must in turn, be carried over to the realm of application, where human ecology has excelled.

A crucial benefit of organicism-holism in ecology is that it is fundamentally a '...theory of development...which means that the image of nature in holistic ecology is erroneously seen as a static one whenever – as occurs very often – an (allegedly outmoded) "ecological balance" is

referred to' (Trepl and Voight 2011: 56-57). It thus points toward a process-based account of socio-ecological systems which, as established by complexity theory, remains mindful that 'stability' is merely transitive, and that the production of negentropy is an inexorable requirement of human societies. Marxism, in turn has suggested remaining mindful of this complexity when considering what specifically constitutes an 'ecological constraint';

> "The significance of Marx and Engels's critique of Malthus is that it involves an explicit recognition of the roles that technology and social organisation play in determining where environmental limits lie and the rate at which they are approached, together with a warning against the dangers of overestimating the natural component where the social is dominant...The superiority of their conception lies in its recognition, unlike that of Malthus, of the interrelatedness of the natural, the social and the technological. Thus, whereas Malthus turns the natural element into a rigid and static absolute, Marx and Engels allow a proper consideration of the role of *each* element" (Hughes 2000: 63)

This should not excuse us from engaging with broader concepts of stability however. According to Trepl and Voight, classical notions of organicism have been supplanted by contemporary notions of ecosystems which are defined as '...open, self-regulating systems in a state of flow equilibrium, their defining characteristic being the uptake and output of matter and energy' (Trepl and Voight 2011: 72-73) – the literature is blighted with similar debates concerning the specification and validity of analytical units as reviewed in chapter 1. The concept thus frames and implicates a broader methodology which is simultaneously holistic and necessarily reductionist, but which ultimately avoids the metaphysicality of 'superorganism' analogies through its subjective definition. Assessing the dimension of stability, however, is far from straightforward; what presents, are numerous possible metrics which have been applied to varying degrees of success (see Holling 1973, Grimm and Wissel 1995, Walker and Salt 2006). What has once again been discovered in this review of epistemological commonalities is a remarkable similarity of debate across both ecology and social science, concerning the merits of abstraction, the treatment of relations between hierarchical levels of organisation, and the relation of individual to collective. The current state of debate which emphasises, in a critical-realist manner, the 'constructedness' of such analytical categories maps further onto debates in sociological methodology which emphasise the benefits of ideal-typical model building from multiple data sources (Ragin 1987, Harvey and Reed 2004). Given that the concept of *ecosystem* emphasises a focus on relations between organisational levels, within which both environment and individual interact, it lends further credence to a methodology of cumulative model-building[72], a theme which will be developed throughout subsequent sub-sections and chapters. Discussion now turns to a group of concepts and measures developed within ecology,

[72] It is preferable to derive general dynamics and abstract sets of relations across multiple cases rather than to pursue the reductionism of previous energetic-anthropological case studies

which have steadily drawn many subsequent contributions from the social science, that have attempted to grasp the dynamics of such abstract collectives in order to derive socio-ecological assessment metrics with varying degrees of analytical precision.

3.3. The possibility of stability/sustainability: situating and incorporating the social

Ecology has given comparatively greater consideration to the question of stability than the social sciences; such a disparity is understandable, and welcome in light of infamous deficiencies in the conservatism of earlier applications of systems theory such as Parsons' model, and later studies which legitimated exploitative 'status quo' relations of inequality by employing interpretive frames of 'functionality' (Grimm and Calabrese 2011). Despite its legacy, this did not restrict its application across a number of anthropological studies – heavyweights of the discipline such as Clifford Geertz argued the utility of ecosystems as analytical units (Winterhalder 1984, Moran 2006), with later studies such as Odum (1971) and Moran (1982) attempting to measure '...the chemical transformation of solar energy into biomass and its gradual diffusion and loss through a food web' (Moran 2006: 23). The roots of this 'energetic efficiency' approach as a potential axiom for evolutionary biology extend to A.J. Lotka, who in 1922 suggested; '...in the struggle for existence, the advantage must go to those organisms whose energy capturing devices are most efficient in directing available energy into channels favourable to the preservation of the species' (1922: 147 cited in Smith 1979: 54). The concept thus transposed to a crude metric of adaptive success in human ecology, whereby social system typologies could be derived by examining the extent to which cultivation strategies optimised energy capture. Smith identifies three key factors of energy-capturing behaviour from previous literature; '...optimal food choice, optimal use of habitat sectors or "patches," and optimal spatial distribution' (1979: 57), which further implicate earlier social sciences with aspirations to human ecology such as geography (Hard 2011). This approach continues to receive attention in the form of the 'SOHO' (Self-Organizing, Holarchic, Open Systems) framework (Kay and Boyle 2008 cited in Cumming 2011: 39), which examines the constraining influence of energy flows and trophic interactions on social development. This perspective remains rooted in the search for a 'common currency' of energy as a thermodynamic basis of social-ecological analysis, albeit one which remains difficult to operationalise due to its level of technicality (ibid).

This 'energetic' perspective, although lending itself well to deductive modeling and the specification of analytical units, ultimately erred somewhat too close to evolutionary biology, where Smith (1979) acknowledged that, at his time of writing at least, consensus around the

mechanism of 'selection for energetic efficiency' was not established. The concept of 'selection for energetic efficiency' itself draws much on notions of reproductive fitness which are difficult and undesirable to operationalise within sociology; the utility of assessing reproductive efficiency in terms of deviations from a theoretical rate of natural fertility (Bongaarts 1975) for example, is highly questionable (the concept itself arguably calls for a comparative assessment of cultural traits and extinction rates). Furthermore, such evolutionary concepts employ limiting base assumptions regarding human intentionality which, as social psychology has demonstrated, are subject to life-course modification through secondary socialization, and variance by social context; '…societies, animal and human, are primarily the outcome of ecological necessity…consequently human beings enter this world not as tabula rasa, but equipped with batteries of specific social aptitudes and preferences' (Field 2000: 129). Mapping notions of natural selection directly onto human populations further ignores a number of important deviations from the 'natural' norm, such as negative feedback (Waldrop 1992), sustainable outcomes of collective governance (Ostrom 1990), and group selection strategies (Field 2000). Although this suggests a complete dismissal of reductionism as an epistemological strategy, this is but one form, whereby manifest behaviour is mapped directly onto unsuitable biological analogies. In the pursuit of socioecological metrics it must be acknowledged that there are other forms of reductionism that require consideration; the term should therefore not be assumed negative by default (i.e. *evolutionary* and *energetic*, as alternative forms of reductionism, may be separated – neither of which in their *unqualified* states are inherently undesirable).

Subsequent applications of 'energetic efficiency' suggest the social sciences were far from immune to the early allure of atomistic reductionism, and the perceived rigours of quantification (Shove 1997). The term 'stability' itself is far from a matter of consensus in the scientific community however, and remains very much contested; Grimm and Wissel's paper (1997) for example, records 163 definitions of 70 distinct concepts of stability. Bergandi (2011) further remarks that early proponents of the ecosystem concept were resistant to the possibility of epistemological reductionism or the reduction of ecosystem analysis to the atomism of physics, and remarks in the preceding section concerning the plasticity of the concept itself serve to illustrate as much. Consequently, the terms 'stability', and its sister concept of 'sustainability' require that the *social* analyst look beyond narrow questions of energy efficient measures alone, toward the role of specific configurations of institutions, norms, culture, and social structure in the assessment of ecosystem health. It further requires, in particular contexts, a recognition that the formulation of such measures is inevitably a 'social processes', and that

the criteria by which such 'healthy states' are assessed are themselves subjectively formed (Norgaard 1990).

Confusions over the meaning of particular 'stability' concepts, according to Grimm and Wissel (1997), often stem from the transplantation of mathematical notions of stability onto ecological systems. Such concepts are by nature unsuited to the task of assessment, given that '...stability concepts derived from mathematics and physics are only suited to characterising the dynamic behaviour of simple dynamic systems, but ecological systems are not simple dynamic systems' (Grimm and Wissel 1997). Subsequent work in complexity has demonstrated that previous assumptions, concerning simplicity of organisation thought to apply to large systems (both social and natural), are not reflected in analyses (Waldrop 1992, Kondepudi and Prigogine 1998, Capra 2005, Urry 2005b). Consequently, Grimm and Wissel (1997) identify a number of general stability properties as a means of qualifying the unacceptable ambiguities of the term; *constancy* 'staying essentially unchanged', *resilience* 'returning to the reference state after a temporary disturbance', and *persistence* 'persistence through time' (Grimm and Wissel 1997: 323). As discussed above, key problems with such metrics are their subjective demands of 'reference state' measures, the nature of data required (longitudinal), issues in feedback-response lag in human agrarian systems, predictability, and their inherent nature as post-hoc assessments of success.

Although somewhat more porous, the concept of 'sustainability', as 'a renewable system that survives for some specified (non-infinite) time' (Costanza et al 2001b: 6), also requires subjective input from the researcher, in terms of defining optimal states. Strategies for the assessment of such 'stable states' have thus run the gamut from precise quantification of short-term energetic efficiency (Moran 20006), calculation of spatial catchments required for waste absorption (Rees 1992), toward more long-term analyses of historical population dynamics and social change (Chirot 1994). A deeper division exists within economics, between practitioners who view sustainability as a project of the joint maintenance of ecological exploitation and economic growth via market instruments (Common and Stagl 2005), and 'energetic' growth critics who point toward the need to reorganise production and social relations away from established growth-centred models on a trans-national scale (Burkett 2006, Daly 2007). Issues of scale are clearly critical in assessing such measures; Moran (2006) remarks how up-scaling to regional level systems analysis in archaeology for example, permitted the assessment of broader dynamics of landscape change than were possible within previous localised anthropological case studies, which often (mistakenly) interpreted the ecosystem concept as synonymous with spatial boundaries (which itself lends further weight to the argument to view

such concepts as heuristics rather than concrete spatial units). Furthermore, such studies incorporate a range of analytical units from countries, to settlements, to individual households – the latter of which will be singled out for specific attention within the forthcoming case study.

Despite its crudity, the above example of energetic efficiency studies demonstrates the dangers of unqualified cross-disciplinary transfers of concepts, and *particular* forms of reductionism. This section thus proceeds to discuss a number of research strands which have attempted to derive appropriate measures and analytical approaches suited to the complexities of the concept of stability, and studies which have assessed the role of institutions in resource-allocation efficiency. An outline understanding of some general terms associated with agriculture, nutrient cycles, and the assessment of energy capture and conversion must first be established; although this current study lacks sufficient data to fully operationalise such concepts, it is essential that they are acknowledged, given that they are implicated at numerous points of the forthcoming analysis.

3.3.1. Biophysical processes, nutrient cycles and energetic efficiency[73]

Without the above contextual note on the extent of previous energetic efficiency studies within anthropology, the immediate relevance to sociological research of an outline understanding of energy appears obscure. Disciplinary specialities, as alluded to in previous chapters, understandably play into this, and the separatisms established in chapter 2 suggest the irrelevance of such issues to sociology – clearly there are disciplines better equipped to assess energetic efficiency. Aversions to such issues are in part attributable to 'Sociology's own theoretical unease with technology and the physical/natural worlds, and its insular tendencies in regard to other disciplines' (Lutzenhiser 1994: 58 cited in Shove 1997: 262). As a lower level of reduction however, energy, and the efficiency of its conversion across various trophic levels is implicated in any study of agrarian systems, and previous discussions of eco-regulative labour have directly identified the maintenance of energetic efficiency as a primary goal of such efforts (Benton 1989, 1996). The concept of *adaptive capacity* (discussed further on), in its social-scientific application expresses such dynamics, as it first appeared within cultural ecology where Julian Seward mapped biological notions of adaptation onto the study of human societies, albeit in a manner considerably more nuanced than with the assessment of competitive advantage. Such early applications established a foundation within the social

[73] Much of the material in the following section derives from two principal sources; Chapter 2 of Mazoyer and Roudart (2006); *Evolution, Agriculture, History – Section 4: Biomass, Soil, and Fertility* and Chapter 2 of Common and Stagl (2005); *The Environment*

sciences which permitted the comparative assessment of socioecological systems resilience by incorporating social, institutional and political factors into the assessment of eco-regulative success (Plummer and Armitage 2010).

The current state of research is somewhat different, and without explicit recourse to mapping energy flows and conversion efficiency, alternative outcome measures such as population stability/composition and land-use cover are typically preferred in the assessment of adaptive capacity and resilience. Despite such variations in methodology, the fact remains that there are 'reducible' mechanisms, processes and lower-order units of measurement underpinning such manifest variations in population-level outcomes that must be taken into account. Indicative of this necessity are studies such as Myers (2002) whose 'energetic' analysis of tillage forms recorded significant benefits in labour saving by lazybed cultivation. Based on a standardised comparison of labour requirements for both level fields and lazybeds, Myers study reveals a mechanism of 'cultural selection' whereby optimal strategies favouring reductions in labour take hold, although such strategies of tillage-form selection depended substantially on factors such as local topography, tenure systems and selection of crop. Relative to yields (of which lazybeds performed somewhat less favourably), the experiment provided some validation of the 'energetic efficiency' hypothesis, which arguably fits safer within a framework of 'cultural selection', rather than species-level inferences regarding comparative advantage. Other studies such as Hornborg (2007) have also attempted to estimate the aggregate labour requirements of production systems to allow comparisons of efficiency.

Within disciplines where engagement with ecology has become almost paradigmatic such as ecological economics, outline understandings of core aspects of biology and ecology are immediately forthcoming (Common and Stagl 2005). Such grounding considerations are required due to the extent of connections that have developed between such disciplines, for an understanding of the processes underpinning statistics in aggregate comparisons and for a more nuanced understanding of what precisely may be occurring at micro-level under the influence of particular interventions; '...ecology has firm roots in the real world chemical and thermodynamics laws that are the universal regulators of all energy and material transformations in the organic world' (Rees 1992: 122). The remainder of this section thus addresses these areas by outlining some basic biogeochemical terms and processes – this outline will function not only as a primer to discussions of agricultural practice in later chapters, it will also serve to illuminate certain terms employed previously in an analogical manner. The reader must also trust, for now, that certain distinctions presented in this section regarding the movement of energy and nutrients, and population dynamics must be established

as they are implicated and expanded upon at numerous points throughout this thesis; they are essential primers for addressing a number of concepts which have seen prominent deployment in the social sciences, such as metabolic rift (Clark and York 2005, Clauson 2007), resilience (Holling 1973; Fraser 2003, 2007; Cumming 2011), adaptive capacity (Armitage and Plummer 2010), carrying capacity (Rees 1992) and panarchy (Fraser 2006).

A common error committed across numerous publications is a misuse of the term 'energy consumption'. The laws of thermodynamics specify the impossibility of *consuming* a single unit of energy; a more appropriate restatement of the problem would specify *efficiency of energy conversion*, and *natural resource consumption* – the difference is critical in a number of respects. Energy, as the capacity to do work or supply heat takes various forms[74]; *potential energy* (which exists by virtue of position – i.e. raised bodies of water), *kinetic energy* (energy which exists by virtue of motion – i.e. flowing water), *radiant energy* (given off by objects such as the sun), *electrical energy* (carried by flows of charged particles in a conductor), and *chemical energy* (given off in reactions such as combustion) (Common and Stagl 2005). The first law of thermodynamics, as a law of quantity, states that energy may neither be created nor destroyed, but merely converted from one form to another. In the industrial production of electricity with fossil fuels for example, chemical energy (i.e. coal) is converted to other forms; energy conversion is always necessarily 100%, but the thermal efficiency of the combustion process (the ratio of electrical – i.e. humanly useful – to chemical energy content) is typically 35%, the remainder being lost as waste heat. A more precise restatement of the question of energy conservation, therefore, would specify a need to explore methods increasing the thermal efficiency of conversion processes, and reducing the heat or work involved in common tasks (Common and Stagl 2005: 29).

The second law of thermodynamics, discussed previously in relation to its analogical application within the social sciences, addresses the quality of energy at the outcome of the conversion process. A number of definitions of various system types have previously been specified, after which it was concluded that societies must be conceptualised as *open systems*, given that socioecological metabolism involves the exchange of both matter and energy with environment. Such a conceptualisation, as forwarded by Von Bertalanffy throughout the more prolific years of general systems theory, proved instrumental for extending the organicist concept of organisms and societies as open systems, thereby providing a means with which to

[74] Work = force * distance. Energy, work, and heat are measured in joules, whereby 1 joule corresponds to the work done when 1kg is moved by 1metre. 1 joule also corresponds to the heat required to raise 1 cubic centimetre of water by 0.239 degrees (Celsius)

abandon vitalism and teleology (Hammond 2003, Skyttner 2005). Thermodynamically, the distinction is critical, and was a cause of much concern to earlier Victorian commentators such as Léon Brillouin, who captured the pessimism of a worldview in which the 'heat death of the universe' was seen as inevitable; 'How is it possible to understand life when the world is organized according to the second law of thermodynamics which points to decay and annihilation?' (Skyttner 2005: 22).

The second law states that the energy content of an isolated system is constant (Atkins 2007), and that for any process of energy conversion, a downgrading in energy 'quality' is inevitably involved. For practical purposes, the known universe is the only such example of a truly isolated system, apart from a number of laboratory simulations (Common and Stagl 2005). The perception of 'heat death' as an event lying far beyond the boundaries of immediate human concern has led many neoclassical economists to reject the immediate significance of the second law – indeed, Robert Solow previously stated, in response to criticisms of the Cobb-Douglas production function advanced by Georgescu-Roegen; '...no doubt everything is subject to the entropy law, but this is of no immediate practical importance for modelling what is after all a brief instant of time in a small corner of the universe' (Solow 1997, cited in Daly 2007: 135). Such dismissals feature also within Marxism as the 'Podolinsky controversy', in which Marx is claimed to have dismissed Sergei Podolinsky's attempts to advance an energetic analysis of labour, thus reconciling the labour theory of value with the first law of thermodynamics (Burkett 2006). The 'Podolinsky myth' as coined by Foster and Burkett (2008) in their re-positioning of the controversy, is often cited as evidence of Marx's rejection of ecological concerns and thermodynamics, and as one of numerous exhibits in the 'productivist' accusation[75].

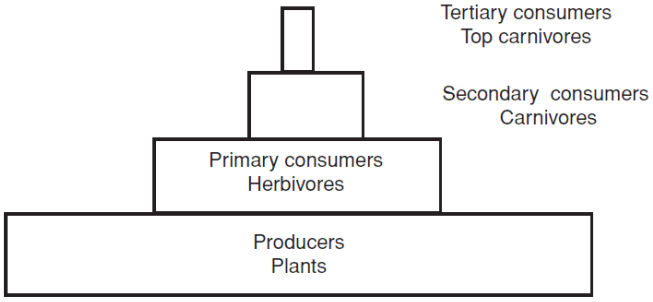
The concept of entropy, as a measure of 'disorder' – i.e. downgrading of energy quality - illustrates its significance. The second law of thermodynamics states that the entropy of an isolated system cannot decrease. By extension, given that the material processes of life require conversions of energy which are inherently inefficient, the quantity of 'useful' energy available must, in turn, inevitably decrease. It is important to note that this measure of disorder applies to isolated systems – the entropy (disorder) of an isolated system cannot decrease, but the entropy of closed or open systems may not necessarily in the short term, due to their ability to import energy from their environments and thereby reduce disorder. Analogically, the principle is intuitive – and illustrates the source of neoclassical economics' dismissal of the law given its

[75] Foster and Burkett's paper (2008) reveals much beyond the accepted version of the controversy, and will be given substantial attention in forthcoming subsections

lack of immediacy. In combination however, the laws point towards the necessity for any system (for now depicted in abstraction) to engage in inherently inefficient conversions, resulting in the inevitable production of entropy. Ecological economics has long pointed to the need for economic models to incorporate considerations of the laws of thermodynamics as a corrective to neoclassical growth theory, which views continued growth as the sole imperative of national policy, thus ignoring the finite and inefficient qualities of resource consumption and energy conversion (Georgescu-Roegen 1979, Christensen 1989, Ehrlich 1989, Cleveland and Ruth 1997, Daly 1999a, Røpke 2005).

The trophic pyramid, illustrated below in figure 3.1, illustrates the rough magnitude of energetic losses incurred in the conversion process between various levels of the feeding chain.

Figure 3.1



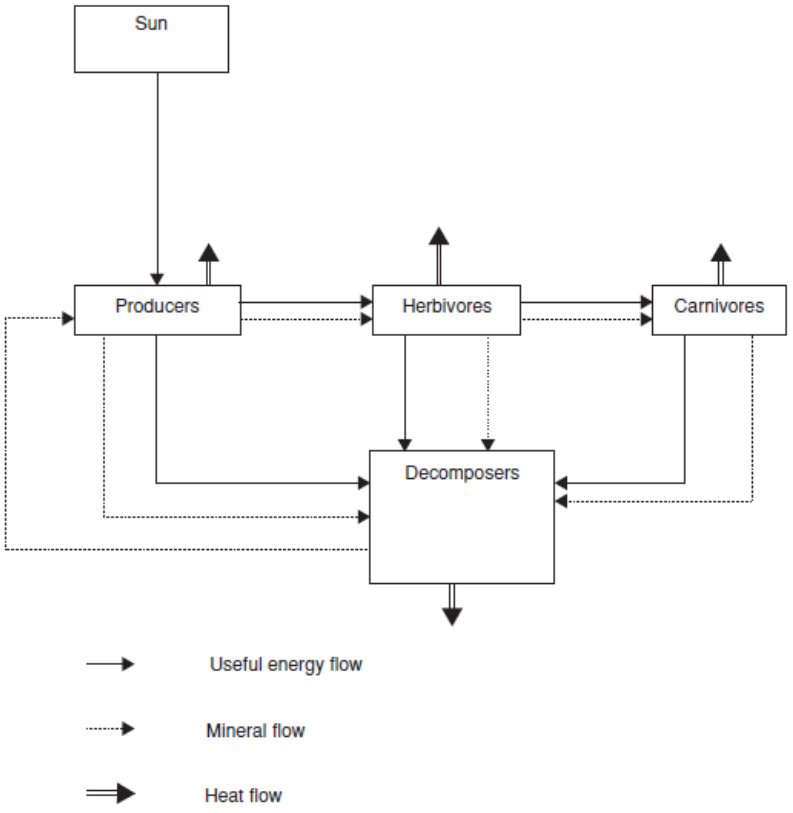
Trophic Pyramid, (Common and Stagl 2005: 38)

The net primary productivity of a particular ecosystem (i.e. the total amount of solar energy fixed by photosynthesis less the amount of energy lost as respiration) specifies the total quantity of energy available to other species at higher trophic levels, such as primary, secondary and tertiary consumers (Common and Stagl 2005). The volume of net primary productivity varies as a function of environmental controls such as available sunlight, water, carbon dioxide, temperature, and nutrient availability. *Fertility*, as a measure of an ecosystems' '...capacity to produce over a long period of time vegetal organic matter useful to humans or domestic animals', thus requires consideration of a myriad of factors such as the physical, chemical, and topographic characteristics of the ecosystem in question (Mazoyer and Roudart 2006: 52-53). The trophic pyramid depicted above represents the relative proportions of conversion efficiency across various ecosystem levels, and for illustration may be considered broadly representative - the basic structure of diminishing returns applies across most systems albeit with variations in ratios between levels.

With regard to trans-boundary movement and *circulation* however, there is an important distinction to be made between the circulation characteristics of energy and nutrients, which is illustrated below in *figure 3.2*. Whereas the flow of energy throughout an ecosystem tends to be unidirectional (energy cannot be recycled), nutrients cycle throughout an ecosystem – assumptions which, for practical purposes, and in the context of most definitions of ecosystem boundaries are sufficient (Common and Stagl 2005: 40). Such movements and circulations may be depicted, under ideal circumstances, as constituting equilibrium; Mazoyer and Roudart offer a definition of ecosystem equilibrium which serves as a useful starting point for later qualification;

> "When an ecosystem is in equilibrium, i.e., when the quantity of organic matter produced each year by photosynthesis is equal to the quantity of organic matter destroyed by respiration and decomposition of the litter, then the quantities of carbon dioxide, water, nitrogen, and various mineral salts, which are absorbed and stabilized in organic matter, are in principal equal to those released by respiration and decomposition. In the same way, the quantities of oxygen released by photosynthesis are compensated by those used by respiration and decomposition. A stable ecosystem neither "creates" nor "loses" anything; it recycles everything" (Mazoyer and Roudart 2006: 54).

Figure 3.2



Circulation of energy and nutrients (Common and Stagl 2005: 41)

The fertility of a particular ecosystem thus depends not only on the cycle of energy, recycling of nutrients and other controls such as topographical characteristics, but also substantially on

the characteristics of living populations within its boundaries. The production of organic matter via photosynthesis depends on the 'breakdown of dead organic matter, which releases the inorganic nutrients that it contains, making it available to be taken up from the soil by living plants (Common and Stagl 2005: 40-41). The process of nutrient recycling is therefore summarised as follows;

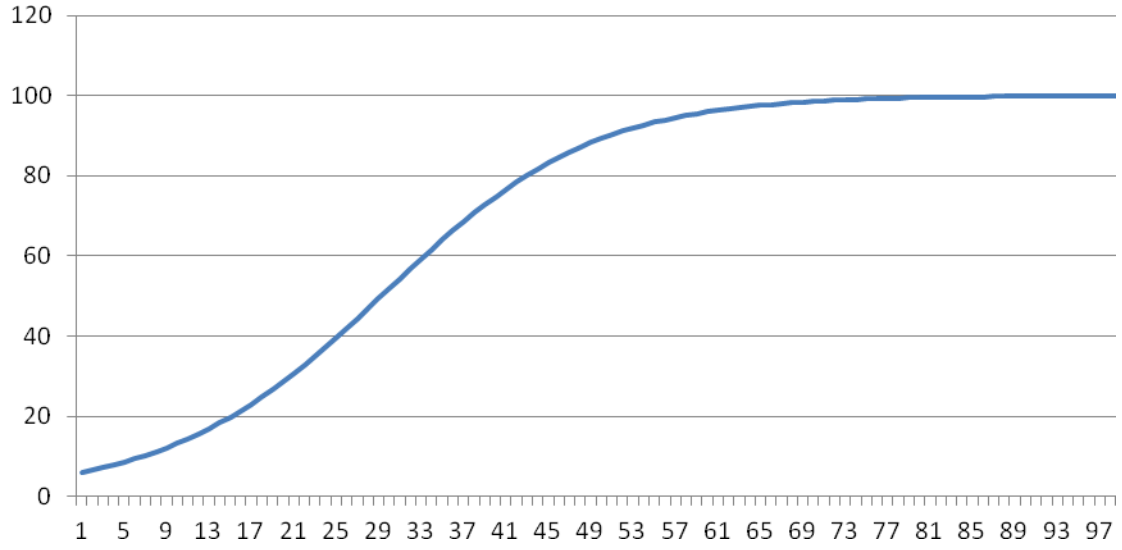
> "...over the course of a given period, the fluctuations in the inflow and outflow of minerals in the soil solution are equilibrated according to a sort of balance sheet. On one side are the additions of minerals from several sources (solubility of the parent rock, fixation of atmospheric nitrogen, decomposition of the humus and organic manure, additions of chemical fertilizers) to which it is necessary to add the stock of preexisting minerals. On the other side are the losses of minerals during the period under consideration (drainage, denitrification, recrystallization, removal of minerals through harvests of plant and animal products, and, if need be, the gathering up of animal excrement) and the residual mineral stock" (Common and Stagl 2005: 59)

'Fertility' is therefore not constant, and is subject to variation due to both ecosystem characteristics (soil and bedrock composition, sunlight and rainfall levels) and human intervention; '...from the moment a soil is cultivated, its fertility becomes a historical variable, largely influenced by successive agrarian systems' (Mazoyer and Roudart 2006: 59-60). The 'social' thus plays a critical role in determining the form of interventions used to maintain fertility. Communal organisation of land within rundale communities – and indeed within infield-outfield systems across Europe in general - provided one such method of maintenance. By designating specific portions of land for cultivation and others for grazing (typically in a concentric or nucleic layout with production centred close to dwellings), efficient transfers of biomass were permitted by herding and collection of manure. Systems of rotation such as this were variously augmented with imported minerals or fertilizers and amendments such as burned lime or kelp (Collins 2008) – practices which, as will be demonstrated, were tacitly embedded within broader cultural systems of customary governance[76]. Fertility is ultimately subject to numerous controls, many of which are open – with certain limitations - to human intervention and augmentation. Mineral content and richness are critical, as are temperature, sunlight and available water supply – all of which are subject to various forms of manipulation (i.e. ridge cultivation/orientation or drainage channels). Such natural conditions must inevitably, in the context of human settlement, interact with their resident populations with the effect of imposing certain theoretical limitations.

[76] '…fertilizers are…mineral or organic materials that are incorporated into soil for the purpose of providing the plants with nutritive minerals and possibly other substances such as growth hormones which they need. Fertilizers are distinguished from amendments, which in principle are organic or mineral materials that are incorporated into soil for the purpose of improving its composition and its physical properties' (Mazoyer and Roudart 2006: 62)

For a theoretical system of unrestricted reproduction, population growth is exponential (i.e. with similar proportional increases across particular periods, absolute growth tends to increase indefinitely). The form of a curve depicting exponential growth would here be similar to the quadratic function of *figure 1.1*, and implies unrestricted growth for any population capable of unrestrained reproduction. Population dynamics are, of course, far from uniform, and for human populations at least, significant variations in total fertility rates (TFR) exist across different cultural contexts, from replacement level (as with many present day European populations), to a TFR of 8.5 as recorded amongst Canadian Huttertite populations in the early twentieth century (Livi-Bacci 2005, Common and Stagl 2005). Although the preferred strategy within the social sciences for the explanation of demographic variation is to examine social factors which variously restrict or enable reproductive capacity (i.e. access to stable reproductive unions, industrialisation, social policy, welfare state developments, access to birth control , qualitative accounts of individual decision making and household strategies), the preceding discussion has identified 'natural' limits on the productive capacities of ecosystems, as a function of limitations such as incoming solar radiation, soil composition, topography and rainfall, which consequently impact upon rates of net primary productivity. Setting aside questions of technological innovation and their effect on labour efficiency and yield, ecosystems thus encounter upper limits to levels of population which may be sustained, (i.e. their carrying capacities); population dynamics are thus said to be *density dependent* (Common and Stagl 2005). For human settlement, the relationship between population and ecological constraint is more usefully expressed as '...the maximum rate of resource consumption and waste discharge the can be sustained indefinitely in a given region without progressively impairing the functional integrity and productivity of relevant ecosystems' (Rees 1992: 125). This definition thus corresponds to Hardin's third law of human ecology, whereby [ecological impact = population * per capita impact] (ibid). Such definitions and formulae are in turn closely related to the concept of resilience (presently to be examined) which conceptualises the capability of particular systems to maintain structural and organisational integrity when faced with disruption or external perturbation (Cumming 2011: 14).

Figure 3.3



Logistic growth simulation (authors' version), initial population value of six with 100 iterations (initial formula from Common and Stagl 2005: 46)

Density-dependent population limitations (as a function of ecological carrying capacity) may be depicted in terms of the logistic growth curve reproduced above in *figure 3.3*. The above simulation incorporates a variable growth parameter as opposed to a constant for exponential growth models. As a result, population growth rate varies in proportion to both population size and carrying capacity, confronting limits to continued growth at a theoretical upper maximum carrying capacity (population appears on the y-axis above). This critical assumption is implicated within numerous methodologies such as ecological footprint analysis, and ecological economists' criticisms of production functions which exclude consideration of resource limitations. In ecological terms, 'stability' (as constancy, resilience or persistence) refers to a theoretical population level for which carrying capacity is not exceeded, and for which the characteristics of the socioecological system (i.e. fertility, yield, cultivation strategies, household structures, demography, institutions, and calorific intake) remain relatively stable. In reality, demographic trends are considerably more nuanced than is depicted by the logistic curve; clearly it is far too limiting a model in its current unqualified state, as population alone is arguably a poor metric of socioecological integrity. It is also far too restrictive for the sociologist who wishes to represent system complexity, as well as introducing the possibility of defining 'optimal states' which permeated early development literature. Nonetheless, the above discussion points toward set of inescapable assumptions regarding 'natural limits', and how

natural-social interaction - within agrarian systems at least - must be viewed as necessarily bound to the requirements of fertility maintenance, which in turn impose *theoretical* limitations on development.

There is nothing inherently problematic regarding such assumptions and laws in this ideal-typical state; it is the persistence of perspectives which fail to acknowledge the critical dimension of *social form* which have attracted criticism from numerous scholars (Burkett 1999, 2006; Foster 1999; Hughes 2000). Unqualified, they are little more than limiting Malthusian assumptions, but with qualification, they function as essential baseline principles with which to begin typifying and assessing socioecological systems in terms of their resilience, capacity for adaptation to perturbation, and the energetic efficiency of their productive strategies (the latter of which, as previously suggested, includes institutions, modes of regulation, governance, culture and norms as much as specific tillage and husbandry techniques). This process of qualification begins by examining a number of concepts which have seen much successful application, and which return discussion to that of establishing dialogue between complexity theory and ecology.

3.3.2. *Resilience* as a social-ecological heuristic: establishing common ground

Although multiple definitions of *resilience* abound within existing literature, the concept itself - in terms of its genesis within ecology – is somewhat easier to locate. Its origins are typically traced to C.S. Hollings' frequently cited paper (Holling 1973), wherein the concept of resilience proposed to resolve certain outstanding issues with equilibrium-based views of ecosystem dynamics which, at Holling's time of writing, were pervasive (Gunderson 2000). Recent commentators remarking on the subsequent trajectory of ecological theory such as Cumming (2011) depict a field currently populated by a range of concepts and a remarkably consistent vocabulary which has moved substantially beyond the restrictions of physics imports such as equilibrium and stability, toward non-linear heuristics and analytical devices such as alternative stable states, phase space, attractor basins, resilience, thresholds, emergentism, and system identity (Cumming 2011). There are close connections between this branch of theory and the broader complexity programme, as the concept of resilience developed initially as a means to assess systems exhibiting far from equilibrium behaviour (Gunderson 2000). Consequently, notions of a singular quantitative metric of stability – rendered considerably less robust when conceptualised in the context of human interaction – remain problematic (Holling 2001, Berkes, Colding and Folke 2003, Armitage and Plummer 2010, Cumming 2011). The development of the concept of resilience is perhaps best interpreted as an attempt to broaden and qualify

various dimensions of stability which, in the context of the emergent field of social-ecological systems research (SES), has since evolved to incorporate questions of non-linearity, relationships across organizational and spatial levels, economic context, the role of institutions of governance, and (where appropriate) the agency of resident stakeholders (De Leo and Levin 1997, Adger 2000, Gunderson 2000, Fraser 2006, Janssen et al 2007, Young, King and Schroder 2008, Ostrom et al 2009, Grimm and Calabrese 2011).

Forthcoming sections argue that a number of benefits ensue from adopting a resilience perspective within socioecological systems analysis. Papers such as Grimm and Wissel (1997), as discussed above, introduced concerns about the validity of unqualified use of the concept of stability given its inherent plurality; resilience, in contrast, has embraced this plurality by viewing the assessment of 'stability' as a considerably more nuanced task. Typical measures of stability have tended to remain variable-oriented (Grimm and Wissel 1997, Cumming 2011), with researchers specifying particular variables with which to assess stability over time;

> "...stability concepts can, with the exception of 'persistence', not be applied to entire systems but only to specific state variables characterizing these systems, for example total biomass, number of species, fixation of CO2, or spatial patterns...Moreover, statements about stability properties also depend on the specific type of disturbance considered, on the temporal and spatial scales involved, and on how, precisely, the reference state or dynamics is defined" (Grimm and Calabrese 2011: 5)

Conversely, Holling's initial proposition (Holling 1973) suggested a move from *engineering* resilience measures which dealt with '...rate and speed of return to preexisting conditions after disturbance' (Holling and Gunderson 2002 cited in Grimm and Calabrese 2011: 6), toward more holistic measures which viewed ecosystems as collectives of relations and components, which by virtue of their complexity and dynamic development, rendered variable-centered 'reference state' measures and future predictability problematic. Crucially, 'resilience', in the form advanced by practitioners such as Holling, and contributors to the resilience alliance, is viewed as an emergent property, rather than a reductionist metric. Consequently, resilience practitioners tend to employ concepts such as *system identity* as a property whose 'persistence' over time may be evaluated (Cumming et al 2005, Cumming and Collier 2005, Cumming 2011, Grimm and Calabrese 2011). This alternative conceptualisation of stability is thus qualitative rather than quantitative, and designates a broad configuration of internal relations, structures, and processes which contribute to resilience as a *property* of particular systems; 'Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still

persist...resilience is the property of the system and persistence or probability of extinction is the result' (Holling 1973: 17).

Resilience is thus not a 'metric' according to conventional engineering definitions, but is instead a property which permits the assessment of '...the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks' (Walker 2004 cited in Grimm and Calabrese 2011: 8). It is an invaluable heuristic on a range of fronts, not least for countering extant shortcomings in structuralist systems theory as outlined in chapter 1. According to Cumming (2011), resilience may be operationalised by quantifying *identity*, which consists of; '...a set of elements...that interact with one another in a shared environment... Identity derives from the maintenance of key components and relationships, and the continuity of these through time. If resilience is low, identity may be lost; and correspondingly, if identity is lost, we can conclude that resilience was low' (Cumming 2011: 10 - 13)

'Identity' offers a welcome corrective to 'structure' – particularly regarding the form articulated within the general systems programme and its variants (Miller and Miller 1992). Despite the fact that the general systems programme maintained a division between 'concrete' and 'abstract' advocates, the abstractions of the latter (such as Parsons 1991 [1951]), as discussed in chapter 1, succumbed to mechanistic reductionism (despite their focus on functional relations and integrative mechanisms, rather than structural elements). This resulted of a process of 'mechanistic transplantation', coupled with a vague vitalism which interpreted the persistence of relations across time (irrespective of questions of equity) as an inherent and desirable property of social systems. In the context of concepts such as resilience, and others developed further in this current subsection, it appears sociology may have abandoned systemic theory somewhat prematurely, as contributors to the resilience debate have here demonstrated a remarkable adaptability to the challenges of complexity, holism and non-linearity. Natural-social dialogue has developed within these debates and contributions to the extent that sociological staples such as 'social capital' are identified, amongst various other relations and properties, as contributors to ecological resilience (Cumming 2011). Furthermore, such authors have, in the process of developing these interdisciplinary frameworks, retained paradigmatic devices (i.e. systemic approaches, analytical techniques and general concepts), whilst advancing generalisable models and heuristics for collaborative management – frameworks which, for certain practitioners, remain sensitive to local variations, whilst avoiding default conflations of neoclassical market logic into effective management.

The question of stability has been debated within ecology as much as was previously within mid-twentieth century sociology; the difference being that 'stability', as a working sociological concept, has long been consigned to theoretical history. Much of the literature on resilience – including its original position paper – developed by drawing a clear distinction between stability as '...persistence of a system near or close to an equilibrium state' and resilience as '...the amount of disturbance that a system can absorb without changing state' (Gunderson 2000: 426), thereby describing a broader distinction between qualitative assessments of internal relations, and quantitative assessments of variable fluctuations. Clearly, in the context of literature reviewed in chapter 1 concerning both ontological and systemic-hierarchical complexity, social theory has long since demonstrated the limitations and damaging implications of imputing equilibrium assumptions onto configurations of social relations, structures and institutions. Resilience thus fits a preliminary requirement by avoiding the specification of optimal states, or particular base values designating equilibrium which may involve subjective or ideological assessment (i.e. returns to population growth following famines or epidemics, or returns to economic growth following recessions). Current interpretations of resilience – with reference to *ecological* as opposed to *engineering* resilience as distinguished above, and elaborated further below – assume the possibility of *multiple stable states*, by which perturbations may 'force' particular systems toward threshold limits, inducing regime shifts, resulting in the system entering an alternative 'stable state' with the loss of elements of its original identity (Gunderson 2000, Cumming and Collier 2005, Kinzig et al 2006).

It must henceforth be acknowledged that a clear distinction exists between these variants of resilience and their sociological counterparts; it remains for this chapter to articulate the precise nature of 'identity' in the context of socioecological systems, but, as discussions of Parsonian functionalism in chapter 1 have demonstrated, faults of conservatism and reductionism must be levelled at the manner in which particular practitioners have employed such devices, rather than suggesting an intrinsic unsuitability with the concepts themselves. By employing 'identity' as a qualitative descriptive device, the requirement of precise quantification – although permitted – is not mandated by default. Furthermore, the multi-scalar nature of such systems permits the use of particular techniques appropriate for specific levels (i.e. quantitative assessments of demographic dynamics and regional productivity, qualitative descriptions of ideal-typical system configurations, cultural patterns, tenure systems and kinship structures – which in combination reflect particular dynamics and properties at multiple analytical levels). If such dynamics and properties are observed to conform to a broad configuration or pattern, they may

be designated collectively as a particular 'identity' – thus fitting loosely and fluidly within a broader structural framework.

As these title concepts are now elaborated below, it is important to acknowledge certain commonalities in the nature of debates thus far examined. In many respects, resilience represents a more applicable operationalisation of complexity, which has been singled out as a 'panchreston' (i.e. broad and oversimplified) by Lindenmayer and Fisher (2006 cited in Cumming 2011: 9). Complexity offers a powerful and deep-reaching paradigmatic narrative of social change rooted in thermodynamics, but in its unqualified form remains at a high level of generality. Furthermore, previous discussion of the labour process, which has identified the critical analytical link between the natural and social, has shown that a grounded materialism is essential for developing any typology of socioecological systems. Within both discussions, the 'master concept' of metabolism looms large, which subsequently directs consideration toward a process-oriented account of any such system, rather than static structuralism. And yet, as certain studies discussed above have demonstrated, this has not precluded the operationalisation of energetics and complexity in other forms such as energetic reductionism – indeed, it is perhaps this inherent difficulty of a perspective which so readily implies a reductionist approach that has led to such difficulties of incorporating the social in a sufficiently holistic manner. Consequently, there is much to endorse in this particular sub-section of human ecology which retains the epistemological problematic of complexity, but which moves toward developing a sufficient analytical basis for practical application.

3.3.2.1. Resilience, adaptive cycles and adaptive capacity

Formulating sufficiently robust and generalisable concepts of social-ecological systems has proven elusive, as the issues raised in chapter 1 concerning concrete systems modelling has revealed. Furthermore, debate has moved substantially beyond questions of distinguishing simply between closed and open systems, and their respective implications for vitalism (which now holds little validity), toward more substantive questions of empirical analysis, management and intervention. Within the literature on human ecology, a number of attempts have been made to formalise working definitions of social-ecological systems in such a manner as to represent universal characteristics, whilst retaining a sufficient degree of case-sensitivity. Cumming identifies such a 'minimal elements' approach within existing SES (social-ecological systems) practice;

> "A minimal framework for SES theory starts with the definition of an SES as a cohesive complex adaptive system with at least three different hierarchical levels...These levels exist at different scales and exhibit dynamics at differing speeds that range from fast to slow. The SES is further defined by the presence of components that include elements of social and ecological systems; interactions between components; some form of continuity in space and time; and a degree of overall system coherence that connects the elements of the system into an identifiable entity...In most cases a set of rules or institutions, both formal...and informal...governs the number and nature of interactions that involve human actors...With the possible exception of the global system, SESs will also have an external environment in which they exist; this environment provides perturbations and surprises, as well as inputs from other SESs and locations or actors to which system outputs are sent" (Cumming 2011: 43)

Although the above (title) concepts are singled out for individual discussion, they are inherently inter-related; together, they propose to capture the manifest dynamics of social-ecological complexity and the interaction of various system components implicated in the production of particular ecological outcomes, as the above, provisional definition of a social-ecological system implies. Collectively, the concepts of resilience, adaptive capacity and panarchy, when operationalised within the context of such a sufficiently general systems concept, present a number of devices with which to discuss and communicate commonalities of process and mechanism across locations, whilst retaining the possibility of descriptive and analytical particularism;

> "...social-ecological systems are neither humans embedded in an ecological system nor ecosystems embedded in human systems...although the social and ecological components are identifiable, they cannot easily be parsed for either analytic or practical purposes. Case studies and models indicate that pathologies of management occur when the stabilization of key ecological processes for economic or social goals leads to a loss of resilience. The loss of ecological resilience tests the adaptive capacity of the human dimensions of the system. Patterns of abrupt change...are described, in a handful of heuristics, by (1) an adaptive cycle, (2) panarchy, (3) resilience, (4) adaptability, and (5) transformability. The first two describe the dynamics of systems within and across scales, whereas the last three are the properties of social-ecological systems that determine these dynamics" (Walker et al 2006: 13-14)

Before elaborating these heuristics, a note of methodological qualification is required. Many authors have emphasised the need for parsimony in mapping any such metamodel onto empirical case studies (Holling 2001, Walker et al 2006). This general 'rule of hand' (Walker et al 2006: 5) specifies that despite the inherent complexities of social-ecological systems; outcomes, dynamics and changes may typically be understood with a small number of dominant variables – for social-ecological systems, such controlling variables may refer to relations or processes (i.e. the role of particular institutions). According to Holling, such systems, as complex adaptive systems, maintain their self-organisation with a limited sub-set of critical processes (2001: 391). As a principle rooted in previous empirical assessments of

resilience, this proposition represents an empirical corroboration of previously difficult to operationalise assumptions of complexity. Moreover, when considered in the context of the above heuristics, it is worth observing how this assumption need not imply excessive simplification; as will be demonstrated, such simple heuristics capture a range of processes and dynamics that permit communication and comparisons of commonalities across case studies, but which are also capable of accommodating empirical diversity. This 'rule of hand' is borne out mathematically, as the principle of parsimony in quantitative research demonstrates. Accordingly, this principle dictates that predictive models should contain no more variables than are necessary to explain particular outcomes. When unnecessary variables are added (whose variation may in any case be subordinate to other dominant variables), precision is in turn lost through coefficient standard error inflation (Agresti and Finlay 2009: 467). Although the above concepts are not to be operationalised in such a manner, the principle is worth bearing in mind, particularly when such systems are examined from the perspective of their panarchical organisation – a concept which mandates the examination of causation across multiple organisational levels.

The 'adaptive cycle' represents the first point of departure in resilience models of social-ecological dynamics; as a 'meta-model' it describes changes over time in both the structure and function of particular systems as a result of internal dynamics, and external influences (Walker et al 2006: 2);

> "...researchers have learned that most systems of nature usually proceed through recurring cycles consisting of four phases: rapid growth, conservation, release, and reorganization...The manner in which the system behaves is different from one phase to the next with changes in the strength of the system's internal connections, its flexibility, and its resilience. This cycle is known as an adaptive cycle...as it describes how an ecosystem organizes itself and how it responds to a changing world" (Walker and Salt 2006: 75)

As a general model, it is considered to represent the development of multiple social, economic, and ecological systems; comparisons between Joseph Schumpeter's depictions of capitalism as a process of 'creative destruction' are typically made to illustrate its social applications (Holling 2001, Walker and Salt 2006, Schumpeter, Joseph 2008 [1942]). The cycle itself is presented as a four-stage, process model of essential ecosystem functions or phases (r, *K*, Ω, α). Initially, systems enter a phase of growth characterised by rapid resource accumulation (***r-phase***), throughout which demands are placed on resources and energy to maintain structure and connections. Species or actors exploit ecological and social resources throughout this period of weak internal regulation, where resilience is initially high due to the inherent

flexibility of the system, thus allowing it to militate against disturbance (Walker and Salt 2006). Phase two is characterised by a slowdown in growth, throughout which the system becomes '...increasingly interconnected, less flexible, and more vulnerable to external disturbances. This is described as the conservation phase' (***K-phase***) (Walker et al 2006: 2). Throughout this phase, component interconnectedness increases, whilst internal states become more strongly regulated (Walker and Salt 2006: 77). This initial sequence (r, *K*), known as the 'fore loop', represents movement from exploitation to conservation, throughout which various forms of capital are accumulated, such as biomass, nutrients, physical landscape structures and social structures, but with a consequent loss of resilience;

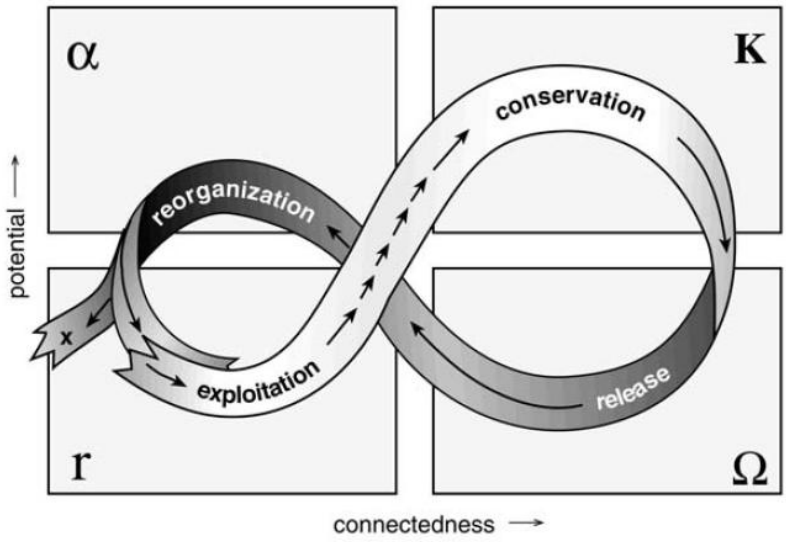
> "As the progression to the K phase proceeds in an ecosystem, for example, the accumulating nutrient and biomass resources become more and more tightly bound...The potential for other use is high, but it is expropriated and controlled by the specific biota and processes of the ecosystem in place. That is, the system's connectedness increases, eventually becoming overconnected and increasingly rigid in its control. It becomes an accident waiting to happen" (Holling 2001: 394)

Such 'accidents' (i.e. disruptions triggered by specific agents such as severe weather or disease) occur due to lost flexibility and resilience throughout the K-phase, leading to a release-reorganisation sequence (Ω, α) in which accumulated resources and capital are released (***Ω-phase***), resulting in a phase of reorganisation (***α-phase***);

> "The longer the conservation phase persists the smaller the shock needed to end it. A disturbance that exceeds the system's resilience breaks apart its web of reinforcing interactions. The system comes undone. Resources that were tightly bound are now released as connections break and regulatory controls weaken. The loss of structure continues as linkages are broken, and natural, social, and economic capital leaks out the system" (Walker and Salt 2006: 77)

This latter sequence (Ω - α) is referred to as the 'back loop' (Holling 2001, Walker et al 2006, Walker and Salt 2006). Collectively, these four phases of the adaptive cycle may be represented graphically as in *figure 3.4* below.

Figure 3.4

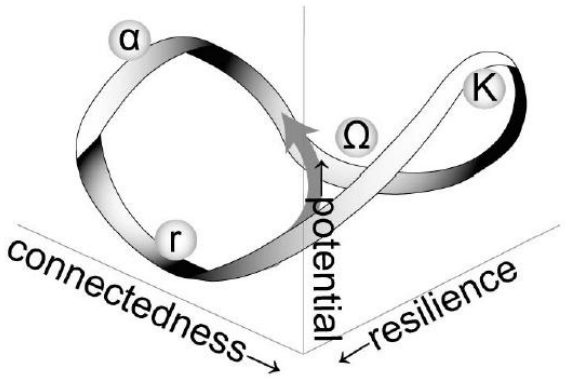


Graphic illustration of the adaptive cycle (from Walker and Salt 2006: 81)

The respective x-y axes of the above graph represent levels of potential (y) and connectedness (x); 'connectedness' '...determines the degree to which a system can control its own destiny, as distinct from being caught by the whims of external variability', or the level of connectedness amongst controlling variables (Holling 2001: 394), whereas 'potential' refers to '...the potential that is inherent in the accumulated resources of biomass and nutrients' (ibid). As observed above in *figure 3.4*, as the adaptive cycle closes the fore loop (r, *K*), both connectedness and potential increase, whilst the back loop (Ω, α) induces a loss of connectedness, with a concomitant increase in potential for reorganisation.

The specific nature and trajectory of adaptive cycles are determined by the resilience, or vulnerability of the system to perturbation. According to Holling (2001), throughout the transition (r - *K*), resilience, initially high throughout the 'r' phase is lost as connectivity increases, and the net costs of failure increase. Resilience therefore increases with innovation and reorganisation throughout the (Ω - α) back loop, which, it must be pointed out, carries in this provisional state, an implicit assumption that self-directed reorganisation is indeed possible. This further dimension of resilience is illustrated below in figure 3.5, according to its varying presence across different stages of the adaptive cycle as suggested above.

Figure 3.5



Distribution of resilience across adaptive cycle stages (from van Apeldoorn, Kok, Sonneveld and Veldkamp 2011: 46)

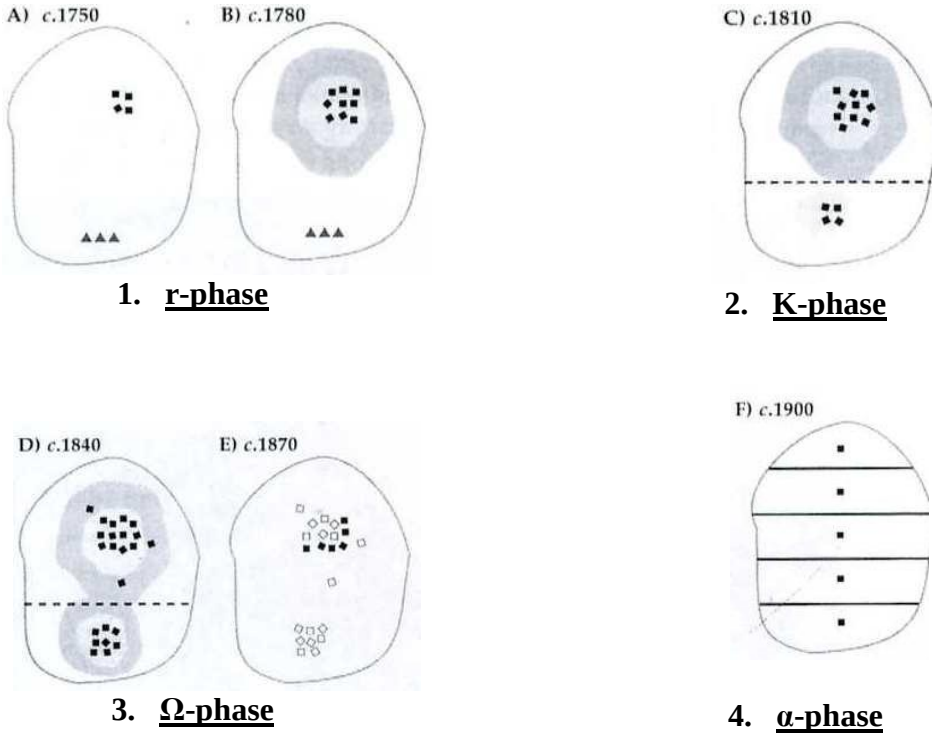
Within the literature on resilience, the fore loop (r - *K*) is commonly referred to as a 'development loop' and the back loop (Ω - α) as a 'release and reorganisation loop' (Walker and Salt 2006: 81), reflecting the inherent nature of such cycles as ones of growth-reorganisation. Phases of the adaptive cycle are therefore linked across both axes in the following manner;

> "Ecosystems are believed to be resilient because they are able to 'adapt' to changes and new conditions. Resilience is believed to be based on cyclic changes of two properties: potential and connectedness: "Potential sets limits to what is possible – it determines the number of the alternative options for the future. Connectedness determines the degree to which a system can control its own destiny...resilience determines how vulnerable the system is to unexpected disturbances and surprises that can exceed or break that control" (Holling and Gunderson 2002: 51 cited in Grimm and Calabrese 2011:9)

A crude example of an adaptive cycle in social-ecological systems was previously outlined (although not articulated as such) toward the end of chapter 1 with a graph depicting population growth in Ireland from the seventeenth to nineteenth centuries. Taking the adaptive cycle illustration *figure 3.4* as a key point of departure, and beginning from the lowest observed population value; within specific regions, the initial growth phase (r, *K*) may be depicted as involving colonisations of previously uninhabited lands, encroachments onto commonage, deforestation and slash-and-burn fertilisation which in turn consolidated stocks of ecological, human, and social capital (i.e. biomass, physical settlements, modes of succession and governance) in systems of high connectivity. Throughout this phase of growth, Irish agriculture

was particularly vulnerable to 'perturbation' from various agents, as the multitude of famines and food shortages in intervening years indicate (i.e. from the early eighteenth century to the great famine). Kinealy (2006) suggests that the famine of 1740-1741 may, in relative terms, have resulted in a greater loss of life than that experienced during the great famine of 1845-1852. Various crop failures and associated diseases - the latter demonstrating the profound epidemiological implications of high connectivity and high-density settlement – resulted in intermittent periods of food shortage in 1800-1801, 1816-1819, 1821-1822 and 1830-1831 (Kinealy 2006: 27). Although it is too restrictive to remain at this aggregate level of analysis (ignoring as it does the diversity of regional agricultural economies, variable degrees of market orientation, settlement types, demographic dynamics and class structures), it nonetheless demonstrates the provisional validity of the adaptive cycle heuristic – if not the specifics and nuances of the forces at work shaping Irish social structure. Furthermore, the critical variable of colonial administration and its associated rental regimes must be further considered in local contexts as a factor fostering resistance to post-release, self-directed reorganisation.

Figure 3.6



1. r-phase **2. K-phase**

3. Ω-phase **4. α-phase**

Ideal-type adaptive cycle of rundale (images from Aalen, Whelan and Stout, 1997)

A more localised manifestation of the adaptive cycle presents within the case study system of rundale. Although debate concerning the precise origins of rundale is complex (further discussion is provided in chapter 6 – see also Slater and Flaherty 2010), general agreement

exists as to the likely physical development trajectories of individual settlements – ignoring variations in modes of local governance and forms of tenure. Illustrated in *figure 3.5* (Aalen, Whelan and Stout, 1997) is an ideal-typical model of rundale system development, from an initial settlement period r (1) to expansion K (2-3) and reorganisation Ω - α (4). Although regional variations abound, the above model depicts physical expansion from an initial period of low-density settlement, with the emergence over phases 2-3 of a typical system of infield-outfield rotation, such as is associated with similar settlement types in cross-European contexts (Uhlig 1961). When considered in the context of overall population growth rates throughout the eighteenth and nineteenth centuries, it becomes possible to appreciate the associated exponential increases in resource and biomass requirements over this period, and the extent of resource centralisations which occurred at settlement level throughout prolonged periods of deforestation and importation of local fertiliser through transhumance. Consequently, within these particular settlements, (which it is estimated comprised up to 63% of the total settled area of Co. Mayo in the 1840's (McCabe 1991), connectivity, coupled with a dependence on market sales of cash crops for rent and consequent subsistence on a narrow range of root crops, increased connectivity and lowered resilience to dangerous threshold levels throughout the pre-famine years.

With the arrival of potato blight in 1845, resilience was ultimately exceeded – the result of a sustained diminishing of the adaptive capacity of rundale - initiating a prolonged Ω-phase of release, facilitated by mortality, disease, clearances, relocation, and assisted emigration. Reorganisation (α-phase) followed throughout the nineteenth century, with a sustained period of reorganisation known as 'striping', whereby depopulated nucleated settlements reorganised according to 'rational' principles of individualisation, a process which incorporated both local redistribution projects, and state-assisted redevelopment schemes (Breathnach 2007, Bell 2007). Although the social, colonial, and economic contexts requires extensive qualification, the heuristic of the adaptive cycle points toward an examination of factors which *inhibit* resilience – an orientation which ultimately implies consideration of social and natural variables, both of which are inextricably implicated in the maintenance of resilience.

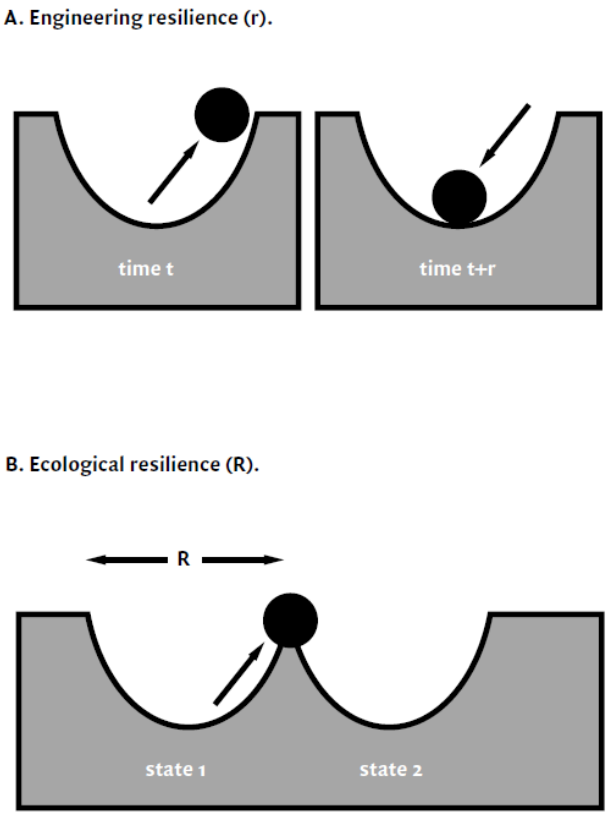
For the purposes of this work, establishing the extent to which this specific adaptive cycle model fits universally with case study data is of less interest (although it inevitably captures, in an ideal-typical state, certain macro-processes and features of settlement expansion for human agricultural systems). In this initial form at least, it represents a welcome corrective to environmental determinism by refusing to interpret social-ecological collapse as a mere deviation from core ecological parameter values. Various papers have identified alternatives to

the adaptive-cycle rule which will presently be discussed, although they also readily acknowledge it constitutes the most widely cross-generalisable model (Gunderson 2000, Holling 2001, Cumming and Collier 2005, Walker et al 2006). Variations, where identified, typically deal with the order of phase transitions in the cycle (i.e. managed systems which transit from accumulation (K) to growth (r) phases without collapse, or which persist within extended growth phases).

Papers such as Abel, Cumming and Anderies (2006) have remarked that the 'adaptive cycle' as a meta-theory, often requires elaboration with further case-specific theories to provide a rounded explanatory framework. In this context, the adaptive cycle model instead reveals a more useful set of general concepts in the form of resilience and adaptive capacity as *properties* of complex social-ecological systems which determine overall vulnerabilities of systems to external shock. This important re-orientation directs discussion away from linear questions of stability, toward an examination of how various elements within such complex systems interact to confer resilience, or how particular circumstances conspire to produce a loss of resilience, and a consequent increased exposure to ecological hazards. Gunderson summaries this orientation as follows; 'Many of the manifestations of human-induced state changes in ecosystems result from alteration of the key variables that influence the underlying stability domains...The property of an ecosystem that describes this change in stability landscapes and resilience is referred to as adaptive capacity' (Gunderson 2000: 428)

As will presently be demonstrated, the concept of system identity features strongly in this account as an important conceptual device for assessing whether resilience has been reduced to a point where the system has crossed a particular threshold. Crucially, these various concepts are amenable to qualitative operationalisation; they do not point *specifically* toward key parameters of stability, or predictive models, but rather designate a range of characteristics and properties whose implementation is required for assessment. The differences between the assumptions and substantive focus of stability vs. resilience approaches to system assessment are typically depicted using the 'cup and ball' illustration below;

Figure 3.7



Engineering and ecological resilience 'cup and ball' heuristic (Gunderson 2003: 35)

According to *figure 3.6,* engineering resilience (A) is typically concerned with characteristics of the shape of the cup (the cup, or trough representing a particular stability domain), with resilience operationalised as the return time after disturbance (r+t) to the trough of the stability domain. Ecological resilience is instead concerned with the width of particular stability domains (i.e. width between peaks) which determines the amount of disturbance a system may undergo before transition to an alternate state is induced – such a property is not readily amenable to precise quantification in most sociological analyses. The probability of a particular system crossing this peak threshold is in turn determined by its *adaptive capacity*, as a heuristic capturing the systems capability to appropriately respond to feedback (Berkes, Colding and Folke 2003, Fabricius and Cundill 2011). The concept of adaptive capacity appears in a multitude of forms across various disciplines; within biology, its classical application has focused on adaptive traits, or '...adaptations...arrived at by natural selection' (Plummer and Armitage 2011: 7). Within the social sciences - particularly anthropology, as discussed above - approaches such as 'cultural ecology' have examined the mediating role of institutions in

human adaptations to environmental conditions. Conceptualized as the capability of systems to exhibit robustness to disturbances, it is defined by Plummer and Armitage according to four requirements; '...(1) learning to live with change and uncertainty; (2) nurturing diversity for resilience; (3) combining different types of knowledge for learning and (4) creating opportunity for self-organization toward social-ecological sustainability' (2011: 1-2).

Although knowledge features prominently in this somewhat 'managerial' definition, it reflects an important distinction between 'natural' and 'social' systems, in that the latter exhibit a capability for self-organised adaptive learning, with the capacity to store, retain and transmit multiple forms of knowledge (i.e. mythological, practical, tacit) through culture and institutions. Social capital is thus identified as a critical component of adaptability by Walker et al (2006), whereby factors such as quality of networks and governance institutions (both formal and informal) impact on the capabilities of such systems to respond to perturbation; '...the adaptive capacity of all levels of society is constrained by the resilience of their institutions and the natural systems on which they depend...the greater their resilience, the greater is their ability to absorb shocks and perturbations and adapt to change' (Berkes, Colding and Folkes 2003: 14). In this respect, social and natural variables interact recursively, and at multiple organisational and spatial scales, to determine levels of resilience. The concept has been usefully applied to sub-Saharan African agriculture by Fabricius and Cundill (2011), wherein a number of issues militating against social-ecological resilience were documented, such as '...inappropriate cultivation practices...biodiversity loss...loss of governance capacity through past political oppression...lack of finances to invest in agriculture' (Fabricius and Cundill 2011: 45). Such circumstances resonate strongly within the Irish pre-famine context, and arguably within more recent instances of famine across the globe where 'political engineering' of social structures toward specific ends has produced conditions of markedly similar diminished resilience.

By adopting a resilience approach, the authors' interventions became structured around an adaptive management frame, whereby social and ecological variables were represented as interacting across multiple scales; their remedial strategies subsequently emphasised an immediate need to restore the adaptive capacity of direct producers. The utility of an ecological resilience approach, as opposed to a 'stability' or engineering resilience approach, rests in its use of the concept of regimes as opposed to equilibrium, whereby a system may be conceived as operating within particular parameters with a broadly defined identity (i.e. within a particular domain of attraction as represented by the cup). Regime-transition to an alternative state may thus be assessed by examining the extent to which the system has lost identity. The assessment

of such change, as a consequence of a loss of resilience, necessitates '...a shift in focus from numerical values of state variables to 'relationships', i.e. to the internal organization of ecosystems which gives rise to their properties' (Grimm and Calabrese 2011: 8). 'Adaptive capacity', therefore, is the essential property dictating the nature of particular adaptive cycles; as systems transition through adaptive cycle phases, differing configurations of social-ecological variables interact to confer resilience in the form of robustness to external shocks.

A classical problem with general systems theory, as outlined in chapter 1, was its tendency to employ base assumptions of hierarchical organisation. Such thinking arguably reflected a broader tendency toward scientific formalisation (i.e. by adopting unsuitable measures of closed-system stability), or the presence of assumptions bound up with linear modelling and causality. The above account has suggested that resilience and adaptive capacity function at multiple scales and organisational levels i.e. cultural, ecological, political, local, community, national, trans-national, such that traditional notions of linearity are rendered problematic. Chapter 1 has also presented a 'meta-critique' of linear representation and analysis derived from a complexity epistemology. Typical depictions of hierarchical organisation originating within general systems theory emphasise the nested nature of such hierarchical systems, and the connectedness of higher-order units to lower-level constituents. Accordingly, resilience thinking has suggested that such linear devices may not accurately reflect the true nature of natural-social hierarchies, given that adaptive processes may operate in different ways across various organisational levels. The concept of panarchy attempts to capture the essence of this complexity.

3.3.2.2. Panarchical organisation, biodiversity and scale

As a working concept, panarchy first emerged as an attempt to address certain explanatory deficiencies associated with conventional hierarchy assumptions in ecological theory and analyses. According to Holling (2001), such a re-orientation was necessary due to the persistence of 'top-down' perspectives in ecology, which viewed systems as hierarchies of 'vertical authority' (i.e. downward causation – Holling 2001: 397). Panarchical organisation is thus intuitively recognisable for sociologists (as discussed in chapter 1) given that the discipline had long before opened up debate regarding both the relationship between structure and agency, and the ontological nature of social structures as emergent properties (Sawyer 2005, de Hann 2006). Such thinking also appears in various guises (albeit in more restrictive forms) across other disciplines such as economics in the form of methodological individualism (i.e. rational actor theory). Panarchical organisation in resilience thinking deals more with the nature of

social-ecological systems as 'nested adaptive cycles', rather than questions of lower-order autonomy alone, thereby extending the singular concept of 'adaptive cycles' to incorporate variability across organisational levels; '...the adaptive-cycle dynamics of a system at a particular focal scale, e.g., a region, are influenced by the adaptive-cycle dynamics of linked systems at finer scales, e.g., a farm, and broader scales, e.g., a nation. This cross-scale aspect of resilience theory is termed "panarchy"' (Abel, Cumming and Anderies 2006: 2).

Limitations to assumptions of hierarchical, downward causation (i.e. assuming lower-level processes and entities to be constrained by higher-level) are evident when one considers the nature of rundale settlements outlined above in *figure 3.5*. Such settlements - far from isolated spatial phenomena - existed as complex adaptive systems, which were comprised of, and whose development depended upon, the interactions of multiple factors, crossing various spatial, organizational and ontological levels such as climate, economy, political regimes, legal systems, demography, culture, norms, institutions of governance, transhumance patters, household units, agrarian systems, field systems, and individual cultivation units. Difficulties thus arise in applying the adaptive cycle metaphor to such entities as a single homogeneous unit; given that hierarchical confinement cannot be assumed - i.e. the constraint of small, fast features or levels by broad slow ones. (Walker et al 2006). Instead, such systems are characterised by panarchical relations, whereby properties of units and factors at various levels interact with, or are subject to influence from, processes both 'above and below', which may themselves be subject to the imperatives of multiple adaptive cycles operating at varying speeds. This multi-scalar framework has been applied to Ireland by Evan Fraser (2003, 2006), whose use of the panarchy framework has drawn attention to the outcome of perturbation exposure engendered by high connectivity operating at multiple levels[77] which will be discussed further on. According to Holling (2001), higher-order levels of a particular system transiting through a Ω – phase (release), may trigger a 'revolt' effect (i.e. a cross-scale interaction), whereby connectivity at lower levels within K-phases (high accumulation, connectivity and low resilience) amplifies the effects of perturbation to disastrous consequences. In some contexts, alternative cross-scale interactions know as 'remember' effects may occur, in which properties of higher-order levels may militate against cascade through the mobilisation of accumulated knowledge (Holling 2001, Walker and Salt 2006, Cumming 2011). For social-ecological systems, the concept of 'collective memory' offers one such example of a higher-order

[77] As will presently be discussed, (reflecting the core focus of this thesis), Frasers' account unfortunately does little to account for the complexities of Irish social structure, and further lacks a developed theoretical account of the processes producing internal variation in settlement dynamics

property, and its role in mediating adaptive capacity will be examined under the rubric of 'institutional robustness' in the following section.

The question of assessing and accounting for change and transition in panarchically-organised systems raises a number of points of concern warranting further discussion. Following from the propositions of Walker et al (2006) regarding the validity of the adaptive cycle, and Abel, Cumming and Anderies' (2006) closer examination of the Ω – α phase (i.e. back loop), certain noteworthy conclusions were drawn, namely; '...transitions among the four phases of change may not be a fixed sequence...cross-scale interactions critically determine the form of the subsequent adaptive cycle at any particular focal scale...slowly changing variables control ecological resilience, whereas social resilience is controlled by either fast-or-slow changing variables' (Abel, Cumming and Anderies 2006: 2). Distinctions between fast and slow variables are further elaborated by Walker et al (2006), who identify ecological variables such as sediment concentrations and nutrient content as subject to slower periods of change than social variables which may operate either faster or slower, such as technological development (rapid) or cultural change (rapid in certain cases of agrarian unrest, or slow as with cultural change). Such issues of response-feedback lag are critical in augmenting resilience, as institutional realignment or collective responsiveness may be subject to limitation by 'slow' factors such as cultural convention or government ideology. Similarly, slow ecological variables such as declining fertility, coupled with slow feedback (i.e. yield declines which may require multiple seasons before exhaustion thresholds are acknowledged) may confront an institutional inability to respond (i.e. where the introduction of fallowing or alternative rotation systems is required). The potential for such reorganisation to occur (i.e. adaptive capacity) will, within particular systems, be further augmented by dominant modes of tenure, and overarching economic imperatives. Panarchical conceptualisation is thus critical in accounting for such scale mismatches, and complex, non-linear interactions.

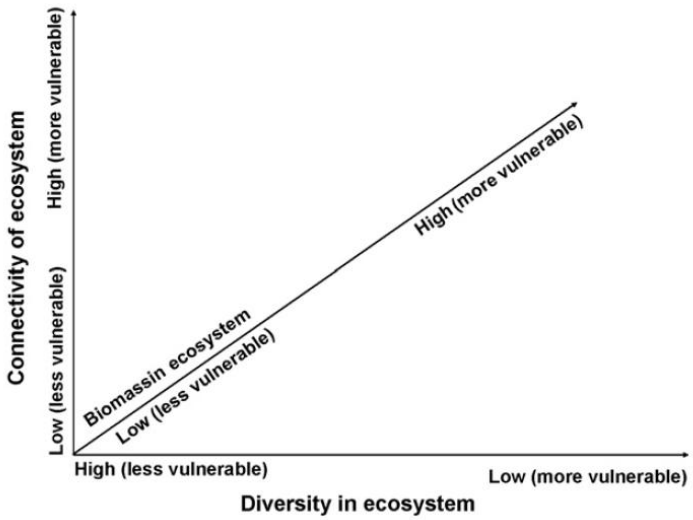
Cumming (2011) offers an expanded model of spatial resilience, which attempts to represent complex panarchies as constituted through multiple spatial levels. Within this broad model, social-ecological systems are viewed as nested within a hierarchy of 'global → regional → local', wherein factors specific to particular levels are viewed as impacting both upward and downward upon neighbouring levels. At local levels, the resilience of such systems is further parsed by Cumming into that accounted for by spatial factors (morphology, boundaries and position within phase space), and identity-related elements such as '...components, relationships, innovation, adaptation, continuity, thresholds, and local perturbations' (Cumming 2011: 48). Questions thus arise as to how processes operating at various spatial levels impact

upon resilience both within particular levels, and in terms of their potential to produce effects at higher and lower levels. Such questions address a number of factors, such as; '... [internal arrangement] flexibility of spatial properties; path dependence in arrangement, [morphology] is it big enough to cope with potential perturbations...is size limiting growth; what is link between size and available resources... [location] what are locally unique or unusual properties that play a key role in system resilience...[spatial subsidies] is the system strongly dependent on external, one-directional inputs; does it provide inputs to another system' (Cumming 2011: 51-52). A similar approach has been taken by Kinzig et al (2006) who identify a number of interacting spatial levels running from small to large, such as patch, individual farm and region. At various scales, regime shifts may be induced by changes at particular levels inducing changes at other levels.

Cumming's extension of resilience to incorporate spatial organisation and variability simultaneously demonstrates a common assumption across all such interpretations of resilience and panarchy; that diversity across multiple organisational and ontological levels functions to enhance resilience. From a purely ecological perspective, Peterson, Allen and Holling (1998) have suggested that species diversity and interaction at multiple scales, functions to confer regenerative capacity following cross-scale disruptions. Under the 'species diversity' paradigm, which traces its origins to Darwin, diversity is viewed as increasing the stability of ecosystem function by introducing cross-scale dampening effects (Peterson, Allen and Holling 1998: 7). Furthermore, the authors outline how '...ecological function is distributed across scales...These interactions encourage functional diversity within a scale, and the distribution of ecological function across scales, enhancing crossscale resilience' (ibid: 14-16). Notwithstanding this purely ecological application, it suggests that the propositions of cross-scale interaction and the role of diversity in augmenting resilience are borne out empirically; system constitution and component interactions are therefore not simply panarchical, but also scale-dependent, and spatially organised. Subsequent applications have repeatedly shown that '...ecosystems with low species diversity are more vulnerable than ecosystem[s] with a large number of species. Ecosystems where the individuals are close (either spatially or in terms of chemical pathways) together tend to be more vulnerable than ecosystems where individuals are widely spaced' (Fraser 2006: 330).

A tri-axial model of this relationship is provided by Fraser (2006), illustrating the relationship between connectivity, biomass, diversity and resilience (reproduced below as figure 3.8).

Figure 3.8



Panarchy framework (Gunderson and Holling 2002 reproduced in Fraser 2006: 330)

Connectivity - as measured by settlement density - when coupled with high concentrations of biomass, and low species diversity (see Peterson, Allen and Holling 1998) functions to lower resilience, and to increase exposure to perturbation. As systems ascend the respective axes toward critical risk exposure levels, the magnitude of disturbance required to induce collapse becomes increasingly smaller. Pre-famine Ireland is therefore cited as a prime example of this critically diminished resilience (as a function of gradual ascension of the above axes), resulting of limited adaptive capacity at local levels. This diminished adaptive capacity encompasses reductions in biodiversity, increases in connectivity and settlement density under demands incurred through population growth and surplus realisation, pre-famine subdivision and both spatial and monetary restrictions on external subsidy imports (Fraser 2003, 2006, 2007, Kinealy 2006). Initially, such ecocentric conclusions were borne out by K.H. Connell's identification of the potato as a dominant independent variable accounting for expanding pre-famine fertility and population density. The classical narrative of biodiversity reduction through monoculture subsistence - somewhat authenticated, albeit with significant regional variation (Bourke, 1959, Downey 1996) - in turn led Connell (1950a) to hypothesise the potato as a key agent facilitating wasteland colonisation, subdivision through subsistence on smaller acreages, with a consequent removal of barriers to early reproductive union.

Clearly there is much possible heterogeneity across various trajectories of systemic development and collapse, and caution must be exercised in mapping any such model (i.e. *figure 3.7*) onto particular case studies. It is a critical oversight of Fraser's that he does not further consider the internal diversity of Irish productive regimes, settlement types, and legal provisions or modes of customary governance and allocation. There is clearly much merit in Cumming's spatial model therefore, which serves to direct discussion away from sweeping statements such as '...the agro-ecosystem in Ireland progressed from a relatively complex system of mixed livestock, grain and potato production to a system that was wholly based on the potato' (Fraser 2003: 4). Works such as Currie (1986), Slater (1988), O'Grada (1994), O' Hearn (2001), McDonough and Slater (2005) have revealed profound variability in factors such as general rental regimes, modes of tenure, regional economies and landholding distributions; points which demand a closer examination of how resilience was distributed across settlement types and modes of production, and in turn augmented by specific local practices.

Numerous authors operating within a resilience framework have seized upon this necessary qualification however, by probing further through mechanisms underpinning collapse and reorganisation, and examining closer the question of multi-scale variation (Holling 2001, Walker et al 2006, Abel, Cumming and Anderies 2006, Janssen et al 2006, Cumming, Cumming and Redman 2006, Gotts 2007). Holling (2001), for example, remarks how human social-ecological development is marked by the gradual emergence of panarchical organisational levels as a function of increasing complexity; such complexities introduce potential for vulnerability at particular adaptive cycles initiating cascading effects of ecological collapse; 'Periods of success carry the seeds of subsequent downfall, because they allow stresses and rigidities to accumulate. Organizations and institutions often fail to cope with these slow changes either because the changes are invisible to them, or they are so complex and highly contested that no action can be agreed upon' (Holling 2001: 399). This need not imply all such collapses proceed from ideal base-states; as the complexity account in chapter 1 has demonstrated, path-dependent lock-in may in certain instances lead to sub-optimal institutional arrangements which are incapable of responding collectively to feedback. Furthermore, as previous distinctions between engineering and ecological resilience have emphasised, such analytical devices are fundamentally non-normative (van Apeldoorn, Kolk, Sonneveld and Veldkamp 2011).

Such issues of scale mismatch permeate development and management literature, as illustrated by Cumming, Cumming and Redman (2006), who identify issues in reconciling social and ecological scale as critical in determining sustainability outcomes; '...scale mismatches occur

when the scale of environmental variation and the scale of the social organization responsible for management are aligned in such a way that one or more functions of the social-ecological system are disrupted, inefficiencies occur, and/or important components of the system are lost' (Cumming, Cumming and Redman 2006: 3). Examples include climate change, urbanization (which produces imbalances of production/consumption within local sites of production), population growth, or changes in organisational levels of governance (i.e. from local to national to trans-national). In terms of analytical units, scale mismatches occur where households may demonstrate marked adaptive and organisational capacity, but with cultures proving resistant (Cumming, Cumming and Redman: 8).

Abel, Cumming and Anderies (2006) are generally receptive to the concept of panarchy and adaptive cycles as an applicable alternative to abstract general systems theory, but are hesitant regarding its predictive capabilities, in the context of noted variations as discussed above. They nonetheless acknowledge the presence of issues of scale, by recognising the potential for cascading collapse inherent within highly interconnected, multilevel systems; 'although there is likely to be intrinsic stochastic cyclicity in any self-organizing system, external disturbances can disrupt this cyclicity at any time. The finer the scale of the system, the more susceptible to external influences it is likely to be' (Abel, Cumming and Anderies 2006: 20). For Cumming, Cumming and Redman (2006) and Abel Cumming and Anderies (2006), 'social' variables are identified as crucial, given the capacity of social-ecological (i.e. human mediated) systems for adaptive foresight and intervention. Although these authors offer much of utility in the form of ecologically-derived heuristics, their treatment of the social is open to, and in need of modification; again, these authors are quick to qualify wholesale applications of the adaptive cycle model, suggesting it functions better as a device '...to integrate disciplinary theories about political economy and the relationships between social, human, and natural capitals and resilience (Abel, Cumming and Anderies: 2006: 20).

On this point of concern, Gotts (2007) discusses a number of commonalities between world-systems theory, and resilience/panarchy as compatible theories of cyclical development and hierarchical organisation. It is worth pointing out the significance of this compatibility, as a number of papers are considered in chapter 5 which connect theories of metabolic rift with world systems approaches (i.e. Moore 2000, 2001, 2003a, 2011); this common thread should here be acknowledged as an important indication of cross-disciplinary amenability. Gotts' discussions of potential synergies draws attention to external factors of collapse, which are themselves often embedded within broader trans-national systems such that; '...economic and politically mediated links with larger national or transnational systems may be primary

determinants of events, rather than merely constraining or triggering factors in the dynamics of the regional systems' (Gotts 2007: 6). These comments fit within the broader world-systems framework which treats the 'world system', rather than more isolated political or spatial entities a key analytical unit, thus tracing connections between core-peripheral regions, and the economic and political structures which maintain relations of inequality (Friedman 2000, Wallerstein 2004). Commonalities of cyclical process are also noted between the adaptive cycle model of resilience (discussed above), and other empirical regularities addressed by world-systems theory such as the Kondratieff cycle. It may be argued that Gotts stages a number of unrepresentative criticisms of resilience however by suggesting it has over-emphasised 'internal contradictions' as an explanatory device in accounting for collapse – numerous case studies have examined external factors operating on multiple scales (Fraser 2003, 2006, Cumming 2011, Armitage and Plummer 2010); indeed the spatial resilience model is epistemologically similar albeit without developed conceptualisations of nation-states, corporations and their inter-dependencies. A number of noteworthy criticisms are offered however, such as his identification of the cumulative nature of technological development (in contrast to the cyclical depiction of technological development within nested adaptive cycles), and its apparent ability to forestall logistic population trends (the form of which is illustrated in figure 3.3). Although this perspective is better suited to interpreting patterns of global change and cross-national variation, it is a worthwhile reminder to consider downward levels of causation and influence when working within local contexts.

Although the heuristic of panarchical organisation is indespensible as a general orienting device in formulating explanatory accounts, it appears somewhat difficult to operationalise, as many of the above-cited authors have noted. One such valuable, multi-scale application is offered by van Apeldoorn et al (2011), who identify three timescales impacting upon the organic matter content of soils; geological evolution (millennia), reclamation (decades-centuries), and current management (seasonal). Examining the capacity of cultivators to transcend local cumulative history through the application of fertilizers allows the authors to view deficiencies at a particular scale (i.e. dependence on external resources) as a potential source of scale-mismatch, and loss of resilience. Thus far, the preceding review of thermodynamics, trophic interactions, and resilience has provided a number of immutable 'first principles'; that acts of production necessarily involve inefficient conversions of energy, that the 'labour process' is the essential emergent category mediating human-natural metabolism, and that population growth – assuming a scepticism of technological optimism – in the context of limits to carrying capacity at multiple organisational levels, must inevitably conform to logistic growth trends in the face of ever-diminishing growth capacity. Discussion of resilience thus far, has suggested that

notwithstanding a number of broad assumptions regarding the trajectories and development trends of such open systems (i.e. adaptive cycle theory), combined social-ecological systems are best assessed not with variable-centred stability metrics, but through a holistic frame of 'systems' as panarchically constituted and adaptive, wherein mitigating strategies become essential in assessing the potential for perturbation exposure.

This now imposes an imminent need to formulate an alternative, albeit necessarily more cumbersome means to assess systemic change and 'function' – bluntly, to operationalise a metric of social-ecological health which is essentially non-normative (van Apeldoorn, Kolk, Sonneveld and Veldkamp 2011). In rejecting singular notions of stability, resilience has instead employed the concept of 'alternative stable states' to express the potential for social-ecological systems to transition to differing configurations of variables within alternative stability domains, without enduring systemic collapse. Assessments of 'stability' (i.e. identity persistence) thus focus on the extent of resilience within such regimes without resorting to baseline-departure specifications. According to Gotts, '...change may occur, but the set of dynamically important variables and interactions remains fixed' (2007: 2); Cumming (2011) has thus suggested that a resilience-based analysis may be implemented by operationalising 'identity' as a typological and comparative device capturing such variables and interactions. What must therefore be established are the criteria by which a particular identity may be designated, the components, characteristics and interactions that constitute a stable identity, and the thresholds at which changes in such identity-constituents may be judged as constituting a critical regime shift. It must here be emphasised that the derivation of a metric of regime transition is not being pursued as such, but rather an exploration of the possibility of explicating a set of characteristics by which particular social-ecological systems may be articulated as ontologically distinct entities. Once established, it becomes possible to assess the dynamics of such distinct systems in terms of their adaptive capacity (i.e. to forestall ascension of the axes in figure 3.7 through productivity optimisation within panarchical adaptive cycles), and to explicate factors of constraint operating at multiple scales either within or beyond local boundaries.

3.3.2.3. Operationalising identity as a metric of resilience

Ecological resilience has been variously defined as '...the ability of a system to maintain its identity, where system identity is defined as a property of key components and relationships...and their continuity through space and time' (Cumming et al 2005), or as '...the capacity of a system to absorb disturbance and reorganize while undergoing change so as to

still retain essentially the same function, structure, identity and feedbacks – in other words, stay in the same basin of attraction' (Walker, Holling, Carpenter and Kinzig 2004: 6). Adaptive capacity has in turn been loosely defined as the capability of actors within social-ecological systems to respond to perturbation at an institutional level, as measured through their capacity to retain institutional integrity and function through space and time. For sociology, 'identity' constitutes one of the quintessential concepts advanced within the interpretivist tradition. Exemplary of developments in post-positivist social theory, identity is a cornerstone of the behaviourist critique of essentialism, which interprets social action and interaction as a fluid outcome characterised by the active negotiation of symbolic meaning, and a recognition of the unique capacities of human agency and language which: '...enables a degree of detachment from the demands and exigencies of the immediate circumstances and...creates a cognitive space in which a considered response (rather than an immediate reaction) may occur' (Layder 1997: 22).

Disciplinary responses (i.e. symbolic interactionism) to previous interpretations of action as a response-stimulus outcome, were in turn bound up with more general movements away from scientific analogizing, as discussed in chapter 1. Indeed, such criticisms interfaced with early sociological systems theory in a substantial way, given that many subsequent behaviourist critiques (i.e. those of G.H. Mead and Herbert Blumer) directly addressed functionalism's linear depiction of socialisation and social structure as agents of pre-ordained role direction. Mead's pronouncements on the self thus depicted identity largely as a social construct, and later variants of a more fundamentalist constructivism (i.e. Berger and Luckmann, 1967) emphasised 'social constructs' as the mainstay of sociological analysis; '...it is only if they are socially constructed that things might be amenable to sociological analysis' (Weinberg 2009: 281). Clearly it is important to distinguish specific variants of constructivism along the continuum suggested in chapter 2; i.e. between those who emphasise the impossibility of 'scientific' objectivity (i.e. extreme variants of linguistic constructivism), and those who view particular institutions, relations or attributes as the outcome of socio-historical shaping (in which case anything exhibiting influence from the hand of humanity is open to interpretation as a social construct).

These observations initially appear largely inconsequential for current research objectives, but the role of such debates in solidifying separatisms of the natural and the social should not be understated, as argued in chapter 2. Concurrent with a general avoidance of notions of truth and falsity, certain strains of relativist separatism have positioned constructivism as the quintessential theoretical basis of sociology, by describing broader dichotomies such as

sex/gender, or illness/disability (Weinberg 2009). The intellectual rigor and practical merits of studies rooted in constructivism are not in question, as clearly ones' choice of research strategy emerges as a consequence of the nature of specific types of research question. In highlighting this apparent incommensurability, an initial difficulty associated with the proposed adoption of 'identity' appears to be that of incorporating a concept associated with legitimating the subjective elements of human life as phenomena amenable to scientific analysis, within a framework offering a device for the systematic analysis and comparison of coherent systems (resilience and panarchy). It is here re-emphasised that this sociological debate need not be considered a significant barrier to operationalising identity in such a manner as is now attempted – chapter 2 has demonstrated how constructivism occupies a continuum encompassing 'soft' alternatives, and this chapter has shown how identity, in the context of its deployment in resilience ecology, is inherently fluid, qualitative, and furthermore proposes to move beyond simplified, fixed structural components. In this sense, it is worth bearing in mind Byrne's endorsement of the saliency of theories of the middle range, as suggested above. Given that foregoing discussion has established resilience as such an approach occupying this necessary middle ground between grand abstraction and working hypothesis, Byrne's affirmation of the utility of such a conceptual frame to practical investigation warrants endorsing; '...the use of that word – emergence – implies that our view of the impossibility/undesirability of grand unifying theory also applies to much of the natural world, and with particular force to intersections between the natural and the social' (Byrne 2009a: 4)

The problem of articulating distinct components of identity appears as philosophically problematic within human ecology as within the social sciences, and should therefore not be approached in a positivistic manner (whereby the pre-existence of an exhaustive, generalisable typology of system components and attributes is assumed). This does not mean a certain degree of conceptual stability is impossible however. In the context of its sociological application, Mead stated that identity '...represents the internalized norms and mores and moral standards that are current in the groupings to which the individual belongs' (Layder 1990: 23). Sociologists are accustomed to treating identity as the outcome of progressive influences of agents of socialization, through which individuals acquire, and subsequently actively negotiate, aspects of identity such as ethnicity, family, occupation, politics and ideology, values, sexuality and religion. It is thus a precarious stability across a matrix of such factors at the level of the individual, or within culturally-defined parameters of specific collectives, which constitutes a particular 'identity'. The acquisition of identity, as a consequence of our inherent need to adopt the role of a 'generalized other', is thus essential in order to acquire both the faculties and conventions of language, and to subsequently engage in productive interaction (Johnson 2008:

58). This crucial behaviourist re-alignment conceptualises identity as an active property, thereby describing a broader relationship between 'community conventions' (i.e. structure, or previously 'role expectations') and individual consciousness. This relationship is ultimately depicted as non-linear, in that the individual is viewed as capable of exercising their agency in the negotiation of identity, rather than passivity in the acquisition of fixed culturally defined cues.

This inherent fluidity of the concept of identity-as-construct has therefore not precluded sociologists from identifying in a systematic fashion the existence, persistence, and development of well-defined cultural groups, sub-cultures and identities. The status of identity as an emergent property with regard to social-ecological systems is less certain, given the absence of such a well-defined mechanism as socialisation with which to order thinking on the processes underlying such manifest characteristics, although human ecology in general displays no shortage of rational actor heuristics with which to attempt such grounding (Ostrom 1990), and various mechanisms regarding boundary specification, such as they inform the demarcation of stable systems (i.e. autopoiesis) have been addressed in chapter 1. Within human ecology, therefore, the task of designating identity and the specification of its constituent elements falls to the researcher, whom it has been argued, has previously been quick to rely largely on notions of *a priori* structure as with living systems theory. Cumming and Collier (2005) propose an alternative approach drawn from important lessons gleaned through an examination of evolutionary concepts across both the natural and social sciences;

> "Species, like societies, ecosystems, and economies, are mutable, dynamic entities that change over time. On the other hand, unlike species, which are spatially scattered as individuals and populations, ecosystems and societies are typically localized and spatiotemporally contiguous...Mutable, dynamical entities need not have essential properties that define a kind that is present in all of their parts, i.e., some ecosystem essence that can be recognized wherever one is within a specific ecosystem, although that is not ruled out, either. Instead, this approach maintains that identity is determined by dynamical relations among the parts. The problem is to find suitable dynamical relations that determine system identity by binding the system together. These are the sort of natural properties that we should look for, rather than localized properties that are found in every part of the system...A reasonable addition to current definitions would be to recognize that system identity resides in the continued presence, in both space and time, of key components and key relationships" (Cumming and Collier 2005: 3)

Difficulties of classification and representation addressed by 'identity' in the above quotation have evident origins in earlier debates concerning ecosystems as essentially spatially constituted. For social-ecological systems, problems engendered by purely spatial typologies and boundary definition are numerous; little can be inferred regarding the mechanisms

underpinning continuity in social structures and relations, for example, despite apparent continuities of spatial form, and such problems will later be discussed as prominent shortcomings within previous analyses of the rundale system. Although maintenance of key relationships and components through space and time is essential in defining a particular system identity (Cumming 2011), spatial form alone cannot be relied upon to develop suitable typologies. Furthermore, with reference to the examples above, the necessity of evolutionary definitions, such as with species, is no less mandated by social-ecological systems, given the comparatively shorter time-scales of their transformations. The necessity of such process-oriented conceptualisations is further underscored by the above author's identification of 'continuity through space and time' as a fundamental dimension of identity – clearly a spatial or static-structural (i.e. time invariant) typology of social-ecological systems reveals nothing about the potential persistence of such features which render it coherent (indeed, it is precisely the ability of Marxian historical materialism to abstract from physical form which endows the overall approach developed within this thesis with its investigatory capabilities). Given that resilience is inherently time-sensitive, such a dimension is critical in assessing the adaptive capacity of combined social-ecological panarchies.

Unfortunately, a great majority of current discussions concerning resilience and the operationalisation of identity come from authors with backgrounds in ecology, which somewhat lack depth in their treatment of the social components of identity (assuming for now, some necessary degree of natural-social analytical separatism). A number of authors have attempted to provide some general guidelines on specifying social-ecological identity components such as Walker, Holling, Carpenter and Kinzig (2004), Cumming and Collier (2005), Cumming et al (2005), Janssen et al (2006) and Kinzig et al (2006). There appears a comparative absence of formal discussion regarding identity as a working concept before the above-cited papers, which perhaps reflects a more recent, emerging willingness on the part of both the social and natural sciences to engage in a more critical examination of long-held heuristics, and perhaps also reflects a progressive realisation of the limitations to such spatial/functionalist devices in the context of the range ontological levels progressively introduced into conceptualisations of social-ecological systems (see Winterhalder 1983 for an earlier discussion of such emerging debates within anthropology).

Cumming et al (2005) suggest the following four dimensions as key constituents of identity, which define a broader analytical relationship between identity and resilience;

> "... (1) the components that make up the system; (2) the relationships between components; and (3) the ability of both components and relationships to maintain themselves continuously through space and time... (4) innovation and self-organization; resilient systems will typically be capable of adjusting to a variety of exogenous conditions, although innovation can also reduce resilience...the performance of a particular function or set of functions may also be used to guide the choice of identity criteria (Cumming et al 2005: 976)

In advancing such a framework of identity specification, a similar approach is taken as with the treatment of engineering/ecological resilience, in that the broad scope of the above dimensions avoids an approach solely based upon a-priori specification of critical variables or variable values. Such an approach, as has previously been argued, is insufficient when faced with a range of heterogeneous systems and case studies which may exist under differing configurations of identity criteria. The specification of identity constituents above thus addresses a number of needs, namely to maintain a certain degree of generality, and an avoidance of 'normative' measures, but with the capability to communicate commonalities of process and function – the latter of which is difficult, if not impossible to accomplish with certain variants of constructivism or actor-network theory. Preliminary examples of elements within the above four dimensions are offered by Cumming et al (2005); *components*, which includes '...human actors... institutions... ethnic groups... ecosystem types... forest, grassland... resources... materials...abiotic variables (for example heat, elevation, geomorphology)'; *relationships* which '...describe the ways in which system components interact or fit together...nutrient cycles, food webs, tropic interactions...economic and ecological competition, land tenure...and interactions between human actors'; and *continuity* which '...describes the ability of the system to maintain itself as a cohesive entity through space and time...continuity is facilitated by system memory, which may take the form of...social and biological legacies...customs and taboos, laws' (Cumming et al 2005: 977-978).

Alternative frameworks for the development of typologies of systems or modes of resilience / adaptation have been offered - albeit in a less formalised manner than that cited above - by authors such as Janssen, Anderies and Ostrom (2007), Ostrom (2009) and Janssen et al (2006) whose 'network perspective' proposes to focus on relationships and interactions between components (i.e. dimension two of Cumming et al (2005) above), and to develop stable typologies of social-ecological systems from archetypal network configurations. From their opening commentary (Janssen et al 2006) it is evident that analyses of social-ecological systems themselves suffer from their own 'resilience' to incorporation within general frameworks (i.e. for cases where social processes within systems may exert a dominant influence on ecological outcomes, simple mathematical / structural models which may be

successfully applied to 'natural' systems are not forthcoming). Indeed part of this difficulty, it is readily acknowledged, rests with the comparative inability of social-ecological systems to conform to generalisable structural typologies as discussed in chapter 1, lending further credence to the need for an identity framework which encompasses internal relations and continuities of multiple aspects beyond 'components' alone. Janssen et al's (2006) network perspective proposes to represent social-ecological systems as a series of networked nodes and links, whereby interactions between nodes (which may be social, ecological, or incorporating elements of both) reveal stable elements of social-ecological system structure. A number of attributes for designation as 'nodes' are identified such as trust, power, material flows, and 'hybrid' attributes such as cultivation strategies. According to this perspective, representation is made possible by mapping linkages between ecological nodes created by human activity (i.e. where livestock herding may connect previously unconnected land tracts and resources).

Although this appears to be a more rigorous formalisation of 'identity' (i.e. where archetypal or generalisable forms of natural-social network may be derived), it not readily applicable within the confines of the present case study, given that any such data-rich site as would allow the extensive mapping of such relations is lacking. Furthermore, the manner in which the 'social' is defined and implemented is further indicative of its generally limited treatment within such studies. Janssen et al's (2006) conceptualisation of the 'social' appears limited to the mere presence of 'relatively homogeneous groupings' which engineer linkages between discrete ecological systems through various adaptive management strategies. A limiting, threefold typology of social-ecological network archetypes is thus derived which distinguishes; '(1) ecosystem networks that are connected by people via information or physical flows, (2) ecosystem networks that are disconnected and fragmented by people, and (3) ecosystem networks that connect people' (Janssen et al 2006: 20). Such an approach represents an excessive form of reductionism which ignores the range of complex hybridities and dynamic connections by which humans mediate their ecological engagement. Furthermore, it is excessively static and decontextualised; as the heuristic of panarchy has revealed, dynamic multi-scale interactions characterise any such social-ecological system – and this is not a complexity which is easily represented through static network mapping. Bhaskar (1998) has previously addressed this inadequate conceptualisation of the social, by identifying a common mistake on the part of such authors - that of adopting 'social' as a synonym for 'group', without fully considering the question of the persistence of *relations* as the true analytical focus of social science. In the context of this current argument for operationalising identity - as is evident in the specification of Cumming et al (2005) and Cumming and Collier (2006) – 'identity' offers to better incorporate such questions of connectivity as are addressed by

network theory in a less rigid manner, whilst maintaining the representational complexities of the panarchy heuristic, which is fundamentally concerned with 'relations' as a typological property. Once fused with an ideal-typical modelling strategy and recognition of ontological complexity, it further collapses restrictive ontological binarisms which in turn render methodological pluralism more attractive (discussed in greater detail in chapter 6).

According to Walker, Holling, Carpenter and Kinzig (2004), various attributes of identity function to augment resilience by governing systems dynamics. Given that much of resilience theory (i.e. its core heuristics such as stability domains, attractor basins and multi-scalar interaction models), derives from broader developments in complexity theory and non-linearity, resilience must be approached as a dynamic theory of change (according to the complexity account offered in chapter 1, change and movement are the hallmarks of social-ecological systems). As a theory and metric fundamentally concerned with change and development, the means by which 'transition' is measured with regard to particular systems is intimately bound up with pronouncements on the extent of resilience. Identity, as a designated collective of system attributes is here critical; since chapter 1 has argued extensively for abandoning mechanistic notions of change which emphasise the measurement of departures from key variable values; what may instead be adopted is a provisional working definition of 'persistence of identity over time', as a measure of resilience, augmented with the heuristic of adaptive capacity as a quantifiable quality mediating resilience. The 'adaptive cycle of rundale' (*figure 3.6*) captures one such possible trajectory of 'regime shift' by enabling designation of the post-release and reorganisation in space of such nucleated settlements as a new identity, and, consequently, a new socio-ecological regime. Yet this spatial form represents merely one element of a complex identity; to treat such entities as panarchically organised nested adaptive cycles and sub-systems raises other questions directly implied within the concept of identity.

Existing literature on resilience, for example, has identified multiple trajectories of development, and some notable exceptions to the adaptive cycle rule (Cumming and Collier 2005, Kinzig et al 2006, Abel, Cumming and Anderies 2006, Walker et al 2006). Similarly, as noted above, significant variability abounds within the rundale system itself according to both space and time. Boundary definition within the accepted confines of 'ecosystem' is thus difficult; cultural systems, kinship and demographic trends, modes of cultivation, inheritance and transmission strategies, forms of tenure, customary and folk practices – elements of the panarchy designated by the rundale system – have survived in various locales despite reorganisations of spatial form, and are present or absent to various extents across rundale

variants[78]. And yet, it is the spatial form of rundale which has often served as a baseline typological device (i.e. key element of system identity) within existing studies on the rundale system (see Evans 1939; McCourt 1971; Aalen, Whelan and Stout 1997). Consequently, the combined three dimensions of identity suggested by Cumming et al (2005) of *components*, *relations*, and their ability to *persist* in both space and time is preferable when dealing with systems subject to constraint on their adaptive capacities by both internal and external forces. As a preliminary example of this complexity, factors such as surplus extraction imperatives engendered by the vicissitudes of modes of production operating beyond local system boundaries, and 'macro-level' impediments such restrictions on spatial expansion through enclosure, will later be observed to produce profound demands for local interventions in natural cycles (i.e. the adaptive capacity of such communities is tested by levels of panarchy operating beyond their immediate boundaries). A suitable articulation of such an identity would therefore appear to be an indespensible 'first stop' in assessing adaptive capacity and resilience (i.e. persistence of identity).

Complexity theory has already provided a useful working vocabularly, which maps particularly well onto the concepts outlined in this chapter (this is unsurprising, given that much of the work in this area has developed in close dialogue with more 'paradigmatic' developments in non-linearity as discussed in chapter 1). In mechanistic terms, social-ecological systems may be described statically as occupying a particular 'state space', defined in n-dimensional terms by configurations of values taken by variables constituting the system (as outlined in chapter 1 under *complexity's challenge to linear modelling*). The state space within which a particular system may tend to remain is typically represented as a 'basin of attraction', with various alternative basins (i.e. configurations of variable values in state space) constituting a particular stability landscape. The concept of identity here provides a degree of 'qualitative latitude' in representing social-ecological system dynamics that neither requires nor precludes the use of quantitative metrics. In short, 'identity' allows the formulation of a relatively coherent representation of any complex social-ecological system according to Cumming et al's (2005) criteria, and thus to bring a range of tools of assessment to bear upon it (i.e. resilience, adaptive capacity and panarchy). Analytically, resilience may thus be operationalised according to the amenability of system components to either quantitative or qualitative measurement (i.e. quantitatively with 'latitude' as a measure of maximum change thresholds, 'resistance' as a property of basin topology or 'precariousness' as proximity to thresholds; Walker, Holling, Carpenter and Kinzig 2004).

[78] See McCourt 1953 on folk survivals in the Sperrin Mountain region.

Alternatively, a more flexible approach may be opted for. Although some have complained about the dilution of 'resilience' away from quantitative formalisation (Brand and Jax 2007), the instigators of the resilience approach have remarked that *social*-ecological complexity (i.e. the dimension of the social) often renders traditional ecological modelling approaches either difficult, or invalid, further adding; '…we do believe that substantive qualitative assessments can be made of each of these components of resilience' (Walker, Holling, Carpenter and Kinzig 2004). Consider the following comments;

> "...complex systems are defined by the nature of their main components, the relationships of these components to one another, and the maintenance of both spatial and temporal continuity, i.e., systems may move in space and inevitably move in time, but saltation in either instance constitutes a loss of identity. From this point of view, a complex system is a network of components connected by various dynamical relations that include inputs, outputs, and external constraints" (Cumming and Collier 2005: 4)

Rather than attempt to quantitatively map out or measure transitions between stability domains (arguably an impossibility, given that 'social components' inevitably occupy a lower level of measurement precision), or to rigorously define criteria of systemic collapse, or limits of a critical loss of resilience (i.e. as settlement eradication, mortality of occupants, or reorganization of landscape), it may be more productive to treat the resilience framework in an exploratory manner. It has already been suggested (assuming 'identity' as a working means of system specification), that defining alternative stable states as a stability landscape in a precise manner may be difficult, given the capacity for elements of a pre-existing system identity to persist beyond any such critical resilience loss (i.e. culture, demography, tenure, custom). Consequently, it may be more illuminating to explore, on a range of criteria, the extent of the 'adaptive capacity' of such rundale communities, as designated identities and complex panarchies, in the face of both endogenous and exogenous drivers of change. Systemic variability is in turn captured by the concept of alternative 'regimes' (as a more fluid, qualitative application of the state space descriptor), the baseline characteristics of which are easily represented by specifying identity components.

In terms of assessing change, Kinzig et al (2006) have attempted to advance a general framework and vocabularly for the exploration and assessment of drivers of systemic change and resilience. Regimes, as '...locally stable or self-reinforcing set of conditions that cause a system to vary around a local attractor...[or] the dominant set[s] of drivers and feedbacks that lead to system behaviour' (Cumming 2011: 14) may therefore 'shift' due to the interactions of variables at multiple levels leading to differing internal controls and aggregate characteristics – or identities (Kinzig et al 2006). To implement such a heuristic in an exploratory manner

therefore involves mapping out the trajectories of such systems at multiple domains and scales (social, economic, ecological), and specifying the manner in which identity may be demarcated. Furthermore, it involves establishing the various threshold levels of its attributes by which identity change may subsequently be measured.

Ultimately, any such regime shift (i.e. loss of resilience / identity) proceeds in a non-linear manner; according to Kinzig et al (2006) both external perturbation and internal dynamics interact such that; '...crossing a single threshold between alternative regimes often leads to a "cascading effect" in which multiple thresholds across scales of space, time, and social organization and across ecological, social, and economic domains may be breached' (Kinzig et al 2006: 1). Numerous examples of such threshold effects and cross-scale interactions have been presented (although not articulated as such) by researchers of Irish agriculture and economy such as Almquist (1977) who have examined drivers such as long-cycle fluctuations in grain and linen pricing as drivers of localised reorganisation in household, regional labour market and regional demographic patterns. Although Frasers' depiction of panarchy is useful (as a heuristic of connectivity, diversity and biomass concentration – figure 3.8. above), it lacks the means with which to introduce nuanced classificatory precision, cross-scale interaction, and internal system dynamics. Crucially, it also neglects the internal complexities of Irish society, and the capacity for an internal, differential distribution of resilience across settlement, or regional variants. An articulation of the general attributes of system identity would thus allow the presentation of a more nuanced picture of localised system dynamics and variants along with such higher-level properties as are described in figure 3.8.

There are two ways in which a complexity / resilience approach may be implemented empirically in this manner; firstly, by using existing literature and research to derive an 'identity template' with which to define the system in either it's ideal-typical, or spatio-temporal variants. As Cumming et al state; 'The use of an identity definition...forces us to be explicit about the system attributes that we are most interested in, creating a focal point for the analyses that follow and facilitating the operational step of selecting scales of analysis' (Cumming et al 2005: 978). From this, a priori criteria may be established (i.e. thresholds) by which changes in particular components may be judged to constitute a loss of identity, and therefore, of low resilience. This critical empirical starting point is addressed further in chapter 6, wherein an ideal-typical set of components and relations across various organisational and spatial scales are identified with greater precision as a general systemic template. At a more exploratory level, classificatory statistical techniques such as cluster analysis, and configurational techniques such as Qualitative Comparative Analysis (QCA), may be employed

in order to assess the 'state-space' of Ireland (i.e. to identify general macro-characteristics of rundale-dense regions, or to assess the presence in state-space of configurations of variables at regional level conducive to higher proportions of rundale, or diminished resilience).

To reiterate Cumming's approach;

> "If we think of a complex system as an individual, it only remains the same system for as long as it has a consistent identity. Identity derives from the maintenance of key components and relationships, and the continuity of these through time. If resilience is low, identity may be lost; and correspondingly, if identity is lost, we can conclude that resilience was low. Resilience can thus be operationalised by quantifying identity and assessing the potential for changes in identity" (Cumming 2011: 13)

In such a manner, an initial specification of identity with regard to agrarian systems may include the following components and relations, distributed across various spatial levels as displayed in table 3.1 below. This table should be read as a precursor to the more formal derivation attempted in chapter 6, and it is provided here merely to illustrate to the reader a potential means of addressing the designation of identity components. A more rigorous articulation of 'panarchy' remain to be specified (i.e. identifiable paths of cross-scale interaction), and this task is substantively addressed through the articulation of the mode of production of primitive communism developed across chapters 4 and 6[79].

[79] Table 3.1 is presented in list form – there is no correspondence within rows, and individual columns should be read as discrete lists of identity components. Social-economic and ecological components must in turn be viewed as distributed across spatial levels (i.e. as local, national, and international economic regimes and effects, local topography, regional climate etc).

Table 3.1. Key identity components and organisational levels of agrarian systems

Spatial-Organisational Scale	Socioeconomic component	Ecological component	Resilience indicators
Field system	Demography	Nutrient content	Income source diversity
Household	Economy	Crop diversity	Migration trends
Community	Rent	Ridge / drill	Collective resistance
Region (townland)	Tenure	Climate	Seasonal constancy in yield
National	Transhumance patterns	Topography and relief	Post-perturbation recovery time (yield, population, income)
International	Land allocation strategies	Mineralogical composition	Absence of litigation
	Mode of local governance		Demographic trends (fertility, mortality, migration)
	Household labour strategies		Living standards
	Culture, kinship, custom		Population density
	Colonial administrative structures (multiple scales)		Calorific adequacy of diet
			Maintenance of share equality

3.4. Locating the 'social' within an ecological framework

So far, a range of diverse, yet interrelated bodies of literature have been covered, within which a degree of commensurability at the level of epistemology has been established. The problem of natural-social separatism has permeated all such bodies of literature, and the foregoing discussions have considered a number of potential means of integration from the highly abstract (i.e. complexity), to the sociological (i.e. Marxism and the labour process), to the more mechanical (resilience). One requirement is outstanding however; despite the apparent

analytical utility of many of the preceding concepts and heuristics, their treatment of the social is arguably somewhat underdeveloped - particularly in the cases of resilience and human ecology, where it was suggested that 'social' is taken as synonymous simply with 'group', or as a particular organisational level (i.e. farm-level actors, with economies conceptualised as emergent entities). Although resilience ecology has remained critical of mechanistic, 'causational' approaches such as maximum sustainable yield modelling (Walker et al 2004), this discussion has identified a number of critical limitations regarding their treatment of the social, which, it is suggested in the following chapter, requires a theoretical device which is capable of abstracting from concrete conditions to identify a range of dynamics operating across various organisational scales.

Authors, such as Agar (2000), and Janssen, Anderies and Ostrom (2007) have offered some specific attention to the dimension of the social; Agar (2000), partitions ecological and social resilience into distinct domains, in response to a general tendency to 'endogenize' social institutions within the wider environment, such as occurs with the application of ecological analogies without qualification. With specific reference to resource dependent societies – i.e. '...communities and individuals whose social order, livelihood and stability are a direct function of their resource production and localized economy' (Machlis et al 1990 cited in Agar 2000: 352), Agar directs attention to a number of discrete measures of *social* resilience, which he further distributes across the economic and demographic spheres (operationalised as variability of income sources or population displacement). Although apparently face-valid, this is arguably a less desirable reproduction of accepted ontological separatisms, and remains excessively within variable-oriented interpretations of resilience. If migration were taken as a variable or attribute of system state-space for example; what, therefore are the implications of differing levels and forms of migration across systems exhibiting similarity on other variables. If one element of system identity were defined as 'high migration' – the presence of systems with identical modes of governance, but exhibiting low migration, raises questions regarding the generalizability and homology of the identity criteria employed (i.e. could high-low migration systems be considered similar). Furthermore, it reveals little regarding cross-scale interactions (i.e. how reorganisations of household labour or farm production diversification may emerge as adaptive qualities in response to changes at other levels – i.e. economic change). This is arguably indicative of a pervasive tendency within the preceding literature – as is evident within table 3.1 – to treat relations between components as causative (i.e. to assume economic vicissitudes exert a direct causative influence on social organisation, or that characteristics of regional economies such as market proximity determine regional-level crop distributions).

The benefits of adopting an identity-panarchy approach are that multiple types of system may ultimately be viewed as occupying differing attractor basins (i.e. different values on migration in n-dimensional state space) but also as retaining the same broad identity as defined by 'components and relations' rather than attribute values. Crucially, as complex systems characterised by panarchical organisation, relations between components need not be represented as either linear or causative. Remaining at the level of attribute measurement in assessing resilience – let alone recommending compartmentalisation of ecological and social resilience as above - is therefore problematic. Such an approach, i.e. searching for specific indicators alone within the social domain, is further problematic, as this is essentially a normative approach, in that it ignores the multitude of functions, or potentially beneficial or harmful effects particular variables may display depending on particular contexts. For example, in the absence of reliable, comparable mortality statistics, some authors have used population decline (1841-1851) as a proxy for famine mortality or 'distress'. However this essentially 'normative' measure of system health (i.e. resilience [t1-t2] of population levels) ignores the role migration and remittances may play as an element of adaptive capacity. Emigrant remittances are critical within many such cases of resource-dependent communities faced with limits to subdivision, or restrictive means of land access. Much of this potential nuance is lost unless an approach is taken which recognises this plurality of response strategies in terms of adaptive capacity, and of the possibility of cross-scale interactions between the social and ecological domains, such as is specified within the panarchy approach.

A second mode of thinking on the social is advanced by Janssen, Anderies and Ostrom (2007) who examine a series of case studies of social-ecological systems which have successfully adapted their institutions to various types of economic, political and ecological variability, an adaptability which confers resilience in the form of institutional robustness. Previous studies such as Ostrom (1990) have often observed '...that small-scale governance regimes that incorporate local knowledge, have clear rules that are enforced, and rely on high levels of trust frequently perform well' (Janssen, Anderies and Ostrom 2007: 308). This institutional (i.e. social) resilience is explained as a function of optimisation, whereby regular patterns of level-specific variability become adapted to, with a consequent exposure to alternative, or external forms of perturbation (i.e. institutions of commonage grazing rights allocation which provide essential fertiliser subsidies subjected to limitation from enclosure, which in turn produce cascading effects across subsequent system levels). The logic of such institutional arrangements has been examined in relation to open field agriculture, which the authors suggest served to maintain both economic diversity (tillage and grazing), availability of fertiliser, accommodation of population, whilst inhibiting lone individuals from accumulating greater tracts of land, and

thus gaining a greater bargaining position relative to other commune stakeholders (Janssen, Anderies and Ostrom 2007).

What is required to make sense of this remarkable similarity in organisational and physical form (open field agriculture and common property) across multiple locations is an examination both of socio-economic context, and of the nature of the internal dynamics of communes themselves. The socio-economic contexts of Britain and Ireland for example produced markedly different dynamics of enclosure; in Britain, once industrialisation and transport links developed to an extent which permitted the mass displacement of rural populations (through ease of transportation of produce from rural to urban areas); the demands of self-contained, localised production at village level were relaxed. The emergent institutions of capitalist private property thus dictated the 'rationalisation' of communal holdings which no longer needed to centralise both tillage and meat production, with the enclosure movement representing the execution of such a project on the physical landscape. In Ireland however, the contextual dynamics are somewhat different. Under conditions of feudal rent, and pre-Napoleonic stability in grain pricing, tillage offered an attractive means of rent extraction, with subdivision representing not a barrier to surplus extraction, but a multiplier. Communality in Ireland may thus be interpreted as satisfying a number of concomitant requirements at various socio-economic levels; of production for realisation of rent, of the maintenance of settlement-level productivity diversity, the accommodation of new members through subdivision, and expansions through reclamation (this description is necessarily cursory, and significant qualification is offered across chapters 4 and 5).

Within the unique colonial context of Ireland therefore, the adaptive capacities of the rundale system across much of the early nineteenth century were tested by the dictates of market-orientation engendered by rent realisation. It is this context which thus permits consideration of the question of social dynamics with greater precision than was heretofore attempted, or is arguably possible with a resilience approach alone. In search of a framework with which to conceptualise the embeddedness of the social within the ecological, an important conceptual tool developed by Marx has previously been referred to; that of the 'mode of production' as a trans-historical typology incorporating the social, economic and the ecological in metabolic unity. The necessity of examining Marx's insights on these interrelations is further underscored by the preceding criticisms, as a theoretical grasp of the social has not been enhanced in a satisfactory manner. A growing number of researchers are now turning to Marx's employment of the concept of 'metabolic rift' as a theoretical device with which to place localised systems of production within their broader social contexts of modes of surplus extraction, and class

relations. In the course of developing such a conceptual apparatus however, Marx has also imparted a litany of commentaries and devices previously brought to bear on the phenomenon of communality in pan-European context; it is to these concepts and writings which discussion finally turns, in order to provide a solid foundation with which to theorise 'the social', thus providing a suitable *social*-ecological framework within which assessments of localised systems as complex panarchies may be implemented.

4

Marx's concept of 'mode of production': toward an ecological typology

Despite the intuitive empirical applicability of resilience and adaptive capacity as analytical devices, a certain degree of abstraction is as yet required in order to grasp the nature of the social, and its inter-relatedness with the ecological. Chapter 2 has forwarded the concept of metabolism in resolution of the natural/social dichotomy as a simple category grounded inexorably in the reproduction of all human societies. The preceding chapter has outlined a number of devices which have attempted this conciliation between the social and the ecological, albeit with a tendency to treat both ontological realms (natural/social) as discrete entities, conceptualised and represented as distinct sets of attributes. What is instead required is an adequate conception of totality, in which the co-evolution of nature and society may be represented – ecological conditions and outcomes must therefore be theorised as rooted within specific configurations of social relations. This crucial difficulty in cross-disciplinary communication has tended to work both ways, as discussed in previous examinations of 'human exceptionalist' sociology. The inability of human ecology to holistically incorporate the social is therefore mirrored in the shortcomings of sociologists whom have proven '...unable fully to reconcile their theoretical commitment to classical sociology with their environmental sociology, which demands that an emphasis be placed on the relations between society and the natural environment' (Foster 1999: 370). Discussion has thus far treaded various levels of the critical realist ontological stratification outlined toward the end of chapter 1. Chapter 2 has examined the 'historiography' of nature-society within academic discourse, and chapter 3 has explored a number of devices which have pointedly addressed the analytical incorporation of the ecological. And yet, as stated at the conclusion of chapter 2, the social cannot be treated in as mechanistic a manner as is implied by resilience ecology. Fortunately, a coherent basis for an alternative approach - one which it will soon be argued is inherently compatible with the aforementioned bodies of knowledge - has been established over the past decade by authors drawing upon the works of Karl Marx, particularly his pronouncements on 'metabolic rift'.

The social, contrary to its depiction in previous chapters is not an undifferentiated collective of relativised, trans-historical variables such as 'culture', or 'institutions'; indeed, the discipline of sociology is founded on the very notion that manifest stabilities in social structure and order are both identifiable, and amenable to scientific study. Historical materialism offers an approach

which is both systematic & non-reductionist, and confers a number of tools with which to typify and express the essential dynamics of social systems as historically constituted entities with their own internal logics, and complex trajectories of development. Such unity is captured within the conceptual framework of the 'mode of production', a framework which despite its intuitive utility has courted significant controversy (the complete historiographical complexities of which are beyond the scope of this thesis, although suitably comprehensive discussion is offered).

What is initially offered by adopting a mode of production approach to social-ecological analysis is a framework which serves to counter reification. The epistemological nature of this apparatus remains to be qualified within sections 4.1.1 and 4.1.2; it is sufficient for now to state that the essential process of inquiry inherent in a 'mode of production' approach involves a dialogue between abstract concepts and concrete (empirical) phenomena. In adopting such a movement between the abstract and the concrete, it is suggested, the analyst reduces their risk of succumbing either to naive idealism (through excessive abstraction) or to excessive empiricism (through an over-emphasis on description) which limits both theoretical generalizability and inter-contextual applicability. In a number of respects, the reader is already sensitised to the key elements of this approach, given that critiques of epistemic relativism and social constructivism in chapter 2 developed largely in consequence of a cursory review of the essential tenets of historical materialism, namely the centrality of labour in any theoretical model of social-ecological relations. The concept of 'mode of production', it is here argued, further concretises these abstract, trans-historical characteristics of social form into a historical typology of sorts, whereby particular configurations of relations and forces of production, and modes of surplus appropriation come to define broad parameters of specific forms of social-ecological organisation. This typology is here oriented to the requirements of this thesis - namely an understanding of the social-ecological dynamics of the mode of production of *primitive communism* – although its applicability across other social forms and historical/contemporary contexts, subject to necessary modification, should not be ignored.

Finally, a prominent line of inquiry, which has emerged on foot of a sustained archaeological trawl through the works of Marx, is considered as a means with which to assess the inequitable ecological dynamics engendered under various modes of production and surplus appropriation. The concept of metabolic rift, despite its noted affinities with analytical science (Rudy 2001), and current emphasis on the specifics of capitalism, nonetheless imposes summary order on a range of abstract determinants (such as urbanisation, industrialisation and commodification) which conspire to confer conditions of differential resilience at local levels, through disruptions

in nutrient flows and metabolic pathways. Following a critical assessment of this concept, the preliminaries of an integrative methodology are sketched - with reference to critical realism and complexity - according to which the forthcoming case study may be presented in the final chapters of this thesis.

4.1. Historical materialism as 'science': competing definitions, outline compatibilities

In order to understand the broader epistemological significance of the concept of mode of production within Marxism, a degree of foregrounding with a more general understanding of the nature of Marxism's 'scientific' enterprise is first required. This is best served, in the first instance, by examining the relationship between the work of Marx, and that of Charles Darwin. Various commentators have drawn attention to Marx's admiration for the work of Charles Darwin (see Fay 1978 and Harvey 2010), although Fay (1978) has questioned whether Marx intended to dedicate volume two of capital to Darwin, as is popularly held, in light of evidence which suggests a request issued to Darwin for comments on proof-sheets of volume two may have been issued by Marx's son-in-law, Edward Aveling. Such was the perceived homology between Marx's and Darwin's approaches to their respective subject matter however, that Engels chose to include the following observations in Marx's graveside eulogy delivered at Highgate cemetery; 'Just as Darwin discovered the law of development of organic nature, so Marx discovered the law of development of human history: the simple fact, hitherto concealed by an overgrowth of ideology, that mankind must first of all eat, drink, have shelter and clothing, before it can pursue politics, science, art, religion, etc' (Engels, 1883 [Tucker 1978: 681]). Such comments suggest a degree of admiration beyond a '...reduction of Darwin's scientific significance to a mere "ideological" projection of bourgeois society' (Fay 1978: 133) as more negative commentators have suggested.

Despite the contested issue of Marx's dedication, the importance of the combined study of social and natural processes, and the unifying promise of historical materialism as a common epistemological basis is evident in the substantial treatment of Darwin's subject matter offered within Engels' *Anti-Duhring*, wherein the role of labour as a '...prime basic condition for all human existence' (i.e. mechanism of human evolution) is outlined;

> "...the hand is not only the organ of labour, it is also the product of labour. Only by labour, by adaptation to ever new operations through the inheritance of muscles, ligaments, and over longer periods of time, bones that had undergone special development and the ever-renewed employment of this inherited finesse in new, more and more complicated operations, have given the human hand the high degree of perfection

> required to conjure into being the pictures of a Raphael, the statues of Thorwaldsen, the music of a Paganini" (Marx and Engels 1987: 454)

Assessing the empirical validity of this claim is beyond the scope of both thesis and author; what is clear from a cursory review of Engel's volume however, is the theoretical and analytical centrality of labour, and the depth of interdisciplinary dialogue both Marx and Engels perceived inherent within their approach, encompassing as it did the apparently diverse processes of natural selection, and the dynamics of social organisation. The specific nature of this homology is further illuminated by one of Marx's rare methodological footnotes offered within volume 1 of *Capital*, which in turn goes some way toward illuminating Marx's comment that Darwin's work was noteworthy not for what it considered, but rather what it did not;

> "Darwin has directed attention to the history of natural technology, i.e. the formation of the organs of plants and animals, which serve as the instruments of production for sustaining their life. Does not the history of the productive organs of man in society, of organs that are the material basis of every particular organization of society deserve equal attention? And would not such a history be easier to compile, since, as Vico says, human history differs from natural history in that we have made the former, but not the latter? Technology reveals the active relations of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from those relations." (Marx 1990 [1867]: 493-494)

Despite the significant contributions of analytical Marxism to the formalisation of investigative methodology, these comments (amongst others) have all too often been cited out of context in defence of a technological determinist reading of historical materialism. According to Harvey (2010), the critical 'element not considered', as observed in the above quotation, is the role of human material production in changing the face of the earth, and in effecting changes in modes of social life (Harvey 2010: 190-191). In this sense, historical materialism may be interpreted not simply as the study of discrete events in political history, but of a deeper theoretical exercise, one which places the study of human society on a scientific footing equal to that of the study of natural history; '...Engels described the theory of surplus-value and the materialistic conception of history as the "two great discoveries" of Marx, through which were established the scientific foundations of Socialism' (Banaji 1977: 1). It is the explication of this 'scientific foundation' which, according to Harvey, demonstrates the novelty of Marx's contribution to social thought; '...what Marx appreciated was Darwin's approach to evolution as a process open to historical reconstruction and theoretical investigation' (Harvey 2010: 191).

The critical contribution inherent in this methodology, as opposed to those prevalent amongst analysts of his time, is thus the investigation of human development in terms of processes rather than resorting to either extreme of complete trans-historical abstraction (i.e. utopian idealism), or naive empiricism. The essence, and utility of this approach to the study of human society, according to Harvey (1982[2006]), rests in its integration of multiple 'moments' of varying degrees of abstraction into a common theoretical model. Such 'moments' include, amongst others '...general abstract determinants which obtain in more or less all forms of society...the categories which make up the inner structure...international relations of production' (Harvey 1982[2006]: xiv). Marx's footnote thus continues;

> "Even a history of religion that is written in abstraction from this material basis is uncritical. It is, in reality, much easier to discover by analysis the earthly kernel of the misty creations of religion than to do the opposite, i.e. to develop from the actual, given relations of life the forms in which these have been apotheosized. The latter method is the only materialist, and therefore the only scientific one. The weaknesses of the abstract materialism of natural science, a materialism which excludes the historical process, are immediately evident from the abstract and ideological conceptions expressed by its spokesmen whenever they venture beyond the bounds of their own specialty." (Marx 1990 [1867]: 494)

The latter portion of this commentary is interpreted by Harvey as a refutation of naturalistic reification, a tendency which Marx no doubt ascribed in part to Darwin, given his express admiration for the works of Thomas Malthus. In present-day commentary, such critics of neoliberalism still attack the dominant 'market autonomy' perspective, an assumption which is mandated in service of the free movement of capital, and consequently, as is often argued, its inequitable and disproportionate accumulation. Although both Marx and Darwin may have shared a desirable commitment to advancing a non-vitalist, and therefore non-theological (scientific) worldview, this did not, according to Marx, preclude the tendency of natural science practitioners to engage in reification; '...natural scientists, because they failed to understand their historical moment and were barred by their methodological commitments from integrating human history into their models of the world, frequently ended up with at best a partial and at worst serious misrepresentation of that world. At worst, they concealed their historical and political assumptions under a supposedly neutral and objective science' (Harvey 2010: 197-198)

This apparent distinction between the 'science' of Marxism and that of the English scientist ignorant of historical specificity and the social embeddedness of knowledge is interpreted by Daniel Bensaid (2002) as a consequence of competing meanings of the term. According to

Bensaid, Marx's work is laden with the 'metallic accents of English science', where terminology such as 'commodity form as economic cell form...natural laws of capitalist production...natural laws of its movement' demonstrates an allusion to the objectives of causality and positivistic truth which distinguish formal science from pseudoscience (Bensaid 2002: 203). It is clear from the preceding discussion that Marx perceived a broader 'science' immanent within historical materialism however, finding form as a framework capable of identifying nothing less than the movers of human history, and of thus illustrating the historical specificity, rather than eternal immutability of particular configurations of social relations, as political economists of the time maintained. There is, of course, a more extensive argument to be made further on that this scientific framework also *incorporated* the subject matter of the natural sciences, rather than merely analogised its epistemology. Considered solely on the merits of its treatment of social organisation, it was this elevation of the study of historical forms of social organisation, within an interpretive and predictive model which offered to place Marx's analysis on a scientific footing.

It is equally clear that Marx considered this model of science more than a mere elevation of the study of society to the narrow criteria of positivistic science; the deductive mode of reasoning of the natural sciences, in any case, does not lend itself well to the process of abstraction. Conversely, social scientists are much accustomed to the process of abstraction as an essential analytical device, which allows for the characterisation of social processes typically not susceptible to the methods of measurement and experimental testing prescribed by a natural science model. Dialectical reasoning is perhaps best considered as a means of countering this apparent impasse between abstraction and scientific rigor, by permitting the explication of 'general laws' through a process of abstraction, whilst retaining a semblance of explanatory and predictive capacity. Bensaid again draws attention to the distinction between notions of 'German' and 'English' science, the former as yet imprinted with Hegelian influence, where the presence of speculative philosophy and critique, he claims, has produced a Marxian 'science' difficult to reconcile with Western notions of science as objective and reductionist. The particular method of investigation inherent in this model of science will presently be discussed in the context of dialectical reasoning, as a mode of inquiry which emphasises dialogue between abstract concepts and empirical details – with the former accorded validity on par with that of deductive generalisation. For now, it is sufficient merely to acknowledge the presence of multiple criteria for the status of 'science', which is critical both for understanding the thrust of historical materialism and a key source of frustration on the part of subsequent commentators (see Schumpeter 2008 [1942]). As will be demonstrated, Marx clearly believed that the true progress of science (social and natural) was to be measured not by the compartmentalisation

and fragmentation of its respective fields; the promise of historical materialism was ultimately the incorporation of both the social and the natural within a common model; 'Natural science will in time incorporate into itself the science of man, just as the science of man will incorporate into itself natural science; there will be one science' (Marx 1975 [1844]: 355).

It is important that this outline qualification be offered, as substantial compatibilities between historical materialism and the theoretical informants reviewed throughout the preceding chapters, particularly those of complexity theory, will presently be argued. It must therefore be noted that the body of forthcoming theory is inherently receptive to a range of informants, including those of the 'middle-range analytics' reviewed in chapter 3. Having thus qualified the concept of science in this way, the core concepts associated with the historical-materialist apparatus may be outlined, along with an investigation into how this process of dialectical inquiry differs substantively from that of the deductive analyst[80]. Furthermore, an investigation into the Marxian approach to totality is attempted which, as with emergentism and complexity, treats specific concrete phenomena as composed of multiple determinants and interacting levels in a constant state of historical flux. From this theoretical model derives a broader understanding of *social*-ecological metabolism in its specific historical manifestations.

4.2. Systematic dialectic and categorical exposition

The principal argument to be developed in this section concerns the utility of the concept of 'mode of production' as a typological device analogous to the concept of identity derived from resilience ecology at the conclusion of chapter 3. Just as the concept of system identity designates a range of attributes distributed across multiple levels, by which occupation of particular configurations of values denotes the existence of particular regimes (i.e. the presence of a particular system variant or regime state), so too does the concept of 'mode of production' attempt to outline the essential dynamics of particular social-ecological systems, albeit at a much broader level of generality, and with the benefit of sensitising us to the abstract characteristics and determinants of such systems, according to their dominant modes of surplus appropriation and relations of production, such as they obtain in historically determinate forms. This forthcoming section thus argues an inherent compatibility between a 'mode of production' approach and the central tenets of resilience ecology, complexity theory and critical realism, as avenues toward a social-ecological methodology. The concepts of ontological stratification

[80] In doing so, a further layer of dismissal is offered to the false dichotomies which permeate discussions and critiques of social-scientific methodology. The validity of particular forms of data, or modes of analysis, it will be argued, cannot be called into question on the basis of false or dated characterisations of the epistemologies of its practitioners.

(critical realism, complexity theory) and panarchical organisation (resilience ecology) are thus homologous with the approach of the dialectician whose analysis proceeds with sensitivity to this inherent non-linearity in both analysis and presentation. By mutually informing one another, a more holistic approach to *social*-ecological analysis is thus permitted.

Dialectics is notoriously difficult a term to define in abstraction, and as with many such avenues of Marxist thought, the subject of dialectical thought has spawned its own series of complex sub-debates, a comprehensive review of which is beyond the scope and requirements of this thesis (see Levins and Lewontin 1985, Smith 1993, Arthur 2006, Finelli 2007, Lewontin and Levins 2007, Arthur 2008, Foster 2008, Ollman 2008, Starosta 2008, Smith 2009). Understanding the logic of dialectical reasoning is essential however, for understanding historical materialism; in particular, the centrality of the concept of mode of production. According to Chris Arthur's reading, two broad orientations to dialectics within academic discourse are discernible; (1) dialectics as '...a set of methodological principles for grasping the interconnections of the various aspects and elements of reality, their mutual relations, and the contradictions within and among them that generate forces for change and development' (Engels 1969 cited in Smith 2009: 357), and (2) dialectics as a humanist device emphasising the criticality of human subjectivity, thereby dismissing the former 'ontological dialectics' as spurious (Smith 2009). Without rejecting the political necessity of the latter, this discussion focuses on the former approach as a potential locus of analytical compatibility. A simple introductory interpretation by Murray Smith suggests that dialectics may broadly be understood as '...the antidote to prevailing impressionistic, faith-based and onesidedly rationalistic or positivist methods of explanation and understanding...to "think dialectically" means to break with the static and mechanical ways of seeing things' (2009: 356-367). Consensus on the utility of dialectics within the social sciences remains elusive, as illustrated by Noam Chomsky's remark to Richard Levins that '...he despised the term and that in its best sense dialectics was only another way of saying "thinking correctly" (Levins and Lewontin 1985: vii). Its positioning as a corrective to Cartesian reductionism and dualistic thought has however been consistently advanced by its above-cited proponents, some of whom have drawn attention to its close parallels with systems theory.

In conversation with Richard Levins, Mary Boger thus remarked; 'Despite systems theory's concern with complexity, interconnection and process...it is still fundamentally reductionist and static, and despite the power of its mathematical apparatus it does not deal at all with the richness of dialectical contingency, contradiction of historicity...systems theoretic 'interconnection' does not grasp the subtleties of dialectical 'mediation' (Levins 2008: 26).

Although chapter 1 has addressed a number of these shortcomings of systems theory through the informants of complexity (indeed, the term 'systems theory' alone is inadequately non-specific, given the heterogeneity of the field), certain of these above elements such as 'contradiction of historicity' and 'mediation' remain somewhat underdeveloped.

Marx's appropriation of Hegel's dialectical method is often couched in terms of its materialist slant, or the manner in which Marx and Engels sought to invert the primacy of ideas, searching instead for materialist accounts of historical movement; in short, '...to discover the "rational kernel" within the "mystical shell" of the Hegelian system' (Marx 1977: 103 cited in Murray 2009: 358). In defence of this inversion, Marx remarks in Grundrisse how Hegel '...fell into the illusion of conceiving the real as the product of thought' (Arthur 2004: 6). This alternative 'non-metaphysical reading' (Arthur 2004: 6) is substantiated by the work of Tony Smith (1993), who suggests that Marx took his cue on the nature of theory from Hegel, whereby theory constituted 'a systematic ordering of categories' (Smith 1993: 35). It is this dimension of 'systematic ordering' which illustrates the critical thrust of a dialectical approach, and which renders intelligible the comments of Diptendra, who claims; 'Marxian theory has no necessary connection with the practice of the historian...the historian's concept of his object and method of knowing is necessarily an empiricist one...History is condemned by the nature of its object to empiricism' (1985: 28). However one wishes to frame this 'practice of the historian' (i.e. as Cartesian-reductionist or unilinear), the alternative of dialectical logic instead proposes to order *concepts* rather than discrete historical events in a manner which is '…systematic rather than historical…dialectical logic is that method that allows us to move systematically from one thought determination to another' (Smith 1993: 36). This conceptual reconstruction does not conform to accepted scientific ordering (in the narrowest sense of an archetypal scientific method), by defying traditional confines of temporal order (i.e. the 'practice of the historian'). Conceptual validity thus presides over chronology.

This alternative materialist approach and systematic articulation of categories would continue throughout Marx's later works such as Capital, wherein the informants of German philosophy, utopian socialist thought, and classical political economy merged in critical synthesis (Harvey 2010). Marx's critique of political economy thus culminated in a 'dialectical progression from the most abstract and simple form to those that are more concrete and complex' (Smith 1993: 29). For the Marx of volume one of *Capital*, the simple abstract economic category of capitalism was thus the commodity form (ibid), through which the action of exchange concealed deeper processes and relations of exploitation; the exposition of these relations and the manner in which they internalise processes of 'exploitation', thus developed from this

essential category, in a methodology of expanding complexity. Crucially, this method of investigation involved a particular form of movement between abstraction (conceptual ordering / systematic articulation of categories) and empirical detail according to Ollman's successive moments of the dialectical method (2008: 10). Thus the initially perplexing discussion of the abstract commodity form is encountered in volume one of *Capital*, a discussion which is gradually populated with empirical proof and historical detail, leading progressively toward an understanding of the concepts of valorisation and surplus value – an exposition which defies temporal ordering. This progression is summarised by Banaji as follows; 'In the dialectical method of development the movement from the abstract to the concrete is not a straight line process. One returns to the concrete at expanded levels of the total curve, reconstructing the surface of society by 'stages', as a structure of several dimensions. And this implies, finally, that in Marx's *Capital* we shall find a continuous oscillation between essence and appearance' (Banaji 1979).

Christopher Arthur (2004, 2006, 2008), in his pronouncements on the 'new dialectic' has argued strongly against extant interpretations of Marx's logic - variously attributed to Engels and Sweezy (Starosta 2008: 298) - which depicts his explication of a capitalist mode of production in *Capital* as a linear (historicist) sequence of successive approximations. Consensus now exists regarding the source of this misreading, namely the '*simple commodity production'* thesis, as an erroneous inheritance based upon an excessively linear, historical and empiricist reading by Engels, propagated by subsequent commentators such as Sweezy, Meek and Mandel (Smith 1998, Arthur 2004, Finelli 2007, Starosta 2008). This perspective has been critiqued extensively by John Weeks (1981) in his discussion of Marxian value theory, whereby Engels is charged with mistakenly appropriating the concept of 'socially necessary labour time' as a determinant of price. This erroneous reading thus offered much fuel to the marginalist revolution, in its rejection of the labour theory of value in favour of marginal utility, through its interpretation of Marxian value theory as one of the *quantitative* determination of price[81].

[81] According to Joan Robinson; '…the real difference between Marx and the orthodox schools concerns the question of what governs the accumulation of capital and the distribution of the total product of industry between workers and capitalists. Compared to these problems, the determination of relative prices of commodities appears as a secondary question which has been too much flattered by all the attention that has been paid to it' (Robinson 1951: 140). Economics has long since discarded Marxism on the basis of perceived deficiencies in the labour theory of value, despite its repeated identification as a spurious concern (i.e. a conflation of *formal* with *material* determinants) by commentators within the discipline; '...the theory of value is not intended to deal with relative prices, but with the law of motion of society' (Hilferding 1904: 147). This does not amount to an outright indictment of historical materialism however, as the labour theory of value was never intended to account for the phenomena of interest to the neoclassical program.

A more valid recasting of the labour theory of value debate is thus offered by Eldred and Roth; '...the question is not whether labour determines the value of commodities; the question is rather; what is the

Engels' logical-historical interpretation was in turn permitted by his assumption that *simple commodity production* was not an abstract category, but a historically specific precursor to capitalism, thereby imposing a narrative of historical succession on Marx's exposition of a capitalist mode of production. Consequently, this 'orthodox' reading precluded an understanding of its systematic dialectical structure, and produced a legacy of spurious arguments in the form of the labour theory of value debate, and Marx's perceived 'Prometheanism' with its origins in a developmentalist reading of *Capital* .

A *simple commodity production* reading thus describes a division (now largely rejected) between the initial chapters of capital, in which it is assumed Marx is referring to a historical era wherein '...independent producers supposedly owned their own means of production and brought their output to market, exchanging their outputs in proportions fixed by embodied labour times' (Smith 1998: 461). When placed in context as a particular moment within a systematic (dialectical) exposition, this interpretation is revealed as false, and better interpreted as an '...abstract model rather than as a historical epoch' (Smith 1998: 461)[82].

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specific character of that labour, which determines value?' (1978: 17). The Sraffian critique of the labour theory of value is founded upon Engel's erroneous reading of value (i.e. labour time socially necessary), such as it obtains within a state of simple commodity production. According to Sraffa, the utility of 'labour time' as a determinant of relative price fails to yield to mathematical proof under conditions beyond those of simple commodity production, or what Schumpeter refers to as a *ceteris paribus* state of 'perfect competition' (Schumpeter 2008 [1942]: 24). Furthermore, Gerstein claims; "

> Marx's theory of value is not and does not profess to be a theory of price determination simply because the methodology is not concerned with this neoclassical equilibrium procedure. In short, Marx cannot be interpreted within a neoclassical framework of Walrasian equilibrium. The reason why Marx's theory of value is not a theory of price is that there is no way to reduce observable concrete labour to social abstract labour in advance, outside the market which actually reflects the reduction. Abstract labour as such can be 'measured' only when it takes the independent form of money, a form that poses it against the bodily form of the commodity in which it is embodied (Gerstein, 1986: 52-53 cited in Lucarelli, 2006: 16)

Marxists typically respond by suggesting that the neoclassical program forwards an inadequately superficial level of analysis removed from the totality and material basis under which such 'surface' market conditions manifest; 'Value is, in the first place, a 'definite social mode of existence of human activity' achieved under capitalist relations of production and exchange. Marx is not primarily concerned, therefore, with fashioning a theory of relative prices or even establishing fixed rules of distribution of the social product. He is more directly concerned with the question: how and why does labour under capitalism assume the form it does' (Harvey, 1982: 37). According to Schneider and McMichael; 'His demystification of 'price' (the value-form of a commodity) revealed prices as fetishized representations of the social relations involved in producing commodities. In de-naturalising this value-form, Marx historicised the value relations governing capital's movement and accumulation. In other words, he clarified the social origins of value at a time when classical political economy understood it as a natural attribute' (2010: 478). On value theory and value form, see also Fine (2001), Foley (2000), Robinson (1951, 1969 [1942], 1975a, 1975b) and Rubin (1978). See Skousen (2006) for an appreciation of Marx's current standing within university economics.

[82] There are two senses in which the term *simple commodity production* is here used – as an erroneous precondition of Engel's logical-historical reading of dialectics, and as an empirical category (i.e. concrete moment) observable across precapitalist forms. Engel's misreading of the term as a chronological precursor to capitalist commodity production does not mean it is non-existent empirically. Problems

Arthur has here argued that Marx's subject matter of '...totality, characterised by a set of internal relations' (2004: 17) required a dialectical approach, and that Marx's work should in turn be read as a work of *systematic*, rather than *historical* dialectic, the latter of which, deriving from Engels' *simple commodity production* thesis, has long survived into contemporary use. The continuing effects of this erroneous conflation are evident today, in the form of extensive debates concerning the presence of unilinearism in Marx's model of social change (i.e. his outline of successions of modes of production discussed in section 4.1.3). In this vein, Heather Browne (2010) and Kevin Anderson (2010) have argued against a 'Eurocentrist' reading of historical materialism - notoriously critiqued by Edward Said as *Orientalism* - opting instead for a reading of *multilinealism*, in which the presence of a perceived 'developed west / underdeveloped east' dichotomy, and linear developmental narrative is rejected[83]. An acceptance of this reading hinges upon the theoretical validity of Arthur's reading of dialectics however, as a rejection of the *logical-historical* dialectic clearly expunges the possibility of a 'modernisationist' reading of historical materialism. The alternate form of *systematic* dialectic thus privileges conceptual clarity over chronologically ordered empirical detail, and the question of linear temporal succession becomes irrelevant.

The case may well be made that Marxist scholarship as yet tends to excessively 'bracket out' discussions of these important philosophical underpinnings from other related avenues, such as Marx's use of historical detail. In any event, the implications of this problematic for this research are clear; accepting the validity of a *systematic* dialectical reading, and adopting its methodology will ultimately prove beneficial. As will be outlined in chapter 6, it is precisely an excessive linear empiricism which has inhibited the development of relevant frameworks suited to the interpretation of Ireland's complex social structure, and has ensured a preoccupation with linear succession and deterministic 'prime movers' remains entrenched in many historical-

occur primarily as a result of projecting this (as yet unsubstantiated) concrete moment onto the logical structure of Marx's method.

[83] Marx's numerous references to 'oriental despotism' as yet render this a problematic rejection, and the presence of the as-yet theoretically unresolved *Asiatic mode of production* (AMP) still looms large over historical materialism. The existence of the AMP has served as a problematic thorn in the side of scientific socialism, presenting a paradoxically 'stagnant' social form. Ernest Gellner's introduction to O'Leary's *The Asiatic Mode of Production* (1989) depicts it as a social form of functional exploitation (as centralised irrigation systems required despotic, authoritarian management), in which class exploitation emerges within the system itself, not as its unstable, transient precondition. The AMP has since outgrown its function as a comparative device used to explain the initial emergence of capitalism in the West, to a potent threat to the validity of historical materialism as a proscriptive body of theory. Huang Tan has since argued that the AMP constitutes an essential, and politically necessary proof of Marx and Engel's multilinear approach to historical-economic development; '...a unilinear interpretation endows historical materialism with a historical fatalism which in turn, unfairly grants the theory immense prestige, and opprobrium, as a guarantor of future historical developments...It is only by finally abandoning antiquated and outdated dogmas that Marxism might be able to prove itself' (2000: 126-128).

sociological / geographical accounts[84]. Theoretically, this empiricist problematic amounts to a conflation of concrete with abstract determinants, whereby the concrete is afforded causative primacy. This essential over-determination of concrete form is summarised as follows by Finelli;

> "It is a dissimulation of the abstract in the concrete that occurs through an *overdetermination* of the concrete; that is, through the taking up by the concrete of a dynamic, a value, an energy which does not derive from the concrete but which, nevertheless coincides with its appearance and its activity. This is the fetishism of the concrete *in as much as it is the invisibility of mediation*, of the relations which establish the concrete, which give expression to it and which make it move in determinate ways" (Finelli 2007: 67)

According to Finelli (2007 - in dialogue with Chris Arthur), this conflation may be further reduced to a failure to disentangle *formal* from *material* determination, the former of which may only be grasped through a process of abstraction and systematic categorical exposition. This critique thus echoes others previously encountered (such as those of Swyngedouw), who identifies conflations of ontology with epistemology (i.e. reduction of knowledge of being to state of being) as essential mechanisms dictating the reproduction of dualistic ontology. Elements of this false conflation have previously been challenged in chapter 1, with reference to the pronouncements of complexity theory, and its attempts to explicate abstract models of social change by engaging with the shortcomings of structuralist systems theory (i.e. through Prigogine's advancement of the concept of *dissipative structures*).

Against such tendencies of linear causality, and as a corrective to dualistic ontology (discussed in chapter 2 with reference to the natural-social dichotomy), a dialectical approach thus depicts the ontological realms of nature, society, and human agency as existing in a state of mutual mediation (Smith 2009)[85]. In such a manner, Schmidt described the various economic formations of society as '...modes of natures self mediation', and thus speaks of the reciprocal mediation of nature through society, and society through nature (Schmidt 1971: 79). Although this *implies* a narrative of historical succession (indeed this is a fundamental component of

[84] Particularly regarding the rundale system, which has largely seen excessively spatial and environmental-determinist readings (more of which in chapter 6). Although not necessarily invalid, these particular moments tend to be partailed out from other related concerns and crucial levels of analysis (i.e. an environmental determinist reading of communal tenure must take account of elements within this complex panarchy such as feudal rent relations, colonial administrative structures, customary laws and cultural practices).

[85] This dialectical relatedness of ontological realms thus opens the possibility of assessing ecological outcomes in the context of social form under which natural laws operate – a level of insight developed by the concept of 'metabolic rift', discussed in section 4.2.

historical materialism), it does not imply that accounts of *specific* modes of production need necessarily proceed in a chronological manner of categorical exposition from 'less developed to most developed', according to the manner of Engel's *simple commodity production* reading. The school of systematic dialectics has firmly rejected this reading, claiming that dialectical exposition cannot be read as deductive, since no particular category or starting point may necessarily be taken as axiomatic (Arthur 2008).

Thus far, this position is epistemologically compatible with the approach of resilience ecology and post-Parsonian complexity theory in its rejection of *a priori* explanatory axioms, such as socialisation, or designated equilibrium state values. There is however a deceptive similarity which may be observed within Marx's exposition of a capitalist mode of production, regarding his initial abstraction to the 'cellform' of the commodity, as a consequence of his employed method of exposition;

> "...it is necessary to employ 'the power of abstraction' to arrive at the 'cellform' equivalent of the body of the capitalist totality. The sequence of thought in carrying through this abstraction must be such that it arrives at a starting point that is sufficiently simple to be grasped immediately by thought and yet sufficiently historically determinate to lead to the other categories that structure this specific society, namely, bourgeois society based on the capitalist mode of production. Furthermore, the starting point should presuppose as little as possible, so as not to assert dogmatically what has not been established; and it should itself eventually be grounded as a necessary result of the reproduction of the system" (Arthur 2004: 27)

Although employing certain terms associated with deductive reasoning such as 'cellform', this approach constitutes an inversion of deductive logic; the essential difference, as stated previously, is that this 'cellform' is not a reductive first principle, nor a historically situated 'simple' category poised for progressive evolution. It is instead a category presented for subsequent *dialectical* enrichment in a manner alluded to above by Jairus Banaji;

> "What constitutes progression is an arrangement of categories from abstract to concrete; successive categories are always richer and more concrete...Indeed the basis of the advance is generally that each category is *deficient* in determinacy with respect to the next and the impulse for the transition involves a 'leap' to a qualitatively new categorical level. A dialectical development has nothing in common with a vulgar evolutionism predicated on extrapolating an existent tendency" (Arthur 2008: 214)

Thus far this review is pitched at a high level of abstraction; the preceding discussion does, however, contextualise and point toward a more substantive level of conceptual operation, namely that of the mode of production. Chapter 2 has already elaborated, on the basis of the

theoretical centrality of the labour process, the possibility of explicating a historical typology (alluded to above by Schmidt), as one of historical variants of natural-social metabolic mediation. It will presently be argued that the dialectical approach here outlined, transcends these particular confines in which it is employed (in this section at least), where it has been employed in service of illuminating the abstract dynamics of a *capitalist* mode of production; indeed, it has featured implicitly throughout all preceding discussions within this thesis of non-linearity, historical contingency, and complex systemic constitution.

The content of the preceding quotations thus points toward the next conceptual avenue, by which successive forms of *pre(non)capitalist* totality may be theorised. According to Marx's method of dialectical exposition, simple categories act as deficient preconditions for their successors, in a progression which involves a 'categorical leap' to progressively more concrete levels; the question thus becomes one of locating a logical starting point. Suggestions of where to begin are provided by Arthur's above-stated criteria of *simplicity*, and *sufficient historical determinacy*, such that any starting point '...should itself eventually be grounded as a *necessary result of the reproduction of the system*' (Arthur 2004: 27, emphasis added)[86]. Descending a level of abstraction, this brings discussion closer to what Smith and numerous others have alluded to as the 'historically specific and alterable material-natural and social conditions', or what may be termed 'second nature' (Smith 2009: 366);

> "What is required, then, is that the movement of abstraction retain in the proposed immediacy of the beginning some sign of its origin in a *historically determinate set of relations of production*. This is possible if, instead of taking the shape of a process of elevation to a more generic level, it seizes upon some particular aspect of the whole under consideration which, while simple, is also so implicated in the whole from which it is separated out that it still bears this trace of its origin" (Arthur 2004: 27, emphasis added)

Consequently, the outstanding task is to examine the nature of this *historically determinate set of relations of production* such as they obtain in the abstract, within the precapitalist mode of production of primitive communism[87]. The potential empirical enrichment of this conceptual framework is however rendered problematic by the complexities of nineteenth century Irish society, which Slater (1988) and Slater and McDonough (2005) have argued operated under

[86] Starosta has argued that many previous critics of dialectics have failed to account for the distinction between two separate moments of *analysis* and *synthesis*, which in turn leads to a failure to distinguish dialectical engagement from '…the formalism and atomism of bourgeois conceptions' (2008: 300).

[87] As with Smith and Arthur, Starosta also suggests that dialectical presentation '…starts by taking the immediate concrete appearance of the determinate social form at stake…then proceeds by synthetically unfolding the realization of that…determination' (2008: 301-302).

essentially *feudal* social relations, in the context of its colonial relations with *capitalist* Britain, thus exposing all members of Irish society to the economic vicissitudes of the world system, and the productive imperatives of feudal rent[88]. The concept of mode of production is inherently receptive to this complexity however, and maps well onto resilience ecology's depiction of multilevel panarchies. Attempting to marshall this complexity, Cohen (1978) thus refers to the presence of *dominant* as opposed to determinant, or invariant relations binding immediate producers within particular modes of production. The benefit of adopting a dialectical approach in the context of this problematic is that it is inherently receptive to this complexity, as initial explanatory categories remain open to modification through progressive (systematic) development. *Dominant* relations may thus be complemented with the presence of concomitant abstract determinants, according to the historical vicissitudes of the society in question. As a process of explicating *formal* determinations of totality (distinct from *material* alone), this involves outlining the 'self reproductive logic' of the totality in question, by examining the 'totality of social relations' necessary for its reproduction (Finelli 2007: 63).

Implementing this conceptual approach with respect to the subject matter of the primitive-communal mode of production in nineteenth century Ireland first requires examining more closely the components of this concept of 'mode of production' as a typological device, in order to understand the abstract role of precapitalist modes of production within the historical materialist apparatus. Consequently, the following section culminates in an examination of the dual components of *relations* and *forces* of production, as abstract, formal determinants, as suggested above by Arthur and Finelli.

4.3. Beyond determinism: the concept of *mode of production*

Prominent amongst critics of the *new dialectic* is Callinicos (2005), who accuses Arthur of succumbing to a Hegelian trap of sorts, through his implicit placing of the burden of proof on the logical consistency of the dialecticians' conceptual elaborations. Arthur's proposed outcome of a 'comprehended whole', according to Callinicos, lacks an objective means of verification;

> "...the contradictions that move the exposition on themselves reflect the incompleteness of each determination when isolated from the whole...not simply do the determinations presuppose the totality, but the movement from one to another depends on their relationship to that presupposition...on what basis could we judge that 'the whole system

[88] This 'world-systems' reading of the Irish economy has been developed most prominently by Denis O' Hearn (2001).

> of categories is complete and internally self-sustaining'? How could we tell, in other words, that we had actually reached 'the final goal'?" (Callinicos 2005: 49)

The identified problem resides with Arthur's adoption of an excessively 'Hegelian' interpretation of *category* (or 'formal ontological structure'), which is necessarily, for the purposes of analysis, devoid of content. Indicating a need to descend further levels of abstraction, Callinicos subsequently argues for the adoption of a realist epistemology as a potential corrective;

> "...how can we tell whether the presentation of a new determination in response to a problem posed by a previous determination represents the right step in the larger conceptual reconstruction of the capitalist 'real subject' existing outside and independently of 'the thinking head'? The best answer that both Marx's own approach and contemporary philosophy of science suggest is that the rightness of the successive moves can be established, not piecemeal but globally, through the empirical corroboration of his research programme. Here, again, all sorts of difficulties present themselves, but, in my view, realist epistemology constitutes a better terrain on which to grapple with them than that offered by the 'new dialectic' (Callinicos 2005: 58-59)

Consequently, it is suggested that remaining at such an inadequately high level of abstraction, as is implied by the school of *new dialectics*, inhibits the possibility of both theoretical verification and advancement – although this latter question of 'global empirical corroboration' here remains to be addressed within part II of this work. Directions on implementing this prescribed empirical enrichment regarding the subject matter of this thesis have previously been offered – albeit implicitly - by resilience ecologists, in the form of the concept of system identity. The operationalisation of identity relies on defining a range of system characteristics, but this does not adequately theorise the historical antecedents, underlying relations and contradictions which drive the system and thus produce its manifold surface forms – this falls to the process of abstraction which, far from a mere historical reconstruction of linear succession, seeks to uncover and present dialectically the multitude of complex factors operating at multiple scales which bestow upon the system in question its particular identity. In Marxian terminology, it seeks to explicate a totality generating a 'social form'; Callinicos thus appears to introduce a tension between this necessary abstraction, and its empirical corroboration. Aside from questions of ontology, his comments further pose an epistemological problem in their ambiguity over the requisite balance between both extremes, as was alluded to by Hindess and Hirst in their introduction to *Precapitalist Modes of Production*, where they affirm the role of theory as one of establishing appropriate conditions for concrete analysis – without affording primacy, or hierarchical superiority to either (1975: 9).

The solution, according to Marx, was to move systematically between both, as beneath the level of surface forms (*material*) reside essential inner relations which govern the systems movement (*formal*, Finelli 2007). In this respect, Marx was consistently critical of the narrow abstractions of political economy which remained at too high a level of superficiality. Taking the example of population as a critical social-ecological system variable; 'Population...remained an abstraction unless it was discussed in relation to the social classes of which it was composed; the class structure itself remained equally abstract unless its foundations – e.g. wage-labor and capital – were also considered; and these foundations in turn presupposed a division of labor and exchange' (Patterson 2003: 10). Adopting a dialectical approach thus counters this critiqued reification of variables such as population, by bringing observations into close dialogue with abstract models of the social world derived by the analyst (in the above example, a valid interpretation of the concrete movement of 'population' is possible only through an appreciation of its position within broader relations of class and labour – categories arrived at through processes of abstraction). An epistemological basis for such an approach has however already been elaborated within mainstream social science.

A realist approach (suggested above by Callinicos), as forwarded by Bhaskar and elaborated in chapter 1, assumes the pre-existence of social structures as a necessary precondition for human action; 'social forms are a necessary condition for any intentional act, (and)...their pre-existence establishes their autonomy as possible objects of scientific investigation' (Bhaskar 1989: 14 cited in Archer 1998: 197). This does not however, imply an impasse of the magnitude suggested by Callinicos, in which systematic dialectics 'must be accounted a failure' on the basis of its perceived excessive Hegelianism (2005: 56); critical realism has already productively assimilated the informants of dialectics in Bhaskar's' *Dialectic: The Pulse of Freedom*[89]. Bhaskar thus concludes, in a manner commensurate with critical realism's central tenet of ontological complexity, that; 'Social life qua totality is constituted by four dialectically interdependent planes: of material transactions with nature, inter-personal action, social relations, and intra-subjectivity' (Bhaskar and Norrie 1998: 566). Consequently, a developed and much-debated basis exists for mutual dialogue between dialectics and realism – as well as complexity and resilience ecology, with their methodologies of inductive typifying, and implicit assumptions of ontological pre-existence – more of which in section 4.3. Encouragingly, Ted Benton has also remarked on '...the great diversity of readings of Marxism – ranging from Critical Theory to Althusserian Structuralism - which seem indifferently assimilable to the realist defence' (1998: 297), although Benton stops short of wholly endorsing critical realism's apparently stunted resolution of positivist/hermeneutic polarity, through its

[89] It is curious that Callinicos does not acknowledge this.

reproduction of Kantian dichotomies of nature-society (ibid – as discussed and endorsed in chapter 2).

Proceeding on the basis of Archer's (1998) affirmation of the amenability of social forms to objective investigation, the 'mode of production' of primitive communism must therefore be elaborated to serve as an abstract framework structuring subsequent observations. What is offered by this approach is not an exhaustive model poised for deductive enrichment (although certain working hypotheses are implied subsequent to elaboration of the concept of metabolic rift in the following chapter), but rather a range of formal, abstract mechanisms which serve to account, in a trans-historical sense for these manifest social forms, their movement, and the socio-ecological conditions under which natural-social metabolism operates. Its utility with respect to the subject matter of this thesis has previously been affirmed by Benton (2009), in response to Slater and Flaherty (2009);

> "...the concept of 'mode of production' is a quite central starting point for analysing what Marx called the 'metabolism' of forms of human social life with the rest of nature. This concept includes both the forms of social relationship through which productive activity in relation to nature is conducted and the substantive interactions between human labour thus organised, and the naturally given conditions, means and materials employed. The concept enables transcendence of the 'nature/society' dualism that has limited the ability of both natural and social scientists to provide fully integrated accounts of human socio-ecology. At the same time it avoids over-generalised approaches to the relation between 'humans and nature' that see ecological problems as resulting from 'greed', 'growth', 'hierarchy' or 'technological development' in the abstract. The different modes of production can be seen as so many qualitatively different ways in which human labour is divided and combined with the rest of nature in meeting individual need' (Benton 2009: 27)

Interpretations and applications of the concept of *mode of production* have not proceeded uncritically however, and significant debate surrounds the role of precapitalist modes of production within the historical materialist apparatus, and the validity of 'articulations' of modes of production both as coherent, abstract theoretical totalities, and as historically specific instances of social organisation (Anderson 2007, 2010; Banaji 1977. 2010; Braa 1997; Brown 2010; Cohen 1978; Foster-Carter 1978; Hindess and Hirst 1975; Krader, Lawrence 1976; Milonakis 1993-1994; Murray 2006; Norman Smith 2007; O' Leary 1989; Shanin 1983, Slater 1988; Slater and McDonough 2005, Slater and Flaherty 2009). Overarching these related concerns is a relative deficiency in empirical application, particularly in the case of Ireland, although a number of recent contributions have served to remedy this deficiency (Anderson 2010, Slater and McDonough 2005).

G.A. Cohen's productivist-analytical reading of historical materialism (1978) identifies three distinct usages of the concept of *mode of production* in Marx's writings, a concept distinguished from *economic structure*, the latter of which, according to Cohen constitutes a framework of power relations within which production occurs[90]. In the first instance, according to Cohen, this dominant *economic structure,* giving rise to myriad trans-historical social forms, precludes the possibility of co-existent production relations obtaining in real societies;

> "Whatever the social form of production, labourers and means of production always remain factors of it. But in a state of separation from each other either of these factors can be such only potentially. For production to go on at all, they must unite. The specific manner in which this union is accomplished distinguishes the different economic epochs of the structure of society from one another" (Marx 1957: 34-35 cited in Cohen 1978: 78)

This apparent coherence of economic epochs thus captures the thrust of historical materialism in its theorising of history, and of social change; typologically, various epochs of social organisation may be distinguished on the basis of a *dominant*, albeit contradictory relation under which production proceeds; '...social forms are distinguished and unified by their types of economic structure, as individuated by the production relations dominant within them' (Cohen 1978: 79)[91]. Classically, Marx is said to have advanced a sixfold model of successive

[90] Cohen's reading offers a technicist interpretation of historical materialism in which economic relations are viewed as dominant, and as exerting causative influence – it must therefore be noted that Cohen assumes the independent primacy of economic structures, as broadly invariant relations binding immediate producers within particular societies. The respective modes of production of capitalism, socialism and slavery are thus correlates of economic structure, whereby a particular dominant form of production relation binds immediate producers (Cohen 1978: 77-78). Cohen's contribution represents a much-criticised productivist/technological-determinist, or 'base-superstructure' reading, as is commonly reproduced in classical theory texts (e.g. Ritzer 2003; Doyle 2008; Johnson 2008). Analytical Marxism's hostility toward the Hegelian legacy ensures that this relation between economic structure and the institutions of civil society is viewed as unidirectional, rather than dialectical. This reading traces a direct lineage from Althusser's assertion of an epistemological break in Marx's work, occurring between 1845 and 1857, dividing Marx's work into distinct phases of *liberal-rationalist* (up to 1842), *communalist-rationalist* (1842-1845), *transitional* (1845-1857), and a period of *scientific maturity*, culminating in the three volumes of *Capital* (Levine 2003: 91).

[91] Cohen also offers a formal definition of *economic structure*, as;

> '…the whole set of production relations (which) are relations of effective power over persons and productive forces, not relations of ownership. But it is convenient to represent production relations as relations of ownership…To own an object is to enjoy a range of rights with respect to the use and situation of that object…The rights are limited by the character of the object and the nature of the prevailing legal system. Typical ownership rights are: the right to use an object *o*; the right to income generated by the use of *o*; the right to prevent others from using *o*; the right to destroy *o*; the right to transfer *o*;…Sometimes a person has some of these rights but lacks others' (Cohen 1978: 63)

Legal impediments are an important issue for understanding the dynamics of communality in Ireland, and a critical factor in the distribution of social-ecological resilience –they should not however, be interpreted in reified form apart from their material basis, nor deterministically as a mere consequence of such. Consequently, chapter 6 examines more closely, in the context of Ireland's colonial apparatus, the specific manifestation of formal and customary legal rights under the social form of Irish communality,

modes of production distinguished according to their economic structure; '(1) early stateless, (2) Asiatic, (3) ancient, (4) feudal, (5) bourgeois or capitalist, and (6) socialist' (Anderson 2010: 155)[92]. To this may also be added *primitive communism*, as both a theoretically and empirically distinct mode of production (Brown 2010; Hindess and Hirst 1975; Engels 1882 [1989]; Krader 1976; Shaw 1984; Stahl 1980), a component of this progression designating '...epochs marking progress in the economic development of society' (Marx 1859 cited in Anderson 2010: 155).

By Cohen's interpretation, *modes of production* are not necessarily commensurate with *economic structures* however – a conclusion reflecting the centrality of economy in the productivist/analytical reading. Conversely, a systematic dialectical reading, as discussed in section 4.1.1 above, questions the validity of according primacy to the economic, although acceptance of this reading largely rests on one's stance concerning the epistemological break – more specifically, the extent to which a latent Hegelianism may have survived into the *post-break*, mature Marx of Capital. Explicating *mode of production* further into three essential components - or ways in which Marx himself employed the concept - Cohen identifies a *material mode* (i), as '...the way in which men work with their productive forces, the kinds of material they set in train...forms of specialization and division of labour among them. There is a change in the material mode of production when enclosed fields replace strip farming...here 'mode' means the same as technique' (Cohen 1978: 79-80). The *social mode* (ii) '...denote(s) social properties of the production process...comprising) its purpose, the form of the producer's surplus labour, and the means of exploiting producers (Cohen 1978: 80). Differentiation on this *social mode* dimension thus centres on the extent to which production for commodity exchange occurs (i.e. relative penetration of exchange value), the manner in which surplus is appropriated (i.e. as corveé, rent in kind, money rent, extraction of labour power after subsistence (slavery), retention of relative surplus value), and the means by which a producer is induced to surrender his surplus. Under feudalism, this latter dimension takes the form of extra-economic coercion; since the exploiter cannot induce the producer's free sale of labour, violence, threat of force and ideology are instead applied. Conversely under capitalism, economic coercion under conditions of 'equal right' obtains; 'Because the wage worker owns his labour power, he cannot be threatened with violent reprisal if he withholds it, but because he lacks means of production, no such threat is needed' (Cohen 1978: 83).

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and their role in the effective conditioning of social-ecological reproductive activity across multiple systemic levels.

[92] This preliminary reliance on *economic structure* alone is criticised below

The final component of *mixed mode* (iii) indicates a measure of reluctant deference to a dialectical reading by Cohen, whereby Marx deploys the concept of *mode of production* '...in a comprehensive fashion, to denote both material and social properties of the way production proceeds...its entire technical and social configuration' (Cohen 1978: 85). In the context of the preceding discussion supporting a systematic dialectical reading of Marx (including the work of 'late' Marx), Cohen's division here appears unnecessarily piecemeal, missing a critical unity between the economic and the social. Discussion of the labour process in chapter 2 has already demonstrated how the concept of abstract labour itself describes a unity between the *material* (i) and *social* (ii), with their concrete expression in the labour process - Cohen's reading thus reproduces old ontological divides by positing a separation between the spheres of the material and the social.

Examining Marx's own use of the term according to Patterson's presentation (2003: 18-19), traces of the hypothesised *epistemological break* are encountered, a break which is purportedly evident in a comparison of Marx's pronouncements on *mode of production* between the *German Ideology* (1845), and *Contribution to the Critique of Political Economy* (1859);

> "...mode of production must not be considered simply as being the reproduction of the physical existence of the individual. Rather it is a definite form of activity of these individuals, a definite form of expressing their life, a definite *mode of life* on their part. As individuals express their lives, so they are. What they are, therefore, coincides with their production, both with *what* they produce and with *how* they produce. (Marx and Engels 1976 [1845–1846]: 32-33)

The preceding quotation captures the essence of the concept of 'species being' which was to form the basis for Marx's subsequent elaboration of the notion of 'alienated labour' under capitalism. Prefiguring later commentaries such as those of C. Wright Mills, preliminary observations are made on the relationship between individual and social structure; this observation is in turn bound up with a more humanist-materialist interpretation of 'human nature', namely the capacities for purposive, creative intervention and the capacity to 'construct in thought' and anticipate consequence prior to action (much of which has figured previously in chapter 2 in discussions of nature and society). Crucially, this 'mode of life' bears a close relation to dominant modes of physical reproduction (i.e. the production process). Indeed, the concept of the labour process outlined in chapter 2 specified as much, by asserting the primacy of the manner in which individuals appropriate the produce of nature in understanding social organisation. But does this apparent relationship between 'mode of life' and 'mode of production' constitute a causal relation as per the productivist-analytical reading? According to 'later' Marx;

> "In the social production of their existence, men inevitably enter into definite relations, which are independent of their will, namely relations of production appropriate to a definite stage in development of their material forces of production. The totality of these relations of production constitutes the economic structure of society, the real foundation, on which arises a legal and political superstructure and to which correspond definite forms of social consciousness. The mode of production of material life conditions the general process of social, political and intellectual life...At a certain stage of their development, the material productive forces of society come into conflict with the existing relations of production, or – this merely expresses the same thing in legal terms – with the property relations within the framework of which they have operated hitherto. From forms of development of the productive forces these relations turn into fetters. Then begins an era of social revolution. The changes in the economic foundation lead sooner or later to the transformation of the whole immense superstructure (Marx 1979 [1859]: 20)

David Harvey (1982, 2010), as previously discussed with reference to Marx's methodological footnotes in *Capital*, has argued strongly against interpreting this as a relation of determination – in contrast with the analytical school - arguing instead for a dialectical reading in which culture, society and economy are viewed as an integrated totality[93]. Hindess and Hirst issue a similar caution against economic determinism in drawing attention to the 'matrix role' of economy within modes of production;

> "It is determinant in the sense that its conditions of existence assign to each of the levels of the social formation its precise effectivity and mode of intervention with respect to the other levels. In this respect the economy plays what might be called a matrix role in determining the structure of the articulated hierarchy of levels in the social formation. The economy is also represented as a level within this articulated hierarchy. The place of dominance within the hierarchy of levels must not be confused with the matrix role of determination...The mode of appropriation of surplus-labour is the dominant articulation which governs the character of the corresponding productive forces" (Hindess and Hirst 1975: 21)

In this sense, rejecting a dialectical reading of 'later' Marx offers only a reversion to technological-economic determinism by ignoring both the complexities of economy *vis-a-vis* other levels of this articulated whole, and by ignoring the centrality of surplus-appropriation mechanisms as a more complex characterisation of particular sets of economic relations. Of the French structuralist tradition, and in response to the narrow determinism of the analytical approach, Maurice Godelier thus attempted to conceptualise this complexity through the concept of *infrastructure* as;

[93] See Arthur (2006) on the concept of 'totality' in relation to capitalism; 'Capital is the 'all-dominating economic power' which not only 'must be dealt with before landed property', but subsumes it within the social forms characteristic of capitalism.

> 1. The combination of ecological and geographical conditions within which and from which society extracts its material means of existence
> 2. The productive forces, i.e. the material and intellectual means which man invents and employs in different labour processes in order to act upon nature and to extract therefrom his means of existence and transform nature into 'socialised' nature;
> 3. Relations of production, i.e. all social relations whatsoever, which serve a threefold function: first, to determine social access to and control of resources and the means of production; secondly, to redistribute the social labour force among the different labour processes, and to organise these processes; and thirdly to determine the social distribution of the product of labour (Godelier 1980: 6 cited in O' Leary 1989: 13)

Interestingly, such distinctions in characterisations of modes of production according either to broadly defined *functions or relations* (Godelier 1980; Hindess and Hirst 1975), or narrowly defined *institutions* (Cohen 1978) mirrors prior discrepancies concerning the merits of abstract systemic modelling (Parsons) against those of a more narrow structuralist variant (i.e. Millers' *Living Systems Theory*)[94]. Therefore, although Godeliers model offers a more holistic conceptualisation of such modes according to their functional infrastructures, its defined matrix of functions is considerably broader compared to that of the analytical school.

Retaining a necessary degree of abstraction, a more conducive casting of the term may therefore be derived, according to Hindess and Hirst, as one for which a *mode of production* constitutes an; '...articulated combination of relations and forces of production structured by the dominance of the relations of production. The relations of production define a specific mode of appropriation of-surplus labour and the specific form of social distribution of the means of production corresponding to that mode of appropriation of surplus labour' (1975: 9-10). Interpreted in this manner, a *mode of production* thus comprises dual moments of *relations* and *forces*. Conceptualised and distinguished as such, the trans-historical nature of this abstract typological device becomes apparent;

> "Both the forces and the relations of production of a particular society were the products of particular socio-historical processes and interconnections that developed over time as the members of successive generations worked to gain their livelihoods. In other words, both the forces and relations of production were socially historically contingent and refracted in complex ways the inheritance of the past generations" (Patterson 2003: 20)

Forces of production may here be loosely interpreted as variations of specific labour processes, or as the principle manner in which societies collectively appropriate the produce of nature - a concept previously elaborated by Benton (1991, 1996) in a critique of productivist readings, incorporating both *ecoregulative*, as well as productive labour processes (chapter 2, section 2.2.1). It therefore expresses the unity of labour-power, its intentionality, and its instruments in

[94] This typology of interpretations of *modes of production* is also elaborated by O' Leary (1989)

'...the specific form of their articulation into a concrete labour process' (Hindess and Hirst 1975: 11). Banaji (2010) also affirms the intermittent synonymity of the concept of *Produktionweise* (or mode of production) and labour process in Marx, as a term invoked in order to demonstrate the subsumption of simple commodity production (labour) processes within capitalist forms (i.e. through the concentration of direct producers in manufacture, - Banaji 2010: 50). Banaji's observation thus further underscores the erroneous disambiguation of *forces* from *relations* as per the productivist reading, as the *labour process* cannot be understood apart from the social organisation of labour, as expressed by the concept of *relations* of production. Furthermore, remaining at the level of productive forces alone constitutes an inadequately restrictive typological basis, as it asserts; '...that the nature of a set of production relations is explained by the level of development of the productive forces embraced by it (to a far greater extent than vice versa)' (Cohen 1978: 135). Consequently, the ambiguities implied in a typology explicating various 'levels of development of the productive forces' inhibits the possibility of examining the dialectical relationship between forces and relations, or more importantly, in the context of this thesis, the 'metabolism' of the ecological and the social as will presently be argued.

Relations of production, according to Patterson refer to; '...relations...among the members of a society with regard to control over the productive forces...analogous to property relations...In different societies, the relations of production might variously be communal, tributary or capitalist. In communal societies, the forces of production were held in common by a collectivity, and the members had access to them by virtue of their membership in the group' (2003: 21). This aspect of the mode of production deals not only with conditions of access to the means of production; it incorporates the crucial dimension of surplus *appropriation*, given that 'surplus' presents as a necessary category within all historical modes of production; 'They (modes of production) differ not in the existence of surplus labour but in the mode in which it is appropriated. It may be apportioned collectively as in the primitive communist...or it may be appropriated by a class of non-labourers as in capitalism or feudalism' (Hindess and Hirst 1975: 10). As an articulated, dialectical combination of *forces* and *relations*, the concept of *mode of production* thus permits a distinction between various 'economic epochs' - as manifest, historically determinate social forms - obtaining within a matrix of conditions characterised by individual *modes of production* in the abstract.

In addressing the requisite balance of abstract/concrete operation, or functional/institutional description in the explication of these epochs (according to O' Leary's typology of the *mode of production* debate (1989), it is instructive to return to Christopher Arthur whom, as discussed in

section 4.1.1., has already proposed a theoretical starting point capable of logically explicating the dynamics of such modes of production. According to Arthur, the first movement of abstraction must retain some semblance of '*...historically determinate set[s] of relations of production*.... [which] seizes upon some particular aspect of the whole under consideration which, while simple, is also so implicated in the whole from which it is separated out that it still bears this trace of its origin" (Arthur 2004: 27, emphasis added). Concepts so derived must therefore conform to the criteria of *simplicity* and *sufficient historically determinacy* as a hedge against both idealism and empiricism.

This in turn permits consideration of whether Marx had indeed subjected these modes of production, specifically the primitive communist mode of production, to a similar process of abstraction as that which yielded the capitalist cellform of the commodity, thus providing a logical starting point fitting the criteria of simplicity and historical determinacy. Such questions were addressed substantially by Marx – particularly within his later works, and attention is therefore drawn to Marx's draft letters to Vera Zasulich, on foot of her request for comments from Marx, concerning the possibility of a Russian transition to socialism without progressing through an intermediary stage of capitalism. In response, Marx draws attention to the presence of an essential 'dualism of communality and individualism' thus providing a simple category with which to develop the analysis of this articulated combination of relations and forces governing the dynamics of the concrete social forms to be addressed within the chapters of part two. In the process, an outstanding deficiency in systems-based approaches is addressed; that of the limited development of conceptualisations of *the social* in complexity and resilience ecology. Developing this conceptualisation of the social within the apparatus of the *mode of production* thus permits the exploration of recent developments within Marxism on the concept of metabolic rift, which in turn identifies a critical moderator of resilience within the dynamics of such historically determinate relations and forces of production.

4.4. Marx on precapitalist modes of production and primitive communism[95]

Marx's pronouncements on non-Western and precapitalist societies occupy a contentious position within mainstream Marxism, not least resulting from controversies engendered by the *Asiatic Mode of Production* debates, as threats to the logical consistency of historical materialism and its predictive promise of capitalist transcendence (Anderson 1974; Banerjee 1985; Huang Tan 2000; Krader 1975; Lubasz 1985; O' Leary 1989; Thorner 1982). Regarding the logical consistency of historical materialism and its associated modes of production as models of successive economic epochs, the presence of the *Asiatic Mode of Production* as a static form of 'oriental despotism' has raised a number of theoretical dilemmas, one of which in particular has displayed stubborn resilience in contemporary debate, raising deeper concerns over historical materialisms' explanatory power; 'The first dilemma is that the AMP is either part of a unilineal schema, in which case it contradicts the theory of historical progress; or it is part of a multilineal schema, in which case historical materialism ceases to be a theory of history and instead becomes a redescription of world history' (O' Leary 1989: 201). Within this schema, various antecedent modes of production such as the *Asiatic* and *Ancient* feature not only as devices expressing the essential dynamics of social forms according to their modes of surplus appropriation and relations of production; they play a significant part within the broader materialist apparatus, demonstrating the progressive historical development of productive forces leading to capitalism. Within this progression, communality plays a central role as an ideal-typical baseline from which the development of productive forces within successive modes of production is reckoned; the significance of this progressive schema and the centrality of communalism within historical materialism therefore requires underscoring.

[95] A note of qualification is required on the term 'primitive'. Throughout his writings, Marx frequently referred to a state of 'advanced communism' as a successor to capitalism characterised by '…a complex division of labour, centralized and scientifically planned production and highly developed forces of production' (Hindess and Hirst 1975: 42). Primitive communism denotes an antecedent, precapitalist form of communal appropriation, characterised by '…limited development of productive forces and a limited division of labour…Appropriation is collective by temporary or semi-permanent co-operative groups or by ideological unities into which the collective is divided, households, kinship groups, etc. (ibid: 43). Lee (1990) also identifies the conceptual value of a communal mode of production as a comparative heuristic capable of assessing the emergence of social complexity, referring also to its 'emotional loading', and noting its earlier origins in the work of Morgan as an extension of his law of hospitality (Marx read and commented extensively upon the ethnological work of Morgan). Terms such as *primitive communism*, *communality*, *commune* and *communal form* are variously employed throughout this thesis; wherever used, they refer to the latter form of *primitive* (precapitalist) as opposed to *advanced* communism. It must also be acknowledged that the concept of a *primitive communist mode of production*, in its abstract usage bears no trace of ethnocentrism and functions merely as a theoretical tool. The concept of *mode of production* denotes a theoretical construct, or abstract assemblage of *relations* and *forces* of production, characterised by a particular mode of *surplus appropriation*. *Social form* refers to a *historically specific* manifestation of this abstract mode of production (i.e. Irish rundale or Russian Mir).

According to Joseph Schumpeter, Marx's prophetic prognosis of the demise of capitalism constituted an historical inevitability, rendered visible through the presentation of history as a dialectical progression of successive syntheses, of which socialism was to be but one, '...by proclaiming that socialistic deliverance...was a certainty amenable to rational proof…As every true prophet styles himself the humble mouthpiece of his deity, so Marx pretended no more than to speak the logic of the dialectical process of history' (Schumpeter, 2008 [1942]: 6-7). According to Schumpeter's reading, precapitalist modes of production feature merely as moments within this dialectical progression, as alternate modes of surplus appropriation existing in manifold forms within an abstract continuum of 'social development'. This 'science' of historical materialism thus prescribed an inevitable movement toward socialism, in which the contradictions of wage labour and the dominance of the commodity form would eventually resolve through socialisation of the means of production. Therefore, the mode of production of primitive communism characterised by use-value oriented production, peripheral commodity circulation, collectivisation of the means of production, and collective appropriation of surplus, is thus of interest within this schema insofar as it defines the preconditions of primitive accumulation, leading to an eventual 'emancipation' of labour from its objective conditions, resulting in its free sale as commodity for wage remuneration (i.e. the capitalist appropriation of surplus value within the valorisation process). In short, precapitalist modes of production, according to this reading are merely moments of an intractable historical progression amenable to scientific proof, or feature primarily as necessary logical components of a coherent theory of history.

Marx's preparatory notes for what would later become *Capital* (Grundrisse), offer comments to this effect in a section titled '*Forms which preceded capitalist production'*. These comments would subsequently form the basis of part eight of Capital, '*So-called primitive accumulation'*, outlining the separation of labour from its objective conditions as preconditions of a capitalist mode of production. The theoretical significance of such antecedent forms to this emergent theory of history are clear in *Grundrisse* however, as Marx discusses 'small free landed property as well as...communal property' as instances in which '...the worker relates to the objective conditions of his labour as to his property; this is the natural unity of labour with its material' (Marx 1973: 471). Part empirical, part theoretical abstraction, this natural unity, or '...naturally arisen communism found at the earliest stages of all societies' functions as a baseline device illustrating the progressive effects of divisions of labour throughout human development, such as they engender transitions from this archaic communal basis through forms such as the *Asiatic*, *Ancient* and *Feudal* modes of production, as precursors to capitalism (Anderson 2010: 160). In such a manner as alluded to above by Schumpeter, successive

'economic epochs' are thus explicated on the basis of their deviation from this communal state, according to their level of development of the forces and relations of production.

Within this progression, communal property first appears; '...in its naturally arisen form as we find it among all civilised nations at the threshold of their history...The communal system on which this production is based prevents the labor of an individual from becoming private labor and his product a private product; it causes individual labor to appear rather as the unmediated function of a member of the social organism (Karl Marx and Frederich Engels *Collected Works*, volume 29: 161 cited in Anderson 2010: 161). Consequently, social development continues in succession from this archaic communal basis in stages of progressive individuation, for example in Marx's *Ancient* form; '...which appears to emerge directly out of primitive communalism, property is still communal, but the commune is now a civic community to which members belong as citizens, in a society already characterised by a division of labour between town and country...the ancient form is an urban civilization founded on agriculture and landed property' (Meiksins Wood 2008: 81)[96]. This conceptualisation of historical forms constituted a radical break from classical political economists' pronouncements on 'development' as merely the expansion of divisions of labour. Marx's alternate conceptualization incorporated;

> "...not only the emphasis on class divisions but, more particularly, the idea that historical progress has been a progressive 'separation of free labour from the objective conditions of its realization – from the means of labour and the material for labour' (Marx 1973: 471), which culminates in the complete separation of the wage labourer in capitalism. Before capitalism, workers related to the basic condition of labour – the land – as their property, whether the communal property of one or another form of primitive communalism or the free landed property of the independent small producing household. Capitalism completely disrupts the 'natural unity of labour with its material presuppositions', and the worker no longer has 'an objective existence independent of labour" (Meiksins Wood 2008: 86)

Against such a unilineal reading, in which historical materialism is charged with reproducing an excessively rigid depiction of social development (variously fostering a latent 'Orientalism'

[96] As Wood (2008) and Patterson (2003) outline, this progression was far from uniform, and with regard to its empirical corroboration, it confronts significant variation in both historical and archaeological record. Nonetheless, as Hobsbawm has suggested, its critical function is not to provide a precise interpretive frame for historical research; '...he does not, in the *Grundrisse*, set out to explain the transition [from feudalism to capitalism], although he does talk about the 'primitive accumulation' that preceded capitalism. His objective is rather to highlight the specificity of capitalism in contrast to earlier forms of property and labour' (Meiksins Wood 2008: 84). Such an approach was necessary in order to counter the 'narrow abstractions' of political economy which seized upon decontextualised categories such as 'trade' or 'money' as transhistorical constants demonstrating the immutability of capitalism. Presenting *precapitalist* modes of production in such a manner was therefore essential in order to outline the historical specificity of capitalist relations and the uniqueness of its particular mode of surplus appropriation

through its depiction of the *Asiatic Mode of Production* as a form of resilient despotism), Kevin Anderson (2010) has recast the role of communal forms as demonstrating the multilineal nature of Marx's reading and theorising of history. Accordingly, Anderson identifies three communal variants in *Grundrisse*; the *Asiatic, Greco-Roman* and *Germanic*. The *Asiatic* form, according to Marx, was characterised by a persistence of communal structures at village level, subject to extractions of surplus product by a despotic 'higher entity' as landowner, existing across India and Asia in concrete variations along a continuum of democratic-despotic (Anderson 2010: 157). The *Greco-Roman* (variously referred to in generalised form as the *Ancient*), constituted an urbanised form with origins in clan-based communities, albeit distinct from Asian forms; 'Property in land existed, although only for the Roman citizen, but this contrasted with the Asian forms, where all property in land was communal and the individual was at most "only a possessor of a particular part," without juridical ownership rights' (ibid: 158).

The third or *Germanic* form comprised a 'periodic coming together to hold a communal meeting' owing to the comparative isolation of rural locales, albeit with an absence of communal landholding practices characteristic of the Asian and Greco-Roman variants (ibid). This *Germanic* form, according to Anderson, constituted the basis of medieval European feudalism, but was afforded comparatively less attention in *Grundrisse* than both the *Asian/Asiatic*, or *Greco-Roman*. Despite Anderson's necessary recasting of Marxism's core heuristic - the result of which has been a significant rebuttal to charges of both teleology and Orientalism - the preceding distinction between forms of communalism reveals merely the possibility of manifold variations obtaining within Marx's initial abstract 'natural unity', according to the vicissitudes of concrete social forms of interest. Given that these ideal-typical variants represent abstractions, albeit ones arrived at through a measure of empirical corroboration, the question thus arises as to whether a more fundamental commonality or category with which to corroborate the empirical niceties of communality in Ireland may be discerned. On this point, as the concept of 'natural unity' arguably constitutes an inadequately abstract starting point; there is little sense of how such devolutions from this state of 'natural unity' may be standardised, nor a sense of what might characterise the dynamics of communalism beyond the mere presence of common property holding, or communal governance.

Marx's discussions of communal forms were not to conclude within *Grundrisse* however; they were instead augmented in subsequent works, through his readings in ethnology. Shanin emphatically characterises this later intellectual movement of Marx as a substantial development in his thought, in which the perceived linearism of his preceding major works was

significantly redressed. It further demonstrates an increased recognition on Marx's part, of a need for more concretised conceptualisations of historically-specific communal forms;

> "...the consideration of co-existence and mutual dependence of capitalist and non-capitalist (pre-capitalist?) social forms made Marx increasingly accept and consider 'uneven development' in all its complexity. New stress was also put on the regressive aspects of capitalism and on its link with the state in Russia. The acceptance of unilinear 'progress' is emphatically out. The extension of an essentially evolutionist model through the ideas of Oriental Despotism is by now insufficient. Specifically, Marx came to see the decline of the peasant commune in Western Europe and its crisis in Russia, not as a law of social science – spontaneous economic process – but as the result of an assault on the majority of the people, which could and should be fought. The consideration of the Russian commune in the drafts of the 'Letter of Zasulich' brought all this to the surface" (Shanin 1983: 15-16)

Contemporary literature reflects a broad acceptance of this position, and development theory in particular has much benefitted from conceptualising modes of production as coexistent, rather than mutually exclusive developmental stages. In such a manner, certain applications of historical materialism within the field of development studies (drawing on the concepts of *mode of production* and its sixfold typology outlined previously), have produced two related problematics and interpretations; those asserting the determination of the institutions of society *vis-a-vis* its economic base or productive forces (as discussed in section 4.1.2), and those of a 'developmentalist' slant, whereby the stages of succession depicted in the preceding sixfold typology of 'economic epochs' represent stages of linear development, proceeding in a manner characterised by Engels as a 'process of evolution' (Engels 1959 cited in Banaji 1977: 1). Modernization theory serves as a recent illustration of the latter, with its assumptions of uniform development, and employment of traditional-modern dichotomies (Larragin 1989: 87).

In response to modernisation theory, and to the assumption of invariant production relations asserted previously by the analytical school, Laclau (Foster-Carter 1978), and more recently Murray (2006), have argued for the continuation of feudal productive relations in Latin America, asserting the potential co-existence of elements of pre-capitalist within capitalist modes of production. Laclau (cited in Foster-Carter 1978) advances his thesis by distinguishing an economic system constituted by market relations in which traces of precapitalist relations of production remain. In the case of Murray's *neo-feudalisation* thesis, this conceptualisation posits a production system based on private, monopolised distribution networks in which direct producers are induced through a form of economic coercion to produce specific crops for

market sale, resulting in land concentration and proletarianisation (2006).[97] On the basis of these latter examples, it may again be observed how an excessive typological reliance on productive forces alone or even the restrictive assumption of homogeneity implied previously by Cohen, whereby singular dominant relations obtain within particular concrete social forms, renders the concept of *mode of production* incapable of accounting for the complexities, coexistences and transitions of multiple modes. So too must the possibility of coexistence be retained when dealing with precapitalist modes of production, as will be substantively argued in chapter 6.

Slater (1988) has previously examined the rundale system in the context of Marx's pronouncements on communality in *Grundrisse*. Accordingly, Marx's conceptualisation points not to a rigid typology of either communal / private, but instead reveals the possibility of conceptualising communal forms along a continuum constituted by a *dualism* of communality and individualism, with the location of concrete social forms determined by the extent to which their property relations are characterised by either complete appropriation of the commune's collective product (referred to by Marx as an *Archaic* form), or by the presence of proprietorship as either fixed or movable (usufruct) property. Such complexity is warranted in order to avoid empiricist pitfalls, as although the presence of particular concrete labour processes may appear capitalistic (i.e. sale of produce for money), they may in turn conceal social relations of production, whereby conditions of obligation, surplus appropriation and tribute may obtain, constituting essentially *feudal* relations amongst producers. Furthermore, property relations may obtain in a complex mix of formal-legal and customary conditions of access, such that access to the means of production proceeds on a communal basis - either as gavelkind, regulation by communal council, or, as in archaic communal forms, by complete collective appropriation of produce.

In such precapitalist forms, relations of production may exist such that labour still retains direct access to the means of production '...under various forms of property and under various degrees of constraint' (Lubasz 1985: 118). Such relations, as will be outlined in the case of Ireland,

[97] According to Foster-Carter, numerous critiques of linearism and alternatives to the analytical rule of 'single-variant' dominance abound; "…Meillassoux describes precapitalist forms as 'being undermined and perpetuated at the same time…Poulantzas points to 'complex forms of dissolution and conservation'…Bettelheim also talks of 'conservation/dissolution', adding that 'all reality is contradictory' (1978: 2). Commentaries on 'multilinearism' often proceeds with this unacknowledged debt to preceding controversies in development theory (particularly the seminal modernisation and dependency debates); these points offer significant evidence to assert the validity of the multilinear reading however, although the precise theoretical basis upon which this multilinearism is asserted must be clearly qualified – (i.e. as variations of relations of production within dominant economic structures, or as differing concrete variants of similar abstract modes of production)

operate in context of an overall absence of formal-legal fixity of tenure, imposed by structures of colonialism[98]. The superficiality of the mere presence of production for market sale, or of protoindustrial activity may also conceal characteristics of simple commodity production, whereby [M-C-M] does not result in the realisaisation of [ΔM], as a consequence both of extra-economic extraction of surplus, and an absence of remuneration on capital investment, resulting in an absence of valorisation on the part of the direct producer, and therefore an absence of developed capitalist relations.

There can be no straightforward imposition of a master narrative on Marx's thought however – not least one which resolves the question of whether Marx in his writings prioritised the features of precapitalist systems insofar as they explained the emergence of capitalism, rather than deriving their specific internal dynamics, as argued by Eric Hobsbawm (Lubasz 1985: 116). Nonetheless, sufficient doubt has been cast on such 'master narrative' readings to warrant a 'bracketing' of Marx' pronouncements on precapitalist modes of production according to the break outlined above by Shanin (1983), and substantiated by Anderson (2010) and Brown (2010)[99]. Justification is here offered by the substantial gains in knowledge accrued within the field of development studies by conceptualising modes of production in terms of their complexity and co-existence, rather than their temporal succession, as per an adapted *simple commodity* or unilinear reading, leading as it does toward the logical pitfalls of modernization theory as outlined above.

According to Meiksins Wood, this 'master narrative' approach had begun to demonstrate fragmentation in Marx's thought as early as Grundrisse, such that he became '...more concentrated on the specificities of every social form, each with its own distinctive relation of direct producers to the means of production and its own specific conditions of survival and self-reproduction' (2008: 88). Consequently, the role of precapitalist modes of production is recast in Marx's later work as one which emphasises how '...each system of social property relations is driven by its own internal principles and not by some impersonal transhistorical law of technological improvement or commercial expansion' (2008: 88). Thus in the manner alluded to above by the school of *New Dialectics*, what is found within 'later' Marx is a more specific conceptualisation of precapitalist social forms, pointing toward empirical corroboration in a

[98] There is no physical or documentary evidence of the existence of this concrete form of archaic commune in Ireland; it remains a component of the typological dualism of communal-individual

[99] A more pessimistic depiction of this 'break' suggests that Marx had, in his later years, lost the capacity for serious intellectual work, owing to a persistent 'nervous complaint' offered in apology for his belated reply to Zasulich in 1883. David Ryazanov thus stated '...I stick to the view already expressed in my lectures on Marx and Engels: namely that it was only Marx's undermined capacity for work...which prevented him from replying in as much detail as he had originally intended' (1983 [1924]: 129)

manner which; '...does not prevent the same economic basis...from showing infinite variations and gradations in appearance, which can be ascertained only by analysis of the empirically given circumstances' (ibid). Consequently, the aforementioned concept of a dualism of communality and individualism with regard to the mode of production of primitive communism, along with the following comments, satisfies the dual criteria of *simplicity* and *historical specificity*, whilst also implicating an understanding of the duality of *relations* and *forces* of production.

Marx's most developed conceptualisation of the agrarian commune is therefore explicated within his third draft letter to Vera Zasulich where he outlines the potential existence of multiple concrete communal forms[100]; 'Primitive communities are not all cut according to the same pattern. On the contrary, they form a series of social groups which, differing in both type and age, mark successive phases of evolution. One of these types conventionally known as *agrarian commune*, (*la commune agricole*), also embraces the *Russian commune*. Its equivalent in the West is the very recent *Germanic commune*' (Marx 1983 [1881]: 118).

This simple typology of communal forms remained long contested within social theory, and the question of the origins of such primitive communities occupied other classical social theorists such as Max Weber, whose thoughts on communality reveal a similar divide as that which defined Irish historical geography throughout the mid-late twentieth century. Weber claimed '...that the most widely held opinion among Russian scholars was that the mir (Russian commune) was not a primordial institution, but a product of the tax system and of serfdom' (Krader 1976: 137). Such comments suggest a discord between explanations depicting primitive communalism as a 'primordial institution', or as a form which emerged later as a consequence of historically specific social-political structures (i.e. Russian serfdom). Consequently, such debates have offered much ideological fodder throughout history; the writings of Edward Wakefield for example, justified the creation of land monopolies as a hedge against potential workers' engagement in subsistence agriculture, thus ensuring unmitigated primitive accumulation as an essential precondition of industrialisation (Bellamy Foster 2008b: 105). Such a position engendered hostilities to collectivisation, which was perceived as a bulwark against land reform and consolidation, and the extent of individualisation necessary for the emergence of wage labour. In Ireland, debate concerning the origins of the rundale agrarian commune as either a primordial institution, or more recent (i.e. seventeenth-century) emergence in response to local ecological and political circumstance remains ongoing – although ultimately this question is of lesser concern to the subject matter of this thesis, and is arguably

[100] As outlined in Slater and Flaherty (2009)

better served by ongoing field research and the discipline of history (Doherty 2000; Evans 1939; Forsythe 2007; McCourt 1971; Whelan 1995, 1999; Yager 2002).

According to B.D. Grekov, the specific history of the Russian commune or *mir* implicates both positions, as the early Russian law codes and records relating to the eleventh and twelfth centuries suggest that governing bodies of this time imposed systems of tax collection and regulation *upon* the manifest collective unit of the peasant commune (Krader 1976: 138). This compelling assertion does not depict communality as a mere consequence of historically specific conditions or administrative imperatives, nor does it completely dismiss the role of the state in accounting for the subsequent trajectories of particular communes. So prevalent were such communes however, that the latter *Germanic* communal form (by Marx's above quotation), according to Engels '...served as the basis and as the type of all public institutions, and permeated the whole of public life, not only in Germany, but also in the north of France, England and Scandinavia' (Engels 1882 [1989]: 441). Regarding this latter *Germanic form*, as a western equivalent of the Russian mir, Marx identified three essential characteristics, offering a further concrete differentiation of these latter forms from the archaic, abstract communalism of *Grundrisse*;

> 1. The Russian variant of the agrarian commune was 'the first social group of free men not bound together by blood ties', while the archaic community was determined by close blood relations between its members.
> 2. In the agrarian commune the house and garden yard belong to the individual farmer, while in the more 'archaic' type of village community there was no private ownership at all.
> 3. The cultivable land, 'inalienable and common property', is periodically divided among the communal members, each of whom works his own plot and appropriates its fruits (Slater and Flaherty 2009: 8)

Marx further suggests that each of the above characteristics internalised a dualism of communality and individualism, by which he accordingly identifies a number of contrasting concrete categories. Consequently, this dualism,

> "...inherent in the constitution of the agrarian commune was able to endow it with a vigorous life. Emancipated from the strong yet narrow ties of natural kinship, the communal land ownership and resulting social relations provided a solid foundation; while at the same time, the house and yard as an individual family preserve, together with small-plot farming and private appropriation of its fruits, fostered individuality to an extent incompatible with [the structure] the framework of the more primitive communities" (Marx 1983 [1881]: 120).

According to Slater and Flaherty (2009), these contrasting categories of *personal / individual* and *collective / communal* represent attempts by Marx to conceptualise the impact of individualisation on the immediate production process. These categories therefore function as a more substantive typological device than that of the 'natural unity' of archaic communalism forwarded by Marx of *Grundrisse*. Within the rubric of a *primitive communist mode of production*, this simple, historically specific dualism of communality-individualism functions as a typological device or continuum along which particular communes may be located according to the extent or impact of individualism on the relations of production, and immediate production process. Here, the necessity of abstraction and dialectical exposition becomes apparent, since a comparison of communal-individual concrete forms relies on an examination of *property* relations, or relations of production (i.e. collective appropriation vs. nominal ownership as per category 3 above);

> "...the comparative aspect of this procedure of assessment revolves around the concept of property (communal and private) and how it relates to concrete spatial forms that were under the auspices of the agrarian commune. In the original archaic form of the commune, all land was communal; so, emerging from that communal property base meant an increasing integration of private property over the communal lands. Therefore, the concepts of communal and private property are phenomenal forms which operate at the concrete level, while the concepts of communality and individualism are abstract formulations since they are part of a concealed 'inner dualism'...As part of the hidden essential structure of the commune, they, as abstract concepts, are the initial concepts used by Marx to uncover the determining laws and tendencies of this particular mode of production" (Slater and Flaherty 2009: 9)

According to the preceding review of the concept of *mode of production*, and in particular, its critique of productivist-analytical interpretations, what must further be acknowledged is the fact that such *relations of production* (i.e. forms of property and conditions of access to the means of production) cannot be conceptualised apart from *forces of production*, or from the concrete spatial forms, and labour processes manifested within the specific commune in question. Consequently, this dualism of communality and individualism merely posits a historically specific connection between property relations and physical production processes, by explicating the conditions of its eventual dissolution (i.e. the eventual erosion of institutions of communality by those of individualism). As Slater and Flaherty (2009) suggest, analysis must move beyond the level of this dualism, as the introduction of forces of individualism (i.e. exchange-value production), although introducing elements which serve to substantially undermine the institutions of communalism, do not determine the ultimate dissolution of the commune. The drivers of change must be located at an alternative level;

> "...since the transition [to individualism] involves a property relationship, which in turn is about changing the usufruct of a spatial entity within the communal lands (Marx stated that it 'leads first to the conversion of the arable into private property'), it must be determined by changes in the customary rights of land-holding through the social mechanism of the communal council or the intervention of an external power to enclose the communal lands (the state or a landlord), or both" (Slater and Flaherty 2009: 9)

On the basis of these comments, the empirical direction of this thesis appears clear; in order to understand the relationship between the social and the natural within this particular social-ecological system, analysis must emphasise (but not overdetermine) such mechanisms and changes in customary landholding and land access rights both internally, in terms of the communal institutions which regulate land division, arable and grazing rights and the accommodation of new members, and also externally, regarding determinants of restrictions on the immediate production process such as economic conditions, enclosure and land reform. Some discussion exists concerning the unique capacities of customary law (i.e. communal governance mechanisms) to confer social-ecological resilience in the form of institutional robustness to external perturbation (Orebech 2005). Such flexibility is considered inherent, given that 'environment' or ecological conditions cannot be considered constant, and history has proven that the imposition of 'top-down' formal-legal regulations on direct production cannot account fully for the vicissitudes of the natural environment[101]. As both resilience ecologists and complexity theorists have demonstrated through the concepts of multiple equilibria and dissipative structures, manifest systemic 'stability' is merely a transient feature of complex systems characterised by constant change.

[101] According to Elinor Ostrom, communal ownership confers a number of comparative advantages over private property when appropriators are faced with problems such as '(1) the value of production per unit of land is low, (2) the frequency or dependability of use or yield is low, (3) the possibility of improvement or intensification is low, (4) a large territory is needed for effective use, and (5) relatively large groups are required for capital-investment activities' (1990: 63). Numerous examples of long-term stable arrangements abound, such as the village of Torbel in Switzerland. Robert Netting commented on the unique capacities of its communal tenure arrangements which 'promotes both general access to and optimum production from certain types of resources while enjoining on the entire community the conservation measures necessary to protect these resources from destruction' (Netting 1976: 145 cited in Ostrom 1990: 63). Recently, the Network of Peasant Organisations and Agricultural Producers in West Africa reported how flexible seed selection by farming women engendered resilience against recurrent drought (Schneider and McMichael 2010: 481). In Ethiopia, the 'Qero' system, which regulated fuel collection and grazing though community imposed sanctions, ensured seasonal constancy, an ability to cope with sudden shock, and a hedge against over-extraction. It also defined rules of exclusion through a tenure system which restricted community access to those of specific lineage, and imposed sanctions and terms of resource distribution through elected village headmen. The system itself survived for several hundred years before it was eventually undermined by Agrarian Reform in 1975, which saw a move to state ownership, and later, management through peasant associations (Ashenafi and Leader-Williams 2005). Methodological individualist assumptions and rational actor heuristics such as the 'tragedy of the commons' have arguably stunted recognition of the inherent capacities of such communal forms, under favourable conditions, to confer resilience beyond that of private or formal-legal regulation. The preceding examples illustrate how such arrangements serve to counteract the problem of individual maximization engendered by the collective appropriation of common-pool resources, through the imposition of indigenous governance structures based on local knowledge.

In this respect, Orebech (2005) suggests that the resilience of systems of customary resource management may be assessed on the basis of their past adaptations to ecological stress, and their ability to implement effective rules whilst offering meaningful feedback mechanisms. Although this does not imply a default superiority of communal forms, it nonetheless offers a theoretical window beyond the reified categories of modern law which almost by default ignore the potential regulatory logic of communalism (either as a means of extractive resource governance or land allocation) as an essential component of adaptive capacity. Since collective governance structures are amenable to inductive adjustment (i.e. adaptive learning by responding to changing local conditions), they therefore avoid the assumptions of ecological constancy inherent in formal-legal regulatory mechanisms, and are therefore better placed *ceteris paribus* to respond to perturbation.

In the context of the preceding conceptualisation of communal forms, this view of legal relations inherently recognises the dialectical relationship between such legal forms and their ecological-economic basis. Consequently, examining the ecological dynamics of this historically specific variant of agrarian communism in the Irish context requires that such communal property relations be placed into their economic context; '...in order to uncover the essential structure of the agrarian commune wherever it is located along the evolutionary path, it is necessary to clarify not only the social relations of the commune (its property relationships) but also its production relations with the land It is crucially a 'double relationship' in which the individual is a member of the community, and in which this social relationship mediates his relationship to the land' (Slater and Flaherty 2009: 10). This unity is in turn captured by the concept of *mode of production*, such as it expresses this essential connection between the natural and the social, and between *relations* and *forces* of production. Consequently, such concrete agrarian communes, wherever they may be located according to the dualism of communality and individualism, may be understood as variants of the same mode of production of primitive communism (Slater and Flaherty 2009: 10)[102]. The empirical task of the

[102] The specific social form, or Irish form is explicated in chapter 6. In sum, it may be stated that this mode of production, as an abstract assemblage of *relations* and *forces* of production is characterised by communal *relations* in various states of devolution from archaic communality to individualism, under which specific labour processes (*forces* of production) operate. In terms of surplus labour appropriation, Hindess and Hirst state 'The product of any given labour process is distributed among the producers and others through the intervention of determinate social relations between the individuals involved...The mechanism of redistribution ensures both the reproduction of the labourer and the reproduction of the economy' (1975: 43). Regarding reproduction of the economy, Hindess and Hirst further state how such conditions of reproduction '...are never reducible to those of the reproduction of the individual labourer. The reproduction of the labourer under conditions of primitive communism is a function of his membership of a redistributive system...The dependence of each labourer on the labour of the collective is apparent' (1975: 63). Here the concept of a dualism is critical, as this ideal-typical state implicates multiple social forms in varying states of devolution from this state of collective dependence and

forthcoming case study is to outline the specifics of the *social form* of primitive communism in Ireland (i.e. the specifics of the rundale system) in order to understand the relationship between the social institutions of communal property and governance, and local ecology.

The final component of this theoretical framework further develops the relationship between the social and the natural as one of *metabolism*; such a concept, according to Bellamy Foster, featured as an integral component of Marx's conceptualisation of modes of production (1999). Chapter 3 has outlined the regulation of this metabolism '...from the side of nature by natural laws governing the various physical processes involved' (Foster 1999: 381). This 'regulation from the side of nature' examined the circulation of nutrients within agro-ecosystems, and the potential variability of ecosystem fertility according to historical modes of cultivation. Exploring such modes of production from the perspective of metabolism thus permits an examination of the relationship between such 'natural' processes, and '...how such a human metabolism with nature is regulated on the side of society. For Marx, the answer was human labor and its development within historical social formations' (Foster 1999: 383). The labour process, in its historical manifestation within *primitive communism* thus permits an examination of this complex relation in the specific form under which it operates in the context of this mode of production.

appropriation according to historical circumstance. Furthermore, the extent to which individualism may have penetrated such communes ultimately depends on their situation relative to other modes of production. Under the influence of feudalism and capitalism, the imperatives of rent production and commodity sale account in part for the penetration of exchange value and 'movable goods' such as private livestock and money as agents capable of undermining institutions of communality. The dynamics of such modes of primitive communism cannot be understood apart from their location within this complex matrix; this complexity is therefore addressed substantively in chapter 6 (see also Foster-Carter 1978).

5

Social-ecological systems as metabolic entities: metabolic rift and methodology

5.1. Metabolic rift and social-ecological metabolism in theory and application[103]

Since the turn of the millennium, a substantial body of literature has emerged invoking the concepts of metabolic rift and socio-ecological metabolism[104]. Popularised by the initial publications of John Bellamy Foster (1999, 2000), both concepts have since forced a paradigmatic revision of Marx's pronouncements on ecology, which in turn have served to redress many concerns of the Prometheanist – productivist critique addressed in chapter 2. As a concept inherent in Marx's depiction of the labour process as one mediating man's metabolic relation with nature, locating the labour process (i.e. as an element of the *forces of production*) within the framework of *mode of production* allows for more forceful theorising of the manner in which various configurations of social relations give rise to particular dynamics of resource imbalance. Contrary to Malthusian assumptions of 'ecological constancy', historical materialism depicts such resource imbalances as historically contingent and variable, rather than immutable natural constants. Consequently, ecological outcomes such as fertility decline may be located within a broader theoretical framework of *modes of production*, outlined above as a construct of identifiable trans-historical configurations of relations and forces of production, which in turn encompass various economic, social, and ecological elements in a model analogous to that of the *panarchy* outlined in chapter 3.

Much work thus far has focused on the mode of production of capitalism, disruptions in socio-ecological metabolism and local fertility engendered by resource extraction and export, and the ecological consequences of industrialisation; comparatively lesser attention has been afforded precapitalist modes of production as distinct totalities. Existing research therefore suffers from three substantial deficiencies; (1) lack of *specific* analyses of the ecological dynamics of

[103] No significant distinction is implied by mixed usage of the terms *socio*-ecological and *social*-ecological, although the latter is typically employed within human ecology, and the former within the social sciences. The former, in context of the works in which it appears, perhaps denotes a more intrinsic relation (i.e. dialectical), whereas the latter, as argued in chapter 3, tends to analytically compartmentalize *social* and *ecological* into sets of discrete variables for outcome modeling

[104] Burkett and Foster 2000, 2006; Clark and York 2005; Clausen 2007; Clausen and Clark 2005; Foster 1999, 2000, 2002, 2007; Foster and Clark 2004; Mancus 2007; McClintock 2010; Moore 2000, 2003, 2003b, 2008, 2011; Schneider and McMichael 2010; Wittman 2009; York 2003

precapitalist modes of production and (2) relative reluctance to operationalise such concepts within specific case studies (with a number of notable exceptions such as Clausen and Clark 2005, Wittman 2009 and York 2003). The following discussion reviews the state of debate thus far, prior to outlining key areas of compatibility with the bodies of work reviewed in chapters one to three. It is subsequently suggested that the concepts of socio-ecological metabolism and metabolic rift are inherently compatible with the informants of complexity and resilience, insofar as the former provide a more comprehensive approach to the analysis of social relations, movement and change, and the manner in which they in turn relate to specific ecological outcomes such as ecosystem fertility and resource constraint. Based on materials reviewed in chapter 3, it is here observed how *resilience* functions to augment the abstract theoretical informants of *mode of production* and *metabolic rift* by offering more readily operationalised analytical tools such as the concept of *regime*, a means of comprehensively conceptualising concrete social-ecological systems (*identity* and *panarchy*), and a non-normative device for their assessment (resilience and *adaptive capacity*). These informants are subsequently situated within an overall methodological strategy in section 4.3.

5.1.1. The metabolism of nature & society: mode of production and differential fertility

Writing in response to Benton (1989), Paul Burkett (1998a, 1998b) sought to identify a number of perceived deficiencies in Benton's reading of Marx on ecology, namely an excessively 'Malthusianised' account of natural limits, and a false dichotomisation of the material and the social. Benton's critique (1989) proved essential in chapter 2 for repositioning 'natural conditions' within social-ecological analysis in both a non-constructivist and non-productivist manner, by suggesting that Marx (and indeed many others later into the social sciences) had overemphasised the capacities of human intervention to forestall widespread ecological failure. As discussed in chapter 2, excessive overreactions to an idealised Malthusianism featured implicitly in constructivist and postmodernist perspectives hostile to notions of structural regularity. Consequently, Benton's contribution proposed a renewed recognition of 'irreplaceable natural conditions, especially in 'eco-regulatory' practices such as farming where the intentional action of human labour is necessarily interrupted by organic processes' (Burkett 1998b: 119). This point has received much corroboration in chapters one and three, and has proven essential, considering many within the social sciences have tended to underemphasise the significance of entropy, which has featured heavily in complexity theorists' accounts of social order, and in ecologists' representations of systemic energy transformation, resulting in

the production of less humanly useful forms according to the laws of thermodynamics (Mayumi 2001)[105].

Ultimately, it is difficult to conclude the practical significance[106] of Burkett's criticisms; although he levels a charge of reintroducing 'ahistorical natural limits' against Benton's dichotomisation of the natural and the social[107], it is clear from Benton's critique and subsequent work that any specific analysis requires careful contextualisation in the manner implied above by the typological device of *mode of production*. Rejection of a dematerialised (i.e. decontextualised) Malthusianism, although warranted irrespective of politics, should not outright reject the immanent possibility of historical variability in resource circulation dynamics, nor the potential of particular system dynamics to give rise to ecological collapse, as with the factors of biodiversity reduction and population & biomass increase in the case of nineteenth century Ireland[108]. In such instances, complexity has revealed that all such labour processes – irrespective of their conceptualisation as productive or ecoregulative – necessarily confront the realities of the laws of thermodynamics, and that any instance of transformative human labour involves a progressive downgrading in energetic 'quality'. Far from a decontextualised Malthusian constant, such laws and tendencies are always subject to variability according to the social forms under which they present. Consequently, what is found

[105] Illustrated in chapter 3 by the *trophic pyramid*

[106] Ultimately, Burkett emphasises and prioritises the political implications of this perceived neo-Malthusianism for the project of socialism, a concern which is beyond the remit of this thesis (see Burkett 1998a: 134)

[107] The specific form of this dichotomy and its political implications are outlined as follows; 'The basic problem here is that Benton's material/social dichotomy prevents him from explicitly recognising the alienated form of the unity of the producers and nature that exists under capitalism – thus closing off all political channels toward a disalienated form of the same unity under a post-capitalist, associated mode of production' (Burkett 1998b: 141). This is a curious stance, considering Benton, throughout his work repeatedly avoids depicting natural-social relations as historically invariant. Commenting on the utility of the concept of *mode of production* with regard to this task, Benton later wrote; 'Each mode would, in other words, be thought of as instantiating a specific form of nature/society interaction, and as having its own distinctive ecological 'niche'. Each mode must be conceptualized in terms of its own peculiar limits and boundaries, and its own associated liabilities to generate environmental crises and environmentally related patterns of social conflict' (Benton 1996: 175)

[108] Although Burkett addresses these issues in his 2006 publication (including a dedicated chapter on the relevance of the entropy law in Georgescu-Roegen and Herman Daly's bioeconomics), his Marxian perspective on the entropy / bioeconomics debate emphasises the dynamics of capitalism and value creating labour with little attention afforded agricultural (i.e. ecoregulative) labour. His critique is excellent, insofar as it emphasises the antiecological character of capitalisms' allocation, growth and scale mechanisms, and the consequent inability of market mechanisms to address environmental problems. Ultimately, Burkett's essential epistemological position is quite similar to that of Benton, as Burkett summarises the limitations of the entropy debate in terms of its '...failure to consider the social relations of production as a factor shaping the use (and abuse) of natural conditions...capitalism experiences periodic accumulation crises rooted in the tensions between capital accumulation and its natural (human and environmental) conditions' (2006: 173)

within Marx's pronouncements on ecology is a perspective critical of ahistorical notions of fertility which fail to place specific labour processes, as processes of *metabolic* exchange, in their broader social-historical context (i.e. within the dynamics of specific modes of production as outlined in the preceding section).

Although John Bellamy Foster's paper (1999) was amongst the first to bring Marx's use of metabolism to greater public attention, the concept had experienced some previous extension from its typical individual-level application within the physical sciences (Fischer-Kowalski and Haber 1993, Fischer-Kowalski and Haberl 1998)[109]. Although 'metabolism' was afforded some attention in chapter 1, it is worth revisiting briefly in light of developments thus far. According to standard biology texts, metabolism constitutes;

> "- All the chemical processes by which food and its derivatives are broken down to yield new building blocks and energy. This segment of metabolism is termed *catabolism*.
> - All the chemical processes by which living cells and tissue are produced and built up. This is *anabolism* (build-up) of new molecules by biosynthesis).
> - All the regulatory mechanisms that govern these intricate systems" (Beck et al 1991: 175 cited in Fischer-Kowalski 1997: 120)

Writing in response to Catton and Dunlap's (1978) charge of conceptual inadequacy on the part of environmental sociology, Fischer-Kowalski and Haberl (1993), drawing upon a systemic epistemology, characterise metabolism at a societal level as follows; 'Metabolism refers to physical input-transformation-output processes between societies and their natural environments: Natural resources are 'ingested', processed internally and released into the environment. Society's metabolism can be related to a biological minimum that equals the sum of the metabolisms of the human beings that make up society (1993: 18). This form of *social*-ecological metabolism may be distinguished from its physical counterpart by virtue of the capacity of societies to fundamentally alter their surrounding natural systems in a form of dynamic adaptation (ibid). This adaptive metabolism, according to Marx, took place at the level of the labour process, which '...regulates and controls the metabolism between himself [man] and nature. He confronts the materials of nature as a force of nature. He sets in motion the natural forces...in order to appropriate the materials of nature in a form adapted to his needs' (Marx 1976: 283 cited in Slater and Flaherty 2009: 21).

Applying insights gleaned in chapter 1, this concept may be extended to a higher systemic and ontological level (i.e. the social), by conceptualising metabolism as an emergent property. As an emergent property, it enables operation at a higher level of abstraction (that of the social),

[109] See Fischer-Kowalski (1997) for a history of the term within the social sciences

and thus assumes a validity which is not contingent on its reduction to constituent parts (i.e. as a mere sum or aggregation of human metabolisms, as the dismissal of reductionism in chapter 1 has argued). This emergent metabolism, conforming to de Haan's criteria of 'type – III reflective emergence' (2006: 298), is one with strong parallels in mainstream sociology, and is characterised by '...the process of objects adapting their interactions to their perception of the phenomena they produce. The recursion lies in the effect that their adaptive behaviour leads to alteration of the phenomena they adapted to' (de Haan 2006: 298)[110]. The concept of social-ecological metabolism, as will presently be qualified, conforms to this criterion of reflective emergence by virtue of its historical variability, and has been adequately conceptualised by systems theorists as an *autopoietic* process of self-organisation by individuals in relation to contextual systemic conditions. Consequently, this emergent metabolism should not be considered a vitalist, autonomous property; as will be demonstrated, it is materially embedded in historically specific configurations of relations and forces of production.

A number studies have attempted to situate and historicise this societal metabolism. Accordingly, Mancus (2007) refers to Sieferle's tri-partite taxonomy of *socio-ecological regime*, as augmented by Fischer-Kowalski and Haberl (2008) through their concept of *characteristic metabolic profile* (Mancus 2007: 274). According to the authors, a society's characteristic metabolic profile (CMP) comprises its material and energy input per capita per year, according to the dominant manner in which it mobilises its natural resources (Fisher-Kowalski 1998: 574). This resource mobilisation is in turn conceptualised by the authors as one of 'colonization', a transformative process by which societies modify natural systems in order to maximise their productivity and social usefulness. The concept of characteristic metabolic profile thus permits a pseudo-'quantitative' comparison of modes of production in terms of the magnitude of their per capita resource requirements. Consequently, Fischer-Kowalski and Haberl identify an average five-fold increase in the scale of metabolic requirements across successive historical social formations (hunter gatherer – agrarian – industrial), owing primarily to increases in biomass requirements engendered at each stage (1988: 578). Each successive transition and consequent increase in biomass, results in a concomitant increase in human labour requirements, owing to the comparative labour-intensity of agrarian colonization in activities such as ploughing, planting, draining and irrigating.

[110] de Haan (2006) refers specifically to Gidden's theory of structuration as a sociological counterpart; this epistemological stance is familiar to all students of social theory as the 'structure-agency problematic', addressed at numerous points throughout this thesis

Mayumi (1991), as reviewed in chapter 2, has also demonstrated how the modern industrial colonization of stocks of past biological productivity (fossil fuels), as applied in intensive agriculture has resulted in a state of accelerated soil degradation (Mancus 2007: 275). Mayumi (2001) thus characterises modern agriculture in terms of the rate at which entropy has increased, owing to modern agricultures' concerns with productivity and efficiency in terms of time. Differing types of 'efficiency', corresponding to relative rates of entropy, may therefore be defined as follows;

> 1. Efficiency of Type 1 (EFT1): It refers to the ratio of output to input. ETF1 does not consider the time required to obtain the output
> 2. Efficiency of type 2 (EFT2): It refers to output per unit time. EFT2 does not consider the amount of inputs to obtain the output (Mayumi 2001: 80)

The metabolism of modern intensive agriculture may be characterised, according to the above typology as one operating under the imperatives of EFT2 efficiency, with priority afforded to production *time*. This type of efficiency prioritises yield maximisation in the shortest possible time, irrespective of input requirements. The result is an increase in entropy, or reduction in humanly useful forms of energy, owing to the energy input requirements of intensive cultivation, necessitating a draw-down of past biotic stocks such as fossil fuels, and the application of chemical fertilisers[111].

Although Fischer-Kowalski and Haberl's (1998) concept of characteristic metabolic profile offers an outline comparative-historical device, a charge of reductionism may well be levelled, as with others considered in chapter 3 and subsequently cited for their energetic reductionism. Furthermore, although this comparative device offers intriguing insight into the dynamics of matter-energy circulation in terms of net individual requirements, thereby edging *social* systems theory further away from conceptualisations of societies as systems of information exchange alone, its applicability to specific case studies at lower levels of abstraction and aggregation is as yet elusive. Although such accounting exercises offer essential insight into the macro-level relationship between social form and ecological spoliation (as with certain case studies of ecological economics to be reviewed below), they offer less qualitative insight into how individual actors and settlements respond to such resource constraint through adaptive

[111] "Agriculture has come to draw the inputs which it uses from more distant sources, both spatially and sectorally, to derive an increasing proportion of its energy supplies from non-renewable sources, to depend upon a more narrow genetic base and to have an increasing impact on the environment. This is particularly reflected in its heavy reliance on chemical fertilisers and pesticides, its dependence upon subsidies and price support and its external costs such as threats to other species, environmental pollution, habitat destruction and risks to human health and welfare" (Hodge, 1993: 3 cited in Rigby and Cáceres 2001: 22)

capacity which, as the concept of dissipative structures outlined in chapter 1 suggests, is the hallmark of immutably transient social-ecological 'stability'. Finally, as per deficiency (1) outlined above, less understood are the specifics of such metabolic profiles in the particular context of precapitalist modes of production. Although biotic stock exploitation and biomass requirements function in this sense as useful comparative heuristics, they reveal little of the specific labour processes, conditions of land access and modes of surplus appropriation prevalent in historically specific social formations.

Recent commentators on Marx have however suggested that the concept of metabolism constituted the essential basis of Marx's conception of *modes of production*. Such commentators have implied that various modes of production of historical materialism may also be viewed as differing modes of relating to nature, engendering differing forms of resource exploitation and movement, and consequently, differing forms of social-ecological metabolism. Although certain scientific and general systems definitions depict *metabolism* as a biological constant or assemblage of essential matter-energy exchange pathways irrespective of historical form, the question of historical variability rests at the heart of Marx's appropriation of the concept, as a characterisation of the sum total of a society's reproductive activity, and is one which, as with the concept of *mode of production*, allows distinction between various forms of human organisation not only in terms of their articulated combination of relations and forces of production, but more fundamentally in terms of their relations to nature, the form of which depends on how they are embedded within a particular mode of production. According to Foster, Marx's development of the term over the course of his writings moved it beyond its initial philosophical-humanist deployment toward a more grounded conceptual device tied to his more general materialist conception of history;

> "Marx's later concept of metabolism, however, allowed him to give a more solid and scientific expression of this fundamental relationship, depicting the complex, dynamic interchange between human beings and nature resulting from human labor. The concept of metabolism, with its attendant notions of material exchanges and regulatory action, allowed him to express the human relation to nature as one that encompassed both "nature imposed conditions" and the capacity of human beings to affect this process" (Foster 2000: 158)

Central to Marx's insights in this respect were the works of James Anderson and Justus Von Liebig, which allowed Marx to move beyond extant pronouncements which served to reify or naturalise current relations between society and nature. Dominant theories of rent within classical political economy, such as those of Malthus and Ricardo argued, without recourse to notions of social-historical variability '...that lands that were naturally the most fertile were the

first to be brought into production, and that rising rent on these lands and diminishing agricultural productivity overall were the result of bringing lands of more and more marginal fertility into cultivation, in response to increasing population pressure' (Foster 2000: 145). Contrary to this notion of historical invariance and natural, constant rates of fertility according to place, James Anderson, writing in his 1777 *Enquiry into the Nature of the Corn Laws*;

> "...attributed the existence of differential rent primarily to historical changes in soil fertility, rather than to conditions of "absolute fertility". Continual improvement of the soil, through manuring, draining, and irrigating, was possible, and productivity of the least fertile land could rise to a point that brought it much closer to that of the most fertile land; yet the converse was also true, and human beings could degrade the soil. It was such changes in relative productivity of the soil, according to Anderson, that accounted for differential rent – not the conditions of absolute fertility – as in the later arguments of Malthus and Ricardo" (Foster 2000: 145)

As with Malthus' naturalised, historically constant law of population overstocking, Marx's contributions recognised the fallacies inherent in such theories which ignored questions of historical variance, thereby 'naturalising' social relations, class structures and ecological dynamics of the present (i.e. capitalism)[112]. An appreciation of the underlying science of fertility and movement of nutrients within agricultural systems was in turn provided by Marx's reading of German soil chemist Justus Von Liebig. On the basis of the works of Von Liebig, agricultural historians often speak of a 'second' agricultural revolution; the 'first', most familiar to historians comprised protracted developments such as the enclosure movement, advances in drainage and the institution of systems of crop rotation. The 'second' agricultural revolution, according to Foster (1999, 2000), was characterised by the emergence of the fertiliser industry. Liebig had thus discovered, through his work in agricultural chemistry, that soil fertility was determined not by natural endowment, but primarily by the nutrient in least supply, or 'Liebig's law of the minimum' (Patterson 2003: 30), whereas Anderson's critique of theories of rent further suggested how this property of fertility could be altered by human interventions in the form of fertilisation and improvement (ibid)[113].

[112] This tacit awareness would later be reflected in the objectives of the Irish Tenant Right Movement, whose arguments for fixity of tenure acknowledged how the development of such differential rental conditions on marginal lands were inhibited not only by geological conditions, but also by restrictions on reimbursement in the form of rent reduction, for capital investments in permanent agricultural improvements such as drainage works.

[113] "Soil health can change over time due to natural events or human impacts. It is enhanced by management and land-use decisions that weight the multiple functions of soil and is impaired by decisions which focus only on single functions, such as crop productivity...Although soils have an inherent quality as related to their physical, chemical and biological properties within the constraints set by climate and ecosystems, the ultimate determinant of soil quality and health is the land manager" (Doran 2002: 120)

According to Foster and Burkett (2000), Liebig's contributions, which offered insight into the physical controls on soil productivity, combined with Anderson's pronouncements on relative fertility, provided not only a refutation of naturalistic accounts of variables such as fertility and rent, but also a direct window into the process by which social relations intervened directly in the physical composition of the soil. By the time of *The Poverty of Philosophy*, Marx had begun to firmly incorporate these scientific insights into historical materialism; 'every moment the modern application of chemistry is changing the nature of the soil, and geological knowledge is just now, in our days, beginning to revolutionize all the old estimates of relative fertility...Fertility is not so natural a quality as might be thought; it is closely bound up with the social relations of the time' (Marx 1963: 162-163 cited in Foster 1999: 375). In such a manner, Marx was therefore able to confront Ricardian theories of rent and Malthus' law of population by examining how barriers to natural resource exploitation '...were imposed by property relations and legal obligations rather than resource endowments' (ibid: 372). This resultant re-orientation of the concept of metabolism thus incorporated an abstract view of the intrinsic relation of human and nature as embodied in the labour process, with a more pointed recognition of how resource constraint was essentially a variable property; 'Contrary to this biological notion, the social concept links material and energy flows to social organization, recognizing that the quantity of economic resource use, the material composition, and the sources and sinks of the material flows are historically variable as a function of the socio-economic production system' (Weisz 2007: 291-292)

5.1.2. Marx and Marxism on metabolic rift

At the height of industrial capitalism, concern was mounting over depletions in soil fertility and yield, requiring large-scale imports of fertiliser by industrialising Western nations (Burkett 2006; Foster 2000; Schneider and McMichael 2010). Prior to the discovery of the Haber-Bosch process which permitted the synthesising of cheap ammonia and synthetic fertiliser, declining crop yields in the nineteenth century were met with the importation of mineral fertilisers such as guano and bone, and through local improvisations such as the application of burned lime, seaweed and farmyard manure (Burkett 2006; Foster 1999, 2000; Mancus 2007; Collins 2008). Liebig was acutely aware however, that this question of declining fertility was not merely a question of chemistry. In his *Letters on Modern Agriculture* published in 1859, Liebig described capitalist agriculture as a '...spoliation system in which the conditions of reproduction of the soil were undermined' further stating '...a field from which something is permanently taken away...cannot possibly increase or even continue in its productive power. In fact, every system of farming based on the spoliation of the land leads to poverty' (Foster 2000: 153).

If the primary social consequence of primitive accumulation was the progressive separation of labour from land, the primary physical consequence of this concentration of labour in urban centres under capitalism was the mass movement of agricultural produce from country to town, necessitated by a growing urban industrial proletariat. In his developed analysis of capitalism as a distinct mode of production, Marx was therefore able to place these ecological conditions in their social context by emphasising how primitive accumulation and the imperative of surplus realisation in its specifically capitalist context, functioned to disrupt social-ecological metabolism; 'It is the separation of human beings from the soil (and hence from the organic products of the soil) and their agglomeration into huge cities that constitutes, for Marx, the *differentia specifica* of capitalism' (Foster and Burkett 2000: 415)[114]. Marx expressed this as follows;

> It is not the unity of living and active humanity with the natural, inorganic conditions of their metabolic exchange with nature, and hence their appropriation of nature, which requires explanation, or is the result of a historic process, but rather the *separation* between these inorganic conditions of human existence and this active existence, a separation which is completely posited only in the relation of wage labour and capital (Marx 1857-1858 [1973]: 489 cited in Foster and Burkett 2000: 416)

At a biological level, Liebig was therefore amongst the first to identify how this separation and agglomeration engendered a permanent removal of nutrients from local sites of production. Whereas various precapitalist or subsistence agrarian systems consumed a sufficient amount of their produce locally, the opposite was true of systems which farmed for export or urban sale[115]. Consequently, under this emerging capitalist system, exacerbated by the progressive separation of land from labour, essential soil nutrients were not recycled back into their local ecosystems of origin. Marx's clearest exposition of the intensification of this discontinuity in social-ecological metabolism under capitalism appears in volume one of *Capital*;

> "Capitalist production collects the population together in great centres, and causes the urban population to achieve an ever-growing preponderance. This has two results. On the

[114] This condition of separation has been outlined above as one of 'primitive accumulation', whereby successive modes of production mark particular stages of the removal of labour from its objective conditions

[115] Rudy (2001) has cautioned against interpreting this as a dichotomy of 'precapitalist = sustainable / capitalist = unsustainable.' Hannah Wittman has also suggested that despite extensive landscape transformations enacted under precapitalist modes, such modifications '...were primarily of a local and regional character, depending on a continual recycling of nutrients between small-scale human settlements embedded in an abundant nature' (2009: 805). Rudy's important observations, offered in his review of Foster (2000) are discussed below.

> one hand it concentrates the historical motive force of society; on the other hand, it disturbs the metabolic interaction between man and the earth, i.e. it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil. Thus it destroys at the same time the physical health of the urban worker, and the intellectual life of the rural worker. But by destroying the circumstances surrounding that metabolism, which originated in a merely natural and spontaneous fashion, it compels its systematic restoration as a regulative law of social production, and in a form adequate to the full development of the human race...Moreover, all progress in capitalist agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress toward ruining the more long-lasting sources of that fertility...Capitalist production, therefore, only develops the techniques and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth – the soil and the worker" (Marx 1990 [1867]: 637-638)

In the above quotation, Marx identifies a number of related factors associated with capitalist totality (as a dialectical assemblage) which point toward a particular, negative ecological outcome. This manner of exposition is further indicative of the centrality of dialectical logic, which resonates profoundly with previous depictions of panarchical social-ecological systems. Such related systemic factors, as outlined above include urban agglomeration, separation of labour from the means of production, circulation of physical nutrients, soil fertility, concrete forms of the production process, individual physical and mental health, and the geographical division of labour. Ellen Meiksins Wood (2000) has drawn attention to how these dynamics presented under capitalism in a fundamentally different manner than within previous social formations, owing to the centrality of the market as mediator between producers and appropriators, and the acceleration of land-labour separation engendered by the enclosure movement as a hallmark of primitive accumulation in industrialising Britain[116]. In volume three of *Capital*, Marx later characterised such market-oriented capitalist relations as ones which '...produce conditions that provoke an irreparable rift in the interdependent process of social metabolism, a metabolism prescribed by the natural laws of life itself' (Marx 1991 [1894]: 949-950)[117].

[116] Foster and Clark (2004) have examined the development of this uneven exchange at a global level under the imperialist system of English 'high farming', held by Liebig as exemplary of the 'spoliation system' of capitalist agriculture. According to Burkett 'This 'early industrialised agriculture', developed on the basis of the forcible separation of the peasantry from the land, 'robbed the soil of England of its nutrients, and then sought to compensate for this by robbing other countries of the means to replace them' (2006: 297). Moore (2000) has attempted to impose some conceptual order on this historical process, by drawing on world-systems theory and metabolic rift to develop his concept of capitalism as a series of 'systemic cycles of agro-ecological transformations,' discussed further below.

[117] Clauson offers a more pointed definition; 'The metabolic rift describes how the logic of accumulation severs basic processes of natural reproduction leading to the deterioration of ecological sustainability Moreover, "by destroying the circumstances surrounding that metabolism," Marx went on to argue, "it [capitalist production] compels its systematic restoration as a regulating law of social reproduction" – a

The concepts of *metabolism* and *metabolic rift* should not be interpreted as mere philosophical heuristics however; they are readily conducive to concrete analysis and critique. Accordingly, these exploitative resource dynamics, such as they operated in the Irish context did not escape Marx's attention as he commented; 'For a century and a half, England has indirectly exported the soil of Ireland, without as much as allowing its cultivators the means for making up the constituents of the soil that had been exhausted' (Marx 1976: 860 cited in Foster 1999: 384). Throughout the early-mid nineteenth century, Britain was a net importer of corn with Ireland as one of its main suppliers, a condition facilitated both by the protectionist corn laws, and the ability of direct producers to subsist on the prolific potato crop. So extensive was this export trade, driven by the imperatives of commodity production engendered by rental obligations under colonialism, that Ireland was often characterised as a '...granary for the remainder of the United Kingdom' (Kinealy 2006: 4). Furthermore, Marx in his various commentaries repeatedly linked the effects of this unequal trade dialectically to the broader colonial apparatus, whilst outlining its ecological consequences for the direct producer;

> "A class of absentee landlords has been enabled to pocket, not merely the labor, but also the capital, of whole generations, each generation of Irish peasants sinking a grade lower in the social scale, exactly in proportion to the exertions and sacrifices made for the raising of their condition and that of their families. If the tenant was industrious and enterprising, he became taxed in consequence of his industry and enterprise. If, on the contrary, he grew inert and negligent, he was reproached with the "aboriginal faults of the Celtic race." He had, accordingly, no other alternative left but to become a pauper—to pauperize himself by industry, or to pauperize by negligence. In order to oppose this state of things, "Tenant Right" was proclaimed in Ireland—a right of the tenant, not in the soil but in the improvements of the soil effected at his cost and charges (Marx [MECW 12, 158] cited in Anderson 2010: 120)"

Marx commented further on this exacerbated metabolic rift in the mid nineteenth century, particularly as post-famine adjustments such as mass migration, evictions, relocation schemes and redistribution, resulted in extensive centralisation, and the institution of more commercially viable livestock husbandry under the relative rental regime; 'since 1855, 1,032,694 Irishmen have been displaced by about one million cattle, pigs and sheep...the situation of the mass of the people has deteriorated, and their state is verging to a crisis similar to that of 1846. The relative surplus population [is] now as great as before the famine... So result: Gradual expulsion of the natives, gradual deterioration of natural life, the soil' (Marx [MECW 21, 191] cited in Anderson 2010: 129).

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restoration, however, that can only be fully achieved outside of capitalist relations of production' (2007: 40).

At a further level of reduction, Marx was acutely aware of how such commercial imperatives impacted upon agricultural productivity in terms of energetics. It is often claimed, amongst other criticisms of anti-ecology levelled against Marxism, that Marx and Engels remained hostile to the prospect of energetic analysis, as demonstrated by their indifferent reception to Sergei Podolinsky's energetic analysis of human labour (Burkett 2006, Burkett and Foster 2006)[118]. According to such accepted readings, it is claimed that Marx and Engels, through their dismissal of Podolinsky's energetic analysis of labour under capitalism, summarily rejected the significance of thermodynamics for social-ecological analysis[119], and retained a closed-systems conception of the relationship between economy and environment, by which 'environment', and its potential limitations were rendered irrelevant. This perceived shortcoming in both Marxian and conventional economic analysis proved instrumental in the emergence of ecological economics, predicated upon the contributions of Georgescu-Roegen, who claimed '...for Marxist economists, the patent fact that between the economic process and the material environment there exists a continuous mutual influence carries no weight' (Georgescu-Roegen 1973: 50 cited in Burkett and Foster 2006: 117). The significance of this assumption to the overall dismissal of Marx's work on ecology within economics, and the influence Georgescu-Roegen's work exhibits in the field of ecological economics is borne out by Cleveland and Ruth (1997) who cite Georgescu-Roegen's work on the significance of constraints imposed by the entropy law as a paradigmatic critique of both Marxism, and neoclassical growth theory.

It is therefore interesting to note, in light of Foster and Burkett's (2006) research, what they claim are a number of far-sighted observations from Engels and Marx on the significance of the entropy law, including remarks on the historical invariance of net primary productivity, difficulties in accounting for the distribution of solar energy and the subversion of metabolic cycles through mass exports of nutrients as specified by the concept of metabolic rift. At the level of labour power, characterised as '...energy transferred to a human organism by means of

[118] Podolinsky's correspondence with Marx sought reconciliation of the first law of thermodynamics with the concept of surplus value, or by what means the production process yielded a commodity form embodying greater value than that of the labour-power expended given that the first law specifies the impossibility of creation, merely transformation. Foster and Burkett (2006) have argued that recent critiques of Marx on ecology and thermodynamics are based upon a more detailed edition of Podolinsky's article, and that Marx and Engels comments were based upon earlier, less detailed drafts published in *La Plebe* and *La Revue Socialiste* respectively. Regardless of this difference, the authors argue that Podolinsky's analysis was fundamentally flawed due to its reliance on idealised heuristics, and its reproduction of a reductionist, Ricardian notion of value as embodied labour.

[119] Interestingly, Burkett (2006) argues how Podolinsky may have succumbed to a similar logical trap as Parsons. By failing to recognise Carnot's 'perfect-machine' concept as an idealisation, Burkett argues that Podolinsky was unable to validity orient his approach '...to the more complex reality of far-from-equilibrium, non-isolated, non-closed systems such as life in general and human society/labour more specifically' (2006: 179). Similarly, Parsons' reliance on concepts such as Pareto optimum and concepts of equilibrium associated with closed systems, as outlined in chapter 1, led him to misinterpret 'equilibrium' as an ahistorical state of order

nourishing matter' (Burkett and Foster 2006: 120), Marx incorporates *matter*-energy into his metabolic conception of natural-social interaction. This is a critical observation, as later into the twentieth century, Georgescu-Roegen would argue for a 'fourth law' of material entropy in order to augment strictly energetic interpretations of thermodynamics in economics. According to this 'fourth law', materials, as well as energy are subject to a degradation of organizational state, a view which, according to Cleveland and Ruth, offered a profound critique of accepted orthodoxy, amongst other approaches which incorporated more technological-optimist assumptions (1997: 210)[120]. The concept of metabolic rift is one which is therefore mindful both of energetic efficiency *and* the circulation of matter.

Mayumi (2001) thus endorses Liebig and Marx's insights on matter-energy diffusion under modern conditions of 'ETF2-mania', as a form of entropy characterised by the primacy of production time and net productivity over costs (both monetary and ecological) of material inputs. Commensurate with Marx's exposition of capitalism and the centrality of time in the production of relative surplus value, the concept of metabolic rift, in the context of this ETF2-mania, purportedly exposes this critical cause of accelerated organizational state degradation in terms of social relations;

> "The capitalist mode of production extends the utilization of the excretions of production and consumption. By the former we mean the waste of industry and agriculture, and by the latter partly the excretions produced by the natural exchange of matter in the human body and partly the forms of objects that remain after their consumption. In the chemical industry, for instance, excretion of production are such by-products as are wasted in production on a smaller scale; iron filings accumulating in the manufacture of machinery and returning into the production of iron as raw material, etc. Excretions of consumption are of the greatest importance for agriculture. So far as their utilization is concerned, there

[120] According to the standard Cobb-Douglas production function model [Q = K*(x1) L*(x2) R*(x3)] where Q = Output per time period, K = Stock of Capital R = Flow of natural resources L = Labour supply per time period, K tends toward infinity under the false assumption that '...a given output can be maintained as energy and material inputs vanish if manufactured capital can be increased sufficiently. This assumption is indicative of classical technological optimism (or Prometheanism), whereby K continues to approach infinity by the employment of 'manufactured capital substitution strategies' (Nordhaus and Tobin 1972: 79).

Such assumptions are in turn tied to broader conventions of practice in economic modelling, which tends to emphasise short-term intervals and outcomes, as may be gleaned from Solow's response to Roegen's criticisms of the standard production function maximisation model; 'Do you believe that the matter/energy transformations required by economic activity are constrained by the entropy law? Solow's answer: 'No doubt everything is subject to the entropy law, but this is of no immediate practical importance for modelling what is after all a brief instant in a small corner of the universe' (Daly 1999a: 87). Consistent with forgoing emphases on transformative labour as an epistemic basis for human ecology and historical typology, Roegen's fundamental epistemological contributions are therefore worth bearing in mind; 'It [flow-fund model of the production process] emphasizes that physically what we call 'production' is really transformation – of resources into useful products and waste products. Labour and capital are agents of transformation (efficient causes), while resources, low-entropy matter/energy are 'that which is being transformed' (material causes)' (Daly 1999b: 82-83)

> is an enormous waste of them in the capitalist economy. In London, for instance, they find no better use for the excretion of four and a half million human beings than to contaminate the Thames with it at heavy expense" (Marx 1959: 100 cited in Mayumi 2001: 82)

Such comments are prescient, insofar as Marx's concept of metabolic rift acknowledges the critical role of matter-circulation and loss, as well as offering an implicit consideration of matter-degradation through his remarks on the degradation of capital inputs in industrial production, and the disposal of urban effluent in the above quotation[121]. Such an analytical approach '...is fully consistent with the central concept of Liebig's agricultural chemistry paradigm: "the cycle of processes constitutive for the reproduction of organic structures". This concept is not energy-reductionist, but it does abide by the first and second laws of thermodynamics' (Burkett and Foster 2006: 141).

An important question bears consideration at this point given that the concept of metabolic rift (in the context of preceding discussions) emphasises its manifestation under capitalism in particular; how such resource dynamics manifest under precapitalist modes of production, both in terms of the specific forms of social-ecological metabolism corresponding to various modes of production, and of such historically specific dynamics of resource constraint engendered under various socio-political/economic configurations (social forms). Furthermore, in light of Foster and Burkett's discussion of the 'Podolinsky myth', and subsequent work in ecological economics, the question remains as to whether this renewed incorporation of the entropy law constitutes an implicit recognition of the possibility of 'natural limits,' previously critiqued by Burkett with regard to Benton's work. On this latter question, Burkett suggests that entropy is ultimately relevant, but also that '...short of human extinction, capitalist reproduction in no way hinges on the maintenance of natural wealth of any given entropy level' (2006: 143). This comment bears closer examination, given its forthcoming relevance to the questions of resource constraint and scale, the problem of conceptualising ecological collapse, and to previous critiques of Marxism as excessively productivist.

[121] Engels was profoundly influenced by Edwin Chadwick's *Report of the Sanitary Condition of the Labouring Population of Great Britain* published in 1842, as well as Liebig's *Letters on the Subject of the Utilization of Municipal Sewage* published in 1865, both of which addressed the prospect of recycling back into local sites of production, essential nutrients lost to the Thames; 'If it were practicable to collect, without the least loss, all the solid and fluid excrements of the inhabitants of towns...and to return to each farmer the portion arising from produce originally supplied by him to the town, the productiveness of his land might be maintained almost unimpaired for ages to come, and the existing store of mineral elements in every fertile field would be amply sufficient for the wants of increasing populations' (von Liebig 1863: 261 cited in Foster 2000: 154).

According to Burkett (2006), Khalil (1990) had previously forwarded a perspective suggesting the historical relativity of entropy, albeit one advanced on foot of a reproduction of the idealised 'Carnot cycle', with little basis in the empirical realities of economic behaviour[122]. Accordingly, responses to Khalil from within economics tended to address this latter concern, rather than '...having to grapple with the more difficult historical questions raised by entropy's relativity with respect to human purposes' (Burkett 2006: 149). Elaborating this prospect of historical relativity, Burkett suggests;

> "This crucial *form-divergence* between the economic process and the Carnot cycle leaves quite a lot of space for various degrees of tension between human production and its environmental conditions. Is this indeterminacy not somehow connected with the *relativity* of matter-energy usefulness with respect to the purposeful character of production to which Khalil's analysis points? Presumably, the extent to which an economy accelerates entropy in 'one-way' fashion depends on the particular purposes driving production. This, naturally, points to the social relations that shape and constrain productive priorities, and that determine the way natural resources are valued economically" (2006: 150)

Yet again, the question of historical variability in resource dynamics and metabolism presents, only here in more fundamental terms of matter-energy transformation/degradation. Emphasising the tendencies of both neoclassical economics – and arguably, current social theory as criticised in chapter 2 for its tendency to excessively relativise the objectivity of nature – Burkett suggests that such questions of limits imposed by the conditions of the entropy law must be considered in their historical manifestations, by exploring '...the implication that the social (class) relations of production, and historically specific resource-allocation mechanisms [which] help define these effective limits and determine the extent to which they tend to be exceeded' arguing further that current theory tends to '...treat production, knowledge, and economic limits as if they develop in a social-relational vacuum' (Burkett 2006: 154).

Commenting on Marx's historical relativisation of the concept of human needs in *Grundrisse*, Foster (2008) observes how such metabolic conditions and limits must be viewed as a process of historical coevolution, in which successive modes of production are seen as conferring their own specific dynamics of resource constraint. Such comments are thus commensurate with previous observations of Meiksins Wood (2008), Burkett (2006), Benton (1989) and Callinicos (2005), whom have all argued for a research programme encompassing not only theoretical precision, but appropriate historical situation and empirical corroboration. The uniqueness of capitalism, according to Foster, is that its *differentia specifica* is precisely the 'dialectical

[122] The *Carnot cycle* is a heuristic, consisting of an ideal piston-cylinder engine of 100% thermal efficiency, which functions as a baseline device for measuring thermal efficiency in reality.

inversion' of primitive accumulation, in which property comes to reside entirely with capital, and the uniqueness of capitalisms tendencies to confront natural limits as 'mere barriers (rather than boundaries) to its own expansion' (2008: 100). In this sense, it is clear that natural limits remain relativised for both Foster (1999, 2000, 2008) and Burkett (2006) for the purposes of comparison, in terms both of pre-capitalism-capitalism, and capitalism-developed communism.

What then of production before capitalism? Furthermore, despite Marxism's retention of the explanatory potential of trans-historical concepts such as *mode of production*, and *labour process*, how can such an excessively relativised notion of 'absolute limits,' function in analysis? As an historical heuristic, such pronouncements on metabolic rift as outlined above appear to retain a degree of epistemological restrictiveness comparable to Actor-Network Theory's insistence on co-constructivism, and consequent aversion to normative assessment. This is perhaps understandable, given the political requirements of a relativist concept of 'natural limits'[123]. Furthermore, such pronouncements on metabolic as reviewed thus far appear to imply a dichotomy of 'pre / post-capitalist', for which the specific dynamics of precapitalist modes of production are afforded less attention, or implicitly assumed to operate in a condition of relative sustainability[124]. It is unclear, for example, how historically applicable the concept of metabolic rift may be, given its specificity to the industrialising West, and its relatively concrete level of operation, specifically addressing as it does the related processes of urbanisation, enclosure and commodity trade.

Alan Rudy (2001) has already raised many of these points in a critical review of Foster (2000), where he suggests that the concept of metabolic rift bears a closer affinity with natural resource

[123] On this question of political deployment, retaining a relativist concept of absolute limits has proven essential for ecosocialist critiques keen to emphasise the potential of collectivization to resolve the contradictions of resource allocation and consumption experienced under capitalism; 'What is needed is a critical engagement with the ongoing struggles of workers and communities everywhere to defend and improve their material-social conditions, and to forge new forms of human development. The new socio-economic institutions and ecological values needed to effectively limit entropic destruction can only develop out of collective struggles to disalienated the conditions of human production, to convert them from conditions of exploitative money-making into conditions of sustainable human development (Burkett 2006: 172-173)

[124] Foster has avoided this idealization, albeit with limited elaboration, by outlining, in his 1995 publication how ecologically tenuous arrangements are evident across many historical forms (see chapter 2). Conversely, others have observed '…the greater resilience of 'localised agro-ecological, and small scale initiatives' compared with the lesser adaptability of large-scale industrial agriculture…given capitalism's need to extract natural resources in order to sustain accumulation, the 'antagonism…between economic time, which proceeds to the quick rhythm imposed by capital circulation and the interest rate, and geochemical-biological time controlled by the rhythms of Nature, is expressed in the irreparable destruction of Nature and of local cultures which valued its resources differently' (Schneider and McMichael 2010: 480-481). Despite allusions presented thus far as to the greater adaptive capacities of customary arrangements, this is quite extensive a generalization which doubtless requires greater contextualization.

economics, than dialectical-ecological Marxism[125]. According to Rudy, the concept of a metabolic rift depends on a number of related assumptions which;

> "...really only makes sense in the context of an emphasis on agricultural soils, a precapitalist, relatively non-contradictory, metabolic coherence, and a failure to explore the complexity and unevenness of capitalist agricultural intensification. The metaphor has a tendency to homogenize the different modes of enclosure and rural-urban relations (and politics) across Europe, and much less so across the Atlantic...Further, the radically different dynamics of soil depletion and agricultural overproduction/ concentration across land on different sides of the Atlantic...underlay much of the modes of production debate during the 1970s and 1980s" (Rudy 2001: 57)

Furthermore, Rudy claims the historical and geographical specificity of the concept of metabolic rift implicates a false dichotomy, whereby 'sustainable coherence' is implicitly ascribed to agriculture under precapitalist modes of production. On this latter concern, Rudy's argument falls somewhat short; his critique claims that the enclosure movement engendered an increase in livestock and therefore livestock faeces, making the question of declining fertility one of local allocation and distribution, rather than an inherent imbalance of commodity-oriented urban export. This view ignores the fact that such raw increases in livestock numbers were typically not occurring within settlements of combined tillage/pastoralism, which were progressively being undermined by graziers, intensive tillage and associated imperatives of industrialisation[126]. Moore points toward another false dualism in the form of an excessive dichotomisation of the material and the social whereby '...capitalism becomes a socially constituted subject, one that creates an exogenous 'crisis of sustainability' through the disruption of natural cycles' (2011: 8)[127].

Ultimately, Rudy's most important criticism concerns the restrictiveness of metabolic rift as a generalisable concept for ecological analysis. In advancing such a position, Rudy (2001), as with Moore (2011) suggests that there is more to 'ecology' than the question of nutrient cycles vis-a-vis urbanisation, although his recommendations are limited to a consideration of how selective Marx's adoption of scientific concepts may have been, and an examination of the historical dialectic of nature-society and ecological space as an active entity (studies of which

[125] As discussed below, a neo-classical corollary in the forms of ecological footprint analysis, and the concept of 'appropriated carrying capacity' bears a close analytical resemblance to that of metabolic rift

[126] Rudy alludes to this latter point somewhat by further criticising Foster's treatment of ecological space as passive, a point later expanded by Hannah Wittman (2009), who cites metabolic rift for neglecting the potential 'agency' of nature.

[127] Schneider and McMichael (2010) also criticise it for its over-emphasis on the organisation of labour as opposed to practice, which they claim gives rise to an epistemic separation of the natural and the social on par with neoclassical economists whom have externalised the environment through the application of valuation-based methodologies.

have been reviewed previously – i.e. those of Neil Smith and Michael Redclift discussed in chapter 2). Suggestive of this need for historical nuance and dialectical complexity, Rudy claims; '...the simplification of Marx's potential analysis of what we might now call environmental conditions (more limitedly) to a focus on a "metabolic rift" in "natural" nutrient cycles as a result of enclosure and urbanization is quite problematic (2001: 62). As will be argued, this is a deficiency of analytical generalizability which may productively be addressed by the informants of complexity theory and resilience ecology, which enables pushing the analytical capacities of social-ecological *metabolism* from a relatively high level of abstraction and historical-geographical specificity toward a more localised analysis of resource dynamics and constraint below the aggregate level of town-country. Before addressing this concluding point, consideration must be given to a number of contemporary contributions which have attempted to address this call for a nuanced, historical research programme and analytical operationalisation, beginning with works which have attempted to conceptualise the historical emergence of this condition of rift, in context of the historical emergence of world markets.

5.1.3. Metabolic rift, ecology and the world-system

The works of Jason Moore (2000, 2003a, 2003b, 2008, 2011) have attempted to impose conceptual order on the historical complexities underpinning the emergence of metabolic rift by drawing upon both ecological Marxism and world systems theory. Moore's work is best read cumulatively, as his 2011 publication moves substantially away from earlier vitalist depictions of a macro 'world-system' conditioning local ecological outcomes, toward an interpretation of capitalism as *inherently* an ecological regime, rather than a property which exerts causative influence. Moore's important discussions and theoretical elaborations implicate a number of considerations relevant to this research, and throughout the course of his work, Moore develops a broader historical interpretation of metabolic rift as a continuous process, rather than a discrete rupture characterised by urbanisation, industrialisation or expropriation[128]. His treatment of metabolic rift begins by periodising its emergence and exacerbation as successive 'systemic cycles of agro-ecological transformation' (Moore 2000, 2003a, 2003b), developing in his later work toward a conceptualisation of capital-as-ecology, thereby '...unifying the production of nature and the accumulation of capital' (Moore 2011). Consequently, Moore's earlier works are here used as a basis from which to critically assess the informants of world-

[128] According to Schneider and McMichael; 'He maintains the material and social thrust of the concept as Foster developed it, but extends the concept by theorising 'a succession of metabolic rifts specific to each phase of world capitalist development' (Moore 2000: 128). Foster's concept a metabolic rift specific to the second agricultural revolution in the nineteenth century is, for Moore, just one historically specific manifestation of historical capitalism's general metabolic rift' (2010: 464).

systems theory, and to address a number of related theoretical concerns. Such concerns include the tendency of world-systems theory to emphasise the primacy of markets and circulation, and to offer an inadequately totalising interpretation of the dynamics of capitalism which ignores fundamental continuities in non-capitalist social forms following the 'crisis of feudalism' in the fourteenth century. This discussion concludes with a consideration of its conceptualisation of crisis, and the consequent need to retain a degree of particularism for productive local level analyses.

Jason Moore's first explication of the concept of 'systemic cycles of agro-ecological transformation' (2000) stresses its relevance for understanding the emergence of ecological crises in the twenty-first century, which Moore claims owe their origins as cumulative historical processes, to the transition to capitalism in the sixteenth century (1450-1640). This perspective, informed both by Marxian ecology and world-systems theory, thus claims to move beyond accounts seeking to assign causation for ecological change to individual entities (such as imperialism, technology or firms), accounting instead for the reorganisation of world ecology in terms of the logic of capital. Within this broad historical perspective, Moore asserts that primitive accumulation be conceptualised as essentially *multi-scalar* insofar as consolidation and separation, as social processes underpinning capitalist accumulation, manifest at multiple organisational levels (i.e. at the levels of individual farm, settlement, estate and national trade/debt). This complex process, resulting in the profound town/country antagonism which features centrally in existing accounts of metabolic rift is therefore afforded additional historical attention as a product of an antecedent '...series of successive historical breaks in nutrient cycling' (Foster 1999 cited in Moore 2000: 127). Moore's contribution is therefore to extend this periodisation of metabolic rift across the 'longue duree' of capitalism beyond the confines of the nineteenth-century in which it is typically discussed by authors cited thus far, by illustrating how agriculture had in certain locations become subordinated to capital long before the nineteenth century (2000: 128).

This approach engenders a number of related difficulties however, not least by emphasising what is specifically *capitalistic* about successive historical 'breaks' as components of a broader process. In this sense, the specifics of the ecological dynamics of precapitalist modalities are afforded less attention;

> "...we are talking about a metabolic rift that is specific to the capitalist epoch as a whole. Other historical systems certainly experienced environmental contradictions and crises...These tributary world-systems differed, however, in two important ways – they

> took much more time to develop an ecological crisis, and lacking the global expansionary imperative of capital, these systems generated ecological crises that were localizing rather than globalizing" (Moore 2000: 127)

The epistemological value of the concept of metabolic rift is therefore pitched not in terms of its specific capacity to assess local ecological crises, but of its ability to illustrate the trans-historical and trans-national explanatory power of the abstract logic of capital (in terms of production and accumulation), explaining as it does the formation of world markets through spatial expansion once limits to absolute surplus extraction under feudalism had been reached, and the ability of capital to structure ecological outcomes irrespective of local nuance. Although Moore attempts to qualify this abstraction by citing others such as Arrighi for a deterministic reliance on 'capital' as an independent explanatory force, the mere qualification of capitalist development as a process punctuated by successive intensifications of primitive accumulation - although pointing toward specific ecological outcomes such as land concentration and proletarianisation - is one which for the purposes of this thesis functions at best as meta-narrative. Furthermore, the notion of 'tributary' social forms carries the undesirable connotation of homogenising the complexities of pre-capitalist forms under a reductive commonality of 'simple extractive relations' between direct producers and local ruling classes (see Banaji 2010: 17 and Patterson 2003: 21). Although the spatial fragmentation and relative technological underdevelopment of such 'tributary' modes may have restricted the development of crises of scale, this distinction of 'capitalist-precapitalist' ecological dynamics in terms of scale alone appears an inadequate reduction, ignoring as it does the complex relations between modes, varied effects of encroaching capitalisation (manifested variously as commodity production and enclosure), and the effects of market imperatives and structures of colonialism on the direct production process, in the case of Ireland.

Hornborg's (1998) argument for an 'ecologised dependency theory' previously asserted this need for combined abstraction and local sensitivity in order to assess evident internal inequalities of resource distribution, given that different modes of production appear capable of structuring resource dynamics in variously inequitable ways. Moore's abstraction does however, identify an important general ecological dynamic of capitalisms' historical development; that of its need for intensification through land-grabbing (conceptualised by David Harvey as a 'spatial fix'; Moore 2011: 15), whereby capitalism comes to depend on additional land inputs in order to upscale agrarian productivity, which resulted in a state of high-entropy intensive cultivation under the imperatives of 'ETF2' as discussed previously (Mayumi 1991, 2001). In this sense, it is useful to conceptualise such an abstract dynamic of enclosure and spatial restriction – implicating and combining as it does the logic of capitalist

expansion and energetic efficiency - albeit at the expense of local nuance. The incorporation of world-systems theory thus proposes to augment understanding of this modern condition by examining how the emergence of capitalism was predicated centuries earlier on a crisis of feudalism or 'socio-physical conjuncture,' whereby feudal systems based upon the political extraction of tribute in the form of absolute surplus encountered limits to expansion. These limits, according to Wallerstein, comprised two essential components; '(a) feudal organization of agriculture had begun to exhaust its land and labor power in the European heartland, and (b) the expansion of settlement had brought more and more people onto less and less productive land at the geographical margins of the system' (Moore 2000: 129). On the surface, this appears to confront previous pronouncements on relative fertility by depicting Malthusian 'natural limits' in the forms of naturally unproductive land, and a classical case of population growth confronting limits to its own food supply, exposing the feudal system to periodic 'disaster shocks' in the form of famines, climate change and epidemics such as the black death (although this view is correctly qualified with a consideration of how dominant modes of surplus extraction conditioned both rates and extents of agricultural production)[129].

Wallerstein thus depicts the eventual transition to capitalism in Europe as one contingent on a relationship between class structure and land-labour ratios, according to which, population density conditioned the devolution from manor to small farm;

> "Where population density and urbanization remained relatively high, as in western Europe, the peasantry's power was augmented proportionately, and the predominant agricultural organization moved away from manorial production and toward medium-sized farms, favoring the rise of the yeoman farmer and intensive agriculture. Where population density and urbanization was relatively low, as in eastern Europe and the Americas, extensive agriculture developed on the basis of "coerced cash-crop labor." This difference was the result at once of the differential possibilities for "effective resistance," owing to varying population densities, and of the differential commercial opportunities presented by the relative availability of land..." (Moore 2000: 130)

Imperialist expansion, necessitated by systemic limitations to absolute accumulation under feudalism, thus gave rise to a condition of core-periphery dependency, whereby coerced

[129] Mindful of the various forms this extraction of tribute may take; "Absolute surplus can be extracted either by means of increasing the amount of surplus labour extracted from each worker on the land or by increasing the number of workers on the land...The second route through which absolute rental value extraction may be pursued is through increasing the number of peasants on the land" (Slater and McDonough 2005: 35). Absolute surplus extraction thus features prominently in world-systems accounts, as a factor inhibiting the emergence of relative surplus extraction in the form of increased productivity. This hedge against relative surplus realisation is brought about by effectively restricting the accumulation of capital by direct producers, and therefore its investment in fixed improvements such as drainage and later, machinery. This world-systems crisis of feudalism or 'socio-physical conjuncture' must therefore be adequately qualified by the social form under which this surplus labour is extracted.

production and labour in peripheral countries and colonies (including Atlantic slavery, European 'second serfdom', and Ireland from the seventeenth century) provided grain and raw materials to core regions, facilitating the conversion of agricultural lands, and the freeing of an urban labour supply to fuel emerging industrialisation. The emergence of such world markets was thus predicated upon 'absolute' limits to feudal development, necessitating imperialist spatial expansion beyond the geographical confines of its core regions. At the level of local production, this relationship between class structure and land-labour ratios in particular regional contexts, in turn mediated the dynamics of the domestic peasant economy and its demography through the emergence of 'proto-industrialisation.'[130] The rise of 'market as mediator' (Meiksins Wood 2000) further inculcated a responsiveness to market price fluctuations which impacted on local ecologies by determining which forms of productive activity and variants of crop were optimal under prevailing market conditions[131].

On the question of ecology, Moore's discussion operates at a higher level of abstraction, and Wallerstein's insights on world ecology under capitalisation stress the ability of capitalism to produce an aggregate relative surplus product greater than that possible under previous social

[130] Amongst a number of more nuanced models, Gray (2005) suggests that Medick's 'demoeconomic model' offers useful insights by emphasising the 'dynamic interplay between the micro strategies of rural industrial families, and macro-transformations within the broader socioeconomic system...rural industrialisation disrupted the demoeconomic balance characteristic of the European peasant family, and led to the emergence of a new type of family economy...In addition to expanding the labor supply through population increase, the protoindustrial family economy contributed to macroeconomic growth by enabling merchant capitalists to realize a 'differential profit' (Gray 2005: 46). Gray's review of existing pronouncements thus draws attention to the difficulties inherent in mapping such metanarratives onto regional contexts, indicating that the informants of world-systems theorists require both contextualisation, and augmentation with perspectives capable of incorporating structure whilst representing the structurally-mediated strategies of actors.

[131] On eighteenth century Ireland, O' Brien (1918) discusses the effects of this complex marketisation on the general character of Irish productive activity; 'From the beginning of the last century until about the year 1732 the industry of the Irish appears to have been voluntarily directed to tillage, with a view to export, much more than it was subsequently to that year, and anterior to the year of 1786, probably owing in a great degree to the then condition of its trade and manufactures which was by no means such as to afford sufficient employment. The woollen [sic] manufacture was rapidly declining under the repeated attacks of Great Britain; the linen manufacture was in its infancy; the manufacture of iron was lost by the waste of timber; the importation of cattle and provisions into England had been proclaimed a nuisance; in short, the Irish seemed necessitated to betake themselves to tillage' (O' Brien 1918: 108).

Although market conditions may be here be interpreted as signifying optimal conditions of production, caution must be exercised in interpreting local variations and responses (i.e. concrete productive activity and social organisation) as a mere rational reaction to structural imperative. The concepts of panarchy and cross-scale interaction advanced in chapter 3 should here sensitize us to the fact that world-market structures are but one component of this complex assemblage from micro to macro level. The concept of mode of production in turn suggests that local production under capitalism operates under manifold forms of market-engendered constraint, mediated by conditions of access (relations of production), and modes of surplus appropriation. Marx thus captures the essence of this imperative and relation to local ecology; 'The way that the cultivation of particular crops depends on fluctuations in market prices and the constant changes in cultivation with these price fluctuations – the entire spirit of capitalist production, which is oriented towards the most immediate monetary profits – stands in contradiction to agriculture, which has to concern itself with the whole gamut of permanent conditions of life required by the chain of human generations' (Marx 1991 [1894]: 754)

forms. Driven by a need for food and fuel, global expansion gave rise to a system of enduring ecological inequality under a new extractive global division of labour, conditioning the unequal movement and distribution of natural resources both within and between implicated core and peripheral nations. The effect of this global incorporation upon local ecology and production was to introduce not only an international dimension to resource circulation, but to further subordinate local ecology and production to market and imperialist imperatives, as with the example of Irish and Spanish woodland;

> "...This development of an unequal world division of labor, in turn, created new capitalist efficiencies of specialization between agriculture and pasturage and between agrarian activities and industrial activities. Predictably, these processes encouraged capitalist monoculture and the prioritization of short-run profits over sustainability...England's invasion and subsequent colonization of Ireland after 1600 contained a crucial ecological dimension. Ireland's "woods were used up to supply England with timber." Whereas one eighth of the Emerald Isle was under forest cover in 1600, it had "virtually disappeared by 1700... In Spain, the forests receded under the pressure of a rising sheep population that was a direct response to growing world market demand" (Moore 2000: 134)

Common amongst criticisms of world-systems theory is its alleged tendency to emphasise the market in a manner equating 'the world-system with the world market' (Moore 2000: 135). This is understandable, given that it consistently implicates the 'system as a whole' as its central analytical unit, interpreting social change as a consequence of multi-scalar interaction, rather than locating drivers of change in terms of the idiosyncrasies of individual states (Gotts 2007: 3). Acknowledging world systems theory's tendency to over-emphasise the market, Moore's ultimate theoretical reworking proposes descending to the level of 'socioecological change at the point of production', by interpreting the post-fourteenth century subsumption of feudalism beneath the emerging capitalist world system as one of a world ecological revolution. Giovanni Arrighi's *systemic cycles of accumulation* are therefore augmented as ones of *agro-ecological transformation* which instantiate and accelerate the essential elements of metabolic rift; regional specialisation, simplified ecological complexity and exacerbation of the town-country antagonism - with pronounced consequences for peripheral economies in the form of extractive specialisation and coerced market oriented production[132]. The net effect of each successive phase of reorganisation thus satisfies the logic of capital, as intensification and specialisation tend to cut costs for industry and commerce by raising productivity through the

[132] Qualification of the concept of coercion has previously been offered, distinguishing between economic and extra-economic coercion, the latter of which features prominently in forthcoming discussions of Ireland

application of technology, and (through primitive accumulation in the form of enclosure), produce a reserve army of labour resulting in wage depression[133] (Moore 2000: 141).

Although this offers both an insightful macro-context to the historical period of concern within this work, and a useful integration of related macro-level elements such as ecology, imperialism, global market expansion and capitalist logic; in the context of critiques of world-systems theory as circulationist, it can be argued that this perspective inadequately glosses over other critical elements implicated in the concept of mode of production. As outlined previously, although it is useful from the perspective of macro-context to conceptualise concrete forms of production as conditioned by modes of circulation, such a perspective renders it difficult to incorporate related elements of *modes of production* as 'discrete' (i.e. abstract) totalities. On this point, and particularly in the case of Ireland, the specifically capitalist focus of Moore's world-systems approach, and its depiction of a distinct break between pre-industrial feudalism and capitalism ignores widespread continuities in communal and feudal forms in terms of local relations of production, not only across Ireland, but across wider Europe.[134] At a theoretical level, it cannot be concluded that Moore's historical reworking - insightful a contextual device as it is - functions adequately for the assessment of *production* as manifested under such historically specific modes, and consequently, the *specific* ecological outcomes engendered as a result of the localised metabolic interaction of relations and forces of production. In short, markets and circulation are but one general level of social-ecological systems as complex panarchies, and the subordination of local ecology to capital requires looking to the labour process, conditions of land access, and concomitant modes of surplus appropriation as argued previously.

Dale Tomich encapsulates the thrust of this criticism well. Although endorsing a form of historically grounded structural analysis which 'seeks to attach statements "to specific eras and parts of the world, specifying causes, involving variation from one instance to another within their time limits', Tomich claims this endeavour carries a risk of succumbing to functionalism

[133] Cycle three, *1760 to 1870* is of greatest interest in the context of this thesis. This cycle is characterised by the expansion of European colonial rule to 67% of the globe, acceleration of enclosure, a 50% increase in world cultivated land and 450% increase in the volume of world agricultural trade

[134] The subsumption of Romanian serfdom was a long process of struggle between the feudal Boyar and the peasantry which continued long into the eighteenth century. Outliers of communal villages, the 'underlying fabric' of this social form survived in Romania into the twentieth century (Stahl 1980). Marx's correspondences with Zasulich and Engel's writings on the Mark also reveal a process not of abrupt subsumption, but of complex coexistence. In Ireland, Dáil debate transcripts record questions concerning the continued existence of rundale within parts of Mayo into the mid twentieth century (Dáil Eireann 1947)

or reification, by which such macro-social structures as the world market come to assume an insufficiently grounded causal independence[135] (1994: 342). Suggestive of a need for a multilevel approach (against such potential reification), Tomich elsewhere argues, on the subject of class formation, for a '...more historically and sociologically adequate understanding...in which the *object* of analysis is particular class relations, [but] the appropriate *unit* of analysis is the totality of relations forming the historical world economy' (Tomich 1997 cited in Gray 2005: 8).

Skocpol's review of world-systems theory (1977) presciently draws out a number of related issues dealt with variously throughout this thesis; world-systems theory's tendency toward abstract model building (marshalling evidence through a preconceived and idealised theoretical construct), a lack of theoretical insight into the specific dynamics of feudalism (including an account of its demise whereby limits to accumulation feature as a teleological prime mover), and its repeated emphasis on the world-system as a stable entity which tends toward self-reinforcement through negative feedback. Ultimately, Skocpol locates a critical root of world-systems' circulationism in its 'reduction of socio-economic structure to determination by world market opportunities and technological production possibilities' (1977: 1078-1079). As both complexity and resilience correctly imply, these are related, reductive assumptions which gloss over the complex constitution of social-ecological systems, and which, by invoking assumptions of vitalist self-reinforcement, render the approach incapable of offering a valid heuristic for assessing actors' adaptive capacities toward resource constraint. Skocpol reinforces this concern by suggesting how world-systems theory ignores '...the basic Marxist insight that the social relations of production and surplus appropriation are the sociological key to the functioning and development of any economic system. For this Marxist idea demands that one pay attention to institutionalized relationships between producing and surplus-appropriating classes and allow for the ever-present potential of collective resistance from below' (1977: 1079).

The problem with world-systems accounts in this respect is that when such variation in social form is incorporated, attention restrictively centres on the role of commoditisation in the transition from feudalism to capitalism as a unilinear process. Although this is a key mechanism for understanding the progressive undermining of pre-capitalist forms, it is again inadequately restrictive in its focus; '...commodity production may be generalized in two ways.

[135] As before, deferring to the concept of emergentism suggests neither atomistic reductionism nor vitalism suffice epistemologically in accounting for such structures

Goods and services may be transformed within an established zone of production. Alternatively, the zone of production itself may be extended, allowing the commodification of goods and services previously unknown' (Moore 2003a: 331). The penetration of the commodity form is however more complex a procedure, manifesting within primitive communism as 'moveable goods' which in turn undermine relations of production in myriad ways through progressive individualisation, disrupting ecologies dependent on collectivisation to balance tillage and livestock.

A compelling discussion is offered by Moore on an obverse phenomenon associated with colonisation in the Andean regions (1450-1640), where Spanish colonists instituted systems of collectivisation in order to ensure sufficient mining labour for its exploitation of Bolivian silver. This the colonial administration accomplished by instituting a system of draft labour (mita), which involved conscripting one in seven adult males for work in mining and textiles. A supply of labour was ensured by the colonists' relocation of 1.5 million indigenous people, and the imposition of collective agro-pastoral systems based on commonage, community regulation and herding (Moore 2003a: 342). This reorganisation facilitated two primary outcomes; (1) minimising excess labour requirements associated with intensive, individuated agriculture by eliminating the need for herding and supervision; (2) by instituting commercial wheat production, to which common-field cultivation lend itself well owing to a need for fallowing, crises of declining European yield were met with the externalisation of its ecological burden. In this example, the dialectic of market and socio-ecology is evident, as are its detrimental outcomes; 'Pulling labor out of the villages, the mita undermined socio-ecological reproduction over the short- and long-run. First, the mita often withdrew labor at "crucial moments in the agricultural cycle," further destabilizing traditional production relations in "labor-intensive agriculture." When mitayos returned, many were too sick to return to agricultural labor or found their fields "deteriorating or unworked".' (Moore 2003a: 346)

Although this is a unique example of a particular form of colonial intervention – indeed opposing tendencies of centralisation and individualisation were most common in post-famine Ireland[136] – it reveals something of the explanatory power of connecting broader market imperatives to local accounts of how production is organised at settlement and household level. In the case of Ireland, collectivisation satisfied different requirements associated with increasing absolute rent through subdivision. Consequently, although this constitutes an

[136] Communal systems in Ireland did however exhibit the same tendency to free excess labour for seasonal migration, which according to Almquist's data was positively associated (at aggregate level) with prevalence of common property (r = 0.13), availability of wasteland (r = 0.43) land fragmentation (r = 0.77) and percentage of paupers (r = 0.42) (1977: 213)

obverse example of what is typically the undermining of communal forms by commercialisation, it offers useful insights into how conditions of social-ecological constraint may be engendered and exacerbated by higher-order systemic levels and properties such as international markets, and the colonial apparatus. Although this renewed, nuanced position embraces the prospect of regional variation, it remains rooted to the town-country antagonism, which arguably restricts the consideration of variation not only in terms of scale and space, but in terms of social form (i.e. modes of production, or the localised 'institutionalized relationships between producing and surplus-appropriating classes' suggested above by Skocpol).

By 2011, Moore's discussion of existing pronouncements on metabolic rift had extended to an outright charge of Cartesian binarism. Moore (2011) thus cites existing pronouncements and proponents of metabolic rift for retaining a dualistic view of ecological crisis as an *outcome* of capitalism, rather than a phenomenon constitutive of its development. Furthermore, Moore's later elaboration constitutes a profound inversion of past reliance on *a priori* constructs, arguing instead for recognition of the dialectical interplay of local and global through an integrative ontology which refuses to resort to reductionism or vitalism. This revitalised position raises a number of points which bear close consideration. Although the primacy of market totality is downplayed, the significance of local nuance is again subsumed beneath the perceived explanatory power of capitalism as simultaneously constituted by, and causative of, myriad local social-ecological interplays, which in turn give rise to its emergent macro-structural dynamic (the latter of which occupies centre stage). This raises a further theoretical dilemma, insofar as excessively asserting the social as inextricably bound with nature (in a co-constructive epistemology, as with ANT – see chapter 2) carries the undesirable implication of closing off the empirical enrichment of such a systemic perspective. Although this conceptualisation of capitalism as destructive ecological totality lends weight to political critique, it is merely one side of a necessarily multilayered methodological enterprise.

A critical point of dialogue is therefore found in Moore's discussion of the concept of crisis, which he compartmentalises into epochal crises (marked by transitions between modes of production) and developmental crises (marking transitions from one phase of capitalism to another). In terms of the dominant narrative of world-systems theory, developmental crises are those which punctuate the development of capitalism following its emergence from the epochal crisis of the collapse of European feudalism. There are thus two distinct levels of crisis conceptualisation discernible within Moore which crosses both the general and the particular. On the latter, Moore thus states;

> "If there are many possible forms of 'ecological crisis' in the modern world, the relations underpinning these forms are found in a many-layered process through which the dynamics of accumulation link up with the nature–society relations that are value's point of departure, and point of return. Here the essential limits of expansion are 'external' only in a highly abstract sense, since the external can only be discerned through the labor process" (2011: 10).

This perspective of crisis resonates with emergentist approaches to social-ecological systems conceptualisation, which views distinct labour processes and systems of particular identity as instantiating their own crisis parameters (Bergandi 2011; Cumming et al 2005; Cumming and Collier 2005; Cumming 2011; Holling 2001; Plummer and Armitage 2010). This is in turn wedded to O' Connors general and abstract notion of a 'second contradiction of capitalism', augmenting the traditional Marxist contradiction between forces and relations of production with a contradiction of relations and conditions of production, which consists of; '...rising costs issuing from the degradation of the conditions of production has set in motion a dynamic that will fetter accumulation from the supply-side. This contradiction reinforces difficulties the system already faces in the realization of surplus value through the sale of commodities' (Moore 2011: 12)

This general imperative functions in such a manner as to compel producers to continually expand production with additional material inputs in order to maintain profit (Jorgensen and Rice 2007: 275). Clearly there are merits and pitfalls in this level of abstraction; as a hedge against Cartesian reductionism, it ensures a dialogue between particularism and generality[137], but as before, its historical scope assumes too discrete a break, and perhaps, too extensive a continuity and homogeneity in the penetration of capital. Consequently, although Moore's reformulation fits well within the concept of systems as panarchies, it is perhaps best to overcome this tension between particularism and generality not by viewing this revitalised 'capitalism as ecological regime' as a position antagonistic to local understanding or middle-range methodology, but by acknowledging its place within a broader dialectic of totality.

Therefore, although direct producers in distinct historical epochs are undoubtedly subject to the global reach of capital, this current work represents a more modest dent in this historical maelstrom which seeks to examine how macro-emergent entities such as the logic of capital and its intrinsic metabolic rift function to confer conditions of differential resilience which are in turn mediated through the adaptive capacities of actors operating within local modes and systems of production. This does not preclude a theory of crisis prevailing at a higher level of

[137] This it achieves by uniting both contradictions (the first social, the second, social-ecological) within an integrated theory of crisis.

abstraction, nor does it by default imply crude reductionism or excessive particularism; it merely constitutes recognition of complexity, and a desire for its somewhat more localised operationalisation. The very clue as to how this endeavour might proceed is offered by Moore himself, through the concept of capitalism as ecological *regime* (more of which later; in short, this is a concept which requires greater historical contextualisation and localisation, rather than expanding generality).

Despite these shortcomings in its limited treatment of the concept of mode of production, and reduction of systemic complexity to a market-labour dialectic, Moore's contributions ultimately remain a potent corrective both to the limited operationalisation of metabolic rift as an historical-analytical device, and broader dualistic conceptualisations of nature and society as ontologically distinct;

> "First, the theory of metabolic rift draws our attention to the reshaping of town-country relations at multiple scales in the long sixteenth century. Second, the ecological interpretation of the antagonism between value accumulation and ecology, among other things resulting in a radical simplification of the latter, allows us to put labor into the mix of environmental history. Putting labor at the center in this way accomplishes two main things. It sheds light on the relation between place-specific production and larger socio-spatial relations, such as town and country. And it undermines dualistic conceptions of nature-society in favor of analyses that see human beings as a force of nature in themselves" (Moore 2003a: 359)

What is critically lacking in this variant of a world-systems approach however is a means of imposing assessments of qualitative differences of state at lower levels of abstraction, and of examining local generative mechanisms giving rise to the manifold concrete systems which constitute the emergent world system itself[138]. Crucially, as the preceding review of the processes of categorisation and abstraction in Marxism have suggested, this is an approach which requires greater epistemological depth than simple atomistic reductionism, insofar as these manifold concrete systems must themselves be examined in terms of their own ontological complexities – a question addressed further at the conclusion of this chapter in terms of methodology.

Before concluding this chapter, a brief review of a number of prominent 'place specific' heuristics is required. Such heuristics and analytical devices comprise more empirically-oriented operationalisations of the informants of metabolism and metabolic rift which have

[138] It might be further argued that this level of systemic theorizing constitutes what Smith and Jenks (2006) refer to as a form of excessively totalising grand narrative

addressed, in a mechanistic manner, this question of normative state-assessment; their consideration is warranted for completion. Conversely, consideration must also be given to an opposing extreme of this determination toward the physical-ecological; that of the social, as manifested in politicised applications of the concept of metabolic rift. As with antecedent reviews thus far, the merits of these approaches and case studies stand on their own particular relevance and utility in addressing their authors' research questions, and their criticism is here enacted in service of the requirements of this particular thesis.

5.1.4. Applications within the social sciences and political economy: insights, limitations and respective determinisms

Despite the above-noted shortcomings and relatively abstract level of discussion thus far, the concepts of metabolic rift and metabolism have enjoyed some application in recent years across both sociology and economics. Invoking the concept of metabolic rift directly, Clark and York (2005) have elaborated a theoretical model capable of grasping capitalism's systematic degradation of the biosphere, resulting from increased commodity production which has both flooded carbon sinks, and led to an over-accumulation of atmospheric carbon dioxide[139]. Within the social sciences in general, the concept of metabolic rift has offered a critical basis from which to assess both the historical relativity of present (capitalist) social relations, and to advance a programme for political action (Clausen 2007; Schneider and McMichael 2010; Wittman 2010). For economics and human ecology, these concepts and others of close affinity have seen some use in comparative political economy (Hornborg 2007; Jorgensen and Rice 2007; Rees 1992; Weisz 2007; Wood and Lenzen 2003). Within mainstream economics, the concept of 'ecological footprint' has offered a metric capable of assessing the indirect effects of urban metabolism in terms of the amount of productive land required to sustain its material-energy throughput (Fiala 2008; Rees 1992; Wood and Lenzen 2003).

As a concept of close affinity with that of metabolic rift (insofar as both address questions of imbalances in resource appropriation and repatriation, land regeneration and sustainability), the analytical heuristic of 'ecological footprint' represents a more mechanistic operationalisation of

[139] 'Metabolic rift' has been applied to a diverse number of spatial scales beyond agriculture; Clauson and Clark (2005) have employed it to assess anthropogenic drivers of fish stock depletion and the development of aquaculture in response to increased exploitation under capitalist technological development. In his compelling subjection of a modified IPAT identity to regression modelling, York (2003) claims that modernization (as per the EKC hypothesis) offers little evidence of reducing carbon dioxide loads. Metabolic rift is cited as a useful explanatory device in accounting for the tendencies of increased resource transportation, application of energy-intensive chemical fertilizer, and landfill engendered under capitalism which he suggests drives a continual increase in GHG (greenhouse gas) emissions.

this problematic. Ecological footprint analysis thus offers a quantitative metric capable of assessing the extent of environmental load displacement engendered by various modern settlements, by estimating the *total* area of land required to sustain its population; a quantity which typically exceeds its formal boundaries;

> "The total area of land required to sustain an urban region (its "ecological footprint") is typically at least an order of magnitude greater than that contained within municipal boundaries or the associated built-up area. In effect, through trade and natural flows of ecological goods and services, all urban regions appropriate the carrying capacity of distant "elsewheres" creating dependencies that may not be ecologically or geopolitically stable or secure" (Rees 1992: 121)

Ree's directs further criticism against orthodox neoclassical economics for is excessive abstractions, originating in an uncritical adoption of Newtonian analytical mechanics which '...lacks any representation of the materials, energy sources, physical structures and time-dependent processes basic to an ecological approach' (1992: 122). This approach thus bears close resemblance - albeit without similar critical engagement with questions of historical specificity and social form – to that of metabolic rift which emphasises an antagonistic division between town and country (the 'distant elsewheres' of Rees), and its associated resource circulation imbalances. Operationalisation of the concept of ecological footprint relies on the related concept of *carrying capacity* as the '...population of a given species that can be supported indefinitely in a given habitat without permanently damaging the ecosystem upon which it depends' (Rees 1992: 125)[140]. Ecological footprint analysis thus inverts this latter concept by estimating settlement sustainability requirements not in terms of natural capital, but in terms of '...land in various categories...required to support the region's population indefinitely at a given rate of material standard' (ibid). This dynamic of population growth has been outlined in chapter 3 as 'density dependent growth' by which resource limitations impose certain theoretical upper limits on population growth rates (see chapter 3, figure 3.3).

On the basis of materials reviewed in this chapter – namely the concepts of mode of production, relative fertility and metabolism –this question of variable carrying capacity, at a high level of generality, may now be depicted in terms of the social forms under which production and resource circulation takes place, rather than invoking 'carrying capacity' as an abstract Malthusian constant which seeks to 'expunge historical contingency' (Levins and Lewontin 2007: 16). Density dependent growth is therefore not a historical constant, given that conditions

[140] For human societies, this may be more precisely defined as '...the maximum rate of resource consumption and waste discharge that can be sustained indefinitely in a given region without progressively impairing the functional integrity and productivity of relevant ecosystems' (Rees 1992: 125).

of resource constraint are subject to the vicissitudes implicated by the mechanisms of metabolic rift, and constraints imposed by the parameters of various historical modes of production in terms of surplus appropriation and land access. The concept of ecological footprint thus seeks to pointedly operationalise these resource dynamics in terms of human settlement and space. This heuristic claims to render visible inequalities not adequately represented by the neoclassical paradigm which, as observed at various points throughout this thesis, downplays the significance of natural resources by invoking assumptions of technological optimism or market-conditioned assumptions of resource valuation and variable price mechanisms (i.e. rising prices offsetting ecological degradation by incentivising innovation). The results of its operationalisation are therefore intuitively interpreted;

> "Wackernagel et al. (2002) estimated the footprint for the global economy for each year from 1961 to 1999. They found that the ratio of the footprint size to the land actually available increased from approximately 0.7 in 1961 to approximately 1.2 in 1999. In the latter year, as they put it, it would require 1.2 earths to regenerate what humanity used. There are wide differences in the size of the per capita footprint across different national economies. Whereas the global average is about 2 hectares per capita, for the USA the footprint is 9.7 hectares" (Common and Stagl 2005: 410)

The implementation of this concept thus reveals differential conditions reminiscent of the pronouncements of Liebig and Anderson on differential fertility and ecological burden displacement as appropriated by Marx. Others such as Jorgensen and Rice (2007) and Weisz (2007) have appropriated the concept of metabolism more holistically, attempting to account for such manifest inequalities at lower levels of aggregation, and in comparative-international context. Consequently, Jorgensen and Rice suggest that such manifest differences in ecological footprints '...are illustrative of structural conditions and asymmetrical processes in which more developed countries externalize their consumption-based environmental impacts through the tapping of natural resources and produced commodities of less developed countries, reducing material consumption in the latter while increasing particular types of environmental destruction within their borders' (2007: 273).

Although these structural conditions are not conceptualised with reference to the informants of metabolic rift, by subjecting cross-national aggregate data to regression analysis, Jorgensen and Rice confirm much of the abstract implications of the concept (albeit at an aggregate, national level of 'developed-less developed,' rather than the level of town-country), by noting '...that weighted export flows have a significant negative effect on per capita ecological footprints of less developed countries' (2006: 281). Other predictors exhibit significant association with the dependent variable *combined ecological footprint per capita, 2000* in line with existing theory

such as *level of economic development* ($\beta = 0.739$, $p \leq 0.001$) and *urbanization* ($\beta = 0.338$, $p \leq 0.001$)[141].

More expansive undertakings, such as that of Hornborg (2007) have examined the grand historical reach of unequal resource appropriation, in terms of industrial infrastructure's requirement of continuous net inputs of energy. Here, the concept of *dissipative structures* is invoked in an 'objective' manner in order to grasp the '...asymmetric flows of entropy and negative entropy between different sectors of global society' (Hornborg 2007: 260). In a manner reminiscent of energetic reductionism, albeit one contextualised through the informants of world systems theory, Hornborg outlines the manner in which industrialising nations imported negative entropy and externalised entropy. This he achieves through the conversion of aggregate agricultural statistics into measures of 'embodied land' and 'embodied labour' (annual hectare yields and hours of human labour respectively), in order to subject the hypothesis of asymmetric resource exchange to empirical proof. Although arguably a crude metric with tenuous empirical justification, Hornborg's results offer an interesting empirical window into the hypothesised continuities of world-systems theorists' 'crisis of accumulation' into the time of the industrial revolution, as manifested in differential trends of resource appropriation. Of particular note is Hornborg's conclusion that;

> "...the displacement of demands on land represented by the appropriation of the productivity of 1.1 million hectares of cotton fields in North America, which in terms of revenue ultimately generated £66,475,547, meant the liberation of the over 6 million hectares in Britain that would have been require to generate the equivalent amount of revenue from woollen manufactures. This land area exceeds by almost 50 percent the total area of British wheat cultivation (4,126,800 hectares) in 1850. If we add to this the imports of wool from overseas, an additional 0.75 million British hectares were set free, for example, to fuel the labour force" (Hornborg 2007: 269)

In short, colonial expansion and the appropriation of primary inputs into the production process (in this case, the textiles industry) constituted not only the appropriation of negative entropy, but a comparative offsetting of ecological burden; industrial outputs generated significant monetary return, whilst resultant gains were made in space *not* used to cultivate its inputs. This is but one element of a complex assemblage of social-ecological relations however; as noted previously, Britain also imported significant volumes of foodstuffs to feed its rising, expropriated industrial labour force, and engaged in a further form of energetic appropriation by importing colonial reserves of guano to cope with diminishing yield (Burkett 2006; Foster

[141] Standardised (beta) coefficients reported from 'Model 1', table 14.2 'Standardized coefficients for analyses of ecological footprints per capita, 2000 in LDCs' (Jorgensen and Rice 2007: 282).

2000; Mayumi 2001; Hornborg 2007: 268). Hornborg's most significant contribution is however theoretical; justifying his peculiar form of energetic reductionism, Hornborg states;

> "...this logic remains founded on the imperative – for all kinds of complex systems or structures – to maintain a net input of negative entropy. This can be achieved through a variety of social strategies complementing and succeeding each other over the course of history...the import of raw materials for the textile industry...served to make room for the energy provisioning of the British labour force. Factory workers and coal miners alike ran on wheat" (Hornborg 2007: 269-270)

Although offering unique insight into the disproportionate spatial requirements of various types of settlement and economies, ecological footprint methodologies have attracted some criticism. As a measure of sustainability, its reliance upon arbitrary political boundaries is viewed as problematic, and Fiala (2008) has suggested that rather than measuring 'sustainability', ecological footprint analysis merely represents resource inequality. Consequently, differing ecological footprints may variously be interpreted as a function of local rates of per capita consumption. This is problematic as a measure of sustainability, when such measures are extrapolated from national averages and compared against the estimated biocapacity of the earth (a measure which currently suggests humanity is operating at 25% above earth's biocapacity), as it tends to obscure cross-contextual differences in intensive-extensive production. Furthermore, ecological footprint analysis is historically static, operating under the assumption of a fixed level of technological development which '...can only describe production growth without technological progress' (Fiala 2008: 521). This problem of prediction and extrapolation reflects concerns outlined previously regarding the historical and contextual relativity of fertility and resource imbalance; by assuming invariant levels of technological development (both forward and backward), ecological footprint analysis is thus unable to cope with change and uneven growth. When historical data on cropland are examined, results show significant variation in yield across regions corresponding to respective levels of socio-economic development, reflecting differing levels of technological intensity rather than natural fertility endowment[142].

Ultimately, this form of static methodology is incapable of addressing the consequences of intensive cultivation (land degradation) which may take multiple forms not necessarily represented in aggregate data, such as overgrazing, deforestation, or destruction due to industrialization (Fiala 2008: 523). It may therefore be concluded that such methodologies

[142] Total world cereal production has increased at a yearly rate of 2.17% since 1961. Much of this growth is attributable to intensive rather than extensive cultivation strategies; consequently, American crop yields for 2006 remained 40% higher than global averages (Fiala 2008: 522 *figure 1*).

suffer from a number of related defects; (1) a reductive conversion of settlement throughput into excess land (or labour hours in the case of Hornborg) which reduces the complexities of internal and transnational inequality through an overdetermination of the physical; (2) reluctance to address questions of historical inequality and future change; (3) an inability to consider the role of social relations in structuring conditions of accumulation, intensification and sustainability which ultimately drive ecological footprints ever higher and exacerbate patterns of uneven externalisation[143]. This, in turn constitutes both an epistemological over-determination, and ontological externalisation of 'environment.'[144]

On the observe side of this physical determinism, Schneider and McMichael (2010) have argued that the concept of metabolic rift inadequately over-determines the social (to the point of engendering a renewed epistemic rift) by emphasising organisational, rather than practical aspects of the labour process. Underpinning these shortcomings is a comparatively narrow comprehension of the material dimensions of metabolic rift, which the authors claim '...centres on a particular nutrient pathway whereby nutrients move from the soil, through humans, and back to the soil in the form of 'humanure' (Schneider and McMichael 2010: 467). This critical limitation mandates an excessively abstract focus which disembodies this generalised 'nutrient pathway' from historically specific forms of agricultural practice. Metabolic rift's emphasis on conditions exacerbated by industrialisation and expropriation, according to the authors, renders it incapable of conceptualising this metabolic pathway and soil fertility in general as an historical process rooted also within contradictions in agriculture, as opposed to industry alone;

[143] Downey and Purvais outline how the sustainability of organic farming in a market economy must necessarily factor not only environmental and nutritional considerations, but also its competitiveness and commercial viability; 'Organic farming is inherently more environmentally sustainable than conventional systems, in particular those intensive production systems which have developed to supply the majority of a global market, and which have become a growing environmental concern...Environmental sustainability differentiates organic food products from those produced by intensive production systems, and provides the strongest platform for marketing organic food products' (2008: 6-7). On the question historical and social-relational variability, Rigby and Caceres (2001) have questioned the synonymity of 'organic' and 'sustainable' which although more ecologically sustainable than intensive agriculture in terms of energetic efficiency, nitrate loss and carbon dioxide emission (Downey and Purvais 2008), ultimately depends on consumer demand for commercial viability in a capitalist economy. The concept itself is ultimately valid only in retrospect; 'Sustainable practices will vary both temporally and spatially and can only truly be identified in retrospect. It is not simply a question of tools and inputs, but the context in which they are used' (Rigby and Cáceres 2001: 33).

[144] Polanyi cautioned against this reification of ecological complexity under the 'fictitious' category of commodity form (Schneider and McMichael 2010: 480). According to Polanyi, land commodification '...solidified a historical process that increasingly lumped a wide variety of complexly associated use values (the provision of food for social reproduction and ecological services for the reproduction of socio-ecological systems) into a unidimensional (and fictitious) exchange value – land as tradable commodity. With the prices of newly commodified land and food subject to market fluctuations, Polanyi anticipated the 'annihilation' of soil and the culture of the countryside...capitalist expansion served to separate or disembed long-term relationships between producers, social classes, communities, and the ecologies they worked' (Wittman 2009: 809). The perpetuation of this reification in academic practice may be traced to the subsumption of Marxian value theory, as a result of neoclassical economics' movement toward a 'strong programme' quantitative paradigm.

> "Declining soil fertility, then, is just one problem in soil and is contingent on a complex set of processes both in the soil and outside of it. In short, Marx neglected to include agriculture as a primary driver of the mechanisms of the metabolic rift and failed to understand soil formation as a historical process. Foster's presentation of Marx's argument indicates that Marx ignored the role of pre-capitalist agriculture and relations of production in changing soil fertility and nutrient cycles. Apparently, he took for granted that pre-capitalist agricultural soils were healthy, productive, and well managed (cf. Rudy 2001). Arguably, what mattered to Marx was that soil degradation began when people were separated from the soil, taking their humanure with them. A fuller analysis would explore how the soil and conditions of soil fertility present at the time of the transition to capitalism (for Moore) or at the time of the Industrial Revolution (for Foster) came to be, taking into account the role of soil management" (Schneider and McMichael 2010: 469)

As outlined previously, Moore's is arguably less suitable a path to take in order to address this problem of historical variability, remaining as it does at too high a level of abstraction. Consequently, these comments merely reaffirm much of what has been suggested thus far through the preceding critical review of the concept of metabolic rift; that it, as an historical process, requires appropriate contextualisation within the dynamics of specific modes of production and concrete social forms, and that the question of fertility and yield is greater than a single determinant (i.e. nutrients alone)[145]. This historical investigation must ultimately remain sensitive to the question of agricultural practice as an essential component of the dualism of abstract and concrete labour implied in the labour process.

Offering some methodological guidance, the authors elaborate on this disembodiment of organisation from practice,

> "Marx's myopic focus on the role of a single practice – incorporating human waste into crop fields – is inadequate as an explanation of the overall decline in soil fertility as observed in his time. For Marx to be correct that the capitalist town-country division of labour caused soil depletion because humans were separated from the soil, humanure would have to have been *the* most important material for maintaining fertility in pre-industrial or precapitalist agriculture. In other words, the ability of soils to provide adequate nutrients for crop growth and development would have been dependent on the immediate presence of humans as fertiliser producers, or nutrient recyclers. However, in Foster's representation of Marx's argument, there is no discussion of the practice of spreading human waste in capitalist or pre-capitalist agriculture. By failing to establish the relative importance of this source of nutrients, Marx's material argument is empirically indefensible. It is also reductionist in its narrow focus on a single material instead of considering the mix of practices that constitute agricultural production in particular times and locations" (Schneider and McMichael 2010: 471)

[145] The concept of resilience as a property mediated through adaptive capacity here serves to address much of this reductionist focus. As a holistic concept, it encompasses Doran's (2002) argument for approaching the question of sustainability from the perspective of management strategies as well as labour organisation and biology.

Consequently, this excessive abstraction, which emphasises organisational rather than concrete-practical aspects of agriculture must be addressed not only by complicating the question of fertility both as a multidimensional concept, and continuous historical process, but by examining the concrete practices and organisational forms of historical agricultural systems in order to discern the relative contribution of various farming practices (i.e. inputs, techniques and contextual constraints) to particular ecological outcomes. Crucially, these outcomes are ones which impact not only upon 'ecological' variables such as seasonal consistency in yield and fertility over time, but also on human physiology, health and practical knowledge; 'Abstract concepts such as labour, metabolism, and nutrient pathways must be defined and embodied in order to avoid over-simplifying the ecological processes that underlie them...this approach enables us to see agricultural practices that degrade soil and labourers, as well as those that support and sustain healthy food and agricultural systems' (Schneider and McMichael 2010: 476).

Sensitivity to the organisational-political contexts of agricultural practice has also proven essential for providing a critical basis from which to advance ecological reform through political action. Invoking the concept of food sovereignty as a corrective to the condition of metabolic rift, particularly as worldwide smallholders struggle to compete with imports sourced from economies of scale, Wittman argues for a '...form of agrarian citizenship based on a natural contract' which would '...not just append nature as a virtual signatory to the existing social contract, but would recognise nature's role in the negotiation of agrarian change' (2009: 807). This citizenship-based model thus proposes to exploit fissures engendered under capitalist agriculture by challenging its essential laws of motion (commodification, simplification and rationalisation) through political action which '...demands state re-regulation of the market but also acts to protect itself against the continued decimation of social and ecological spaces' (Wittman 2009: 822)[146]. Wittman's proposed reincorporation of nature is on less sound a theoretical footing however; although this approach claims to reintroduce nature, as reified from its social form through the commodification of land and agriculture, she suggests an emphasis upon '...the 'lively' or material agency of nature', which emphasises nature's ability to 'protest' in the form of backlash or degradation. Consequently, Wittman claims; 'The 'lively' features of nature thus provide opportunities but also shape and constrain human

[146] Clauson also explores this potential for state-oriented reform in Cuba through the urban agriculture department, concluding; 'The state formalised the growers' claims upon vacant lots and legalized the rights to sell their produce. All urban residents can claim up to one-third of an acre of vacant land, as long as they abide by the rules of all organic farming methods...The transfer of technical agricultural knowledge from agronomists to food producers represents one side of the equation for successful sustainable agriculture...The goals of a participatory democracy for agricultural decision making have been incorporated into the new farming model, and this is made possible by the new ownership patterns' (2007: 47).

activity' (2009: 821). This level of discussion thus reverts to debate over the respective merits of ecological vs. social determinism, whilst allusions toward to 'agency' of nature lean toward a form of ANT co-constructivism or 'actant' based conceptualisation. Ultimately, this epistemological dualism is best resolved through retention of the prospect of historical contingency and variability in social form, augmented with a realist epistemology which stresses the objectivity of natural entities, and a stratified ontology with which to comprehend nature and society as a complex whole.

These respective determinisms raise important and related problematics, insofar as each cautions against reducing the incorporation of metabolic rift as a research informant, to singular questions of market-circulation dominance, the over-determination of social form at the expense of material-ecological insight, idealised dichotomies of capitalist/precapitalist, or an excessively technicist focus which obscures the contextual social dynamics driving manifest differences in ecological outcome. Neither should the concept of metabolism be rendered excessively abstract; as Clauson's (2007) discussion of 'rift healing' in Cuban agriculture suggests, analyses suitable for concrete operationalisation must necessarily consider concrete-organisational (i.e. embodied or situated) modes of nutrient cycling in specific contexts. Valid frameworks must therefore strike a balance between this necessary abstraction and empiricism. The following, concluding section imposes a degree of summary order on this diverse assemblage of theoretical and conceptual informants, with a view toward establishing specific guidelines for operationalisation, and a general framework for a case-oriented methodology. Central to this exercise is the concept of a social-ecological regime.

5.2. Toward a methodology for the investigation of social-ecological complexity

As the preceding discussion has revealed, the concept of metabolic rift, as one rooted in the axiom of labour as a transhistorical metabolic moment, is inherently multidimensional, and its appropriation and elaboration by the various authors considered above treads varying levels of abstraction and determination. Pushing the concept of metabolism toward operational utility, as suggested at the beginning of this chapter, has required outlining the inherent benefits of the concept of mode of production as an informant which offers a more rigorous theorisation of the social, from which may be conceptualised various 'social forms' as concrete expressions of abstract modes of production, whose reproduction is ultimately dependent on a constant material interplay between humanity and environment. Consequently, the concept of the *social* may be incorporated not as a discrete component of hierarchical social-ecological systems which typifies social structure alone, nor as simply a concrete form of tenure or resource

governance (i.e. an ontologically distinct independent variable as with resilience ecology). Instead, the concept of *mode of production* directs toward consideration - in broad historical sweep and at a high level of abstraction - the general characteristics of economic epochs in terms of relations and forces of production, and modes of surplus appropriation. This has been addressed with respect to the requirements of this case study, by outlining the abstract characteristics of the mode of production of *primitive communism*, its logical place within the broader historical materialist apparatus, and its merits as a standalone typological device.

The concept of metabolic rift has further underscored the importance of examining how social relations, in particular the dynamics and imperatives of the mode of production of capitalism, instantiate a rift in local nutrient cycles, exacerbated by the imperatives of urbanisation and industrialisation. This resultant 'rift' is multidimensional, insofar as it impacts on a plethora of system properties such as local ecology and fertility, agricultural practice through market signification, organisation of space through enclosure, inequalities in resource distribution and appropriation through exploitation, intensification and the externalisation of ecological damage, demography, relations between town and country, social organisation and divisions of labour, and individual human health and physiology. Despite its emphasis on the dynamics of capitalism, caution must be exercised in over-extending capitalisms' historical reach, and in over-determining and reifying its market dynamics to the ontological status of independent structure with unidirectional causative properties. Furthermore, questions of local sustainability and qualitative assessment should not hinge on an idealised dichotomy which depicts pre-capitalist forms as intrinsically sustainable; as many thus far have suggested, developing a more nuanced appreciation both of the penetration of capitalism as an ongoing process (rather than a distinct historical rupture), and of pre-capitalist modes of production as entities worthy of study in themselves, requires contextualisation, and descending abstraction (Benton 1989; Callinicos 2005; Foster 2008; Meiksins Wood 2008). Chapter 3 has already argued that the concept of resilience permits such a non-normative assessment, as an approach which retains the explanatory promise of systemic complexity, whilst considering the abstract determinants of system dynamics such as 'capital', 'commodification', or 'markets' and also directing attention to the capacities of actors to respond to, and hedge against perturbation.

This review has directed attention toward a number of abstract properties which are best conceptualised as dialectically related elements in panarchical relation; thus, the concept of metabolic rift has shown how the imperatives of surplus realisation and consequent increases in relative productivity through intensification generate a 'second contradiction' between relations and conditions of production which mandates continual expansion of production. The

consequences of this reach of capital are manifest at various levels from the energetic (ETF2 and appropriation of negentropy), and at the levels of social organisation and local ecology as outlined above. Empirical research has further revealed how these imperatives necessarily function in an inequitable manner, through the ability of capital to externalise ecological perturbation through imperialist expansion, or today by the outsourcing of industrial manufacture, importing of foodstuffs, or recourse to various market instruments such as emissions trading. In order to understand the historical penetration of capital however, particularly at such junctures where it confronts precapitalist forms, it is essential to employ a broader definition of 'capital' as the progressive introduction of commodity form into the direct production process. Consequently, operationalisation of the informants outlined throughout this chapter mandates that explication of the social form of Irish communality as an essential point of continuity. The concept of *social form* thus provides a means of concretising, and imposing historical specificity upon the abstractions of various modes of production. On the concept of social formation / social form, and its heuristic-methodological functions, Kuttler writes;

> "The concept is used by Marx in order to indicate the articulation [*Gliederung*] of the process of material reproduction of human society (*MECW* 29, 264). In doing so, an analogy in terms of content and – in the total social and historical concretisation – also a tension is established with regards to the concept of mode of production. It covers that which is occasionally referred to as 'historical formations' (*MECW* 24, 351). Without further specification, 'social formation' is used synonymously with 'social form' (*MECW* 28, 42, 196), on the one hand, and 'totality' (*MECW* 28, 37) on the other. Additionally, it refers to concrete social systems of distinct spatio-temporal extension...From a genetic [*genetisch*] perspective, the development of 'social formations' refers, in the first place, to progressive formation through continuing attempts to secure basic needs of existence (*MECW* 29, 264)...At the same time, social formation is the object of study of an historical science, as opposed to speculative historical philosophy. In historical studies, the term has, in the sense of formative process, a subject and operation-oriented relation" (Kuttler 2011: 229)

The forthcoming case-study of the ecology of the rundale system in Ireland thus begins in chapter 5 with an explication of Irish communality grounded within the parameters of *social form* (as a hedge against excessive abstraction/idealisation), as Marx similarly cautioned against; '...the desire to use his theory as a 'universal key'...instead of as a guiding principle for the discovery of individual concrete-historical developments' (Kuttler 2011: 233). In such a manner of explication, outward movement toward the concrete (more of which below), begins by observing how '...each social form is a relatively autonomous unit of social life, reproduces its own contradictions in its own specific way, and interacts with social forms through 'historically specific *arrangements* and combinations'...that are more often than not contingent to particular countries, localities and times' (Roberts 2006: 86). In terms of an overall

methodological frame - which as this thesis has suggested, requires the introduction of middle-range heuristics and mixed-method techniques - the question of balancing this necessary degree of abstraction with empirical enrichment as yet requires qualification. By way of conclusion, a degree of order must be imposed on these foregoing informants and procedures. Recourse to the informants of complexity theory and critical realism illustrates both how this balance may be struck, and how a degree of logical order may be imposed.

As a broad epistemology of the social and the ecological, authors drawing upon the concepts of positive feedback and non-linearity associated with complexity have sought to rework systems analysis by emphasising the role of small changes in inducing path-dependent systemic change, thereby overcoming prior assumptions of negative-feedback conditioned equilibrium and normative socialisation associated with more restrictive variants of Parsonian functionalism (Urry 2005; Walby 2007). Widespread acceptance within this paradigm of the assumptions of ontological depth associated with critical realism have addressed the structuralist shortcomings of earlier variants of general systems theory as reviewed in chapter 1 (Byrne 1998). Consequently, social-ecological systems may be viewed not as ordered hierarchies of nested sub-systems conditioned by higher-order processes, nor may they be understood atomistically through the study of their agents; instead they are here conceptualised as complex open systems, comprised of emergent social, cultural, economic and ecological properties and levels, in a state of mutual interconnection (Alhadeff-Jones 2008; Capra 2005; Cillers 2001; Harvey and Reed 2004; Miller and Miller 1992; Walby 2007)[147]. This broad, open epistemology offers less concrete specificity on methodology however; more specifically, once a historically specific system of interest has been isolated, on what methodological principles should investigation progress? Part of this direction is imminent – but not substantive - in the 'methodology' of abstraction which exhibits notable similarities with the practical informants of critical realism.

In terms of methodology, Roberts (2006) has outlined a number of compatibilities between Marxism and critical realism, given that abstraction features prominently in Marxist methodology as a tool which permits an assessment of internal structure. This abstraction, lacking in specific empirical guidance, may therefore be enriched by critical realist informants which invoke similar ontological and epistemological standpoints, but which ultimately strive

[147] Daniel Bensaid (2002) has outlined a number of commonalities and homologies between Marxism and complexity. The concept of 'panarchy' as reviewed in chapter 3 further draws attention to how scale mismatches, and the presence of 'fast and slow' variables, and discontinuities in response to signification from higher systemic levels render the concept of hierarchy inadequately restrictive for approximating concrete system dynamics.

toward practical methodology. Critical realism's essential critique of positivism (which is arguably better interpreted as a critique of false methodological dualisms – see Byrne 1998) therefore acknowledges how a methodology without abstraction is incapable of fully understanding '...the (mainly) non-observable internal structure and mechanism of an object, and how this structure and mechanism produce tendencies in the empirical world' (Roberts 2006: 66). Roberts' proposed dialogue between Marxism and critical realism hinges on the utility of critical realism's concept of 'mechanism' as a methodological tool to guide context-specific investigation, thus revealing a means for Marxism, with its employment of abstraction as method, to gain further methodological insight from critical realism[148]. Roberts' argument is worth outlining in detail and proceeds as follows.

First, as Ted Benton had previously outlined, Marxism and critical realism both invoke conceptions of reality as ontologically stratified. Reality, therefore, consists of (1) transhistorical concepts used to organise material irrespective of social form (i.e. abstract labour; *first level of real*), (2) concepts which permit the theoretical analysis of specific modes of production (i.e. commodity, surplus value, usufruct; *second level of real*), and (3) regional theories which refer to concrete forms of labour, and structural properties of historical objects (*final level of real*). Thus far, discussion has emphasised dimensions one and two, by paying specific attention to labour as a transhistorical resolution of the natural-social dichotomy (chapter 2), and by developing concepts specific to the comprehension of various modes of production (this chapter). A Marxist method of abstraction therefore functions as follows;

> '...for Marx, method should be guided by a relational social theory that conceptualises an object of analysis (in this case the state) as *emerging* from a more abstract and simple structural relation (in this case the capital–labour relation). Emergence, on this understanding, refers to those properties and processes that are relatively autonomous of their constituent properties even if they share an internal relationship to them. Emergent mechanisms can therefore react back upon their constituent properties and alter their form...From a methodological point of view this standpoint suggests that we need to abstract an object in a *systematic* manner, that is, abstract within the evolving, necessary and logical contradictions of a particular historical system. More precisely, we need to 'to search for the most *abstract* and *simple* category' associated with a particular system that is, in turn, related to its most *abstract* and *simple* determining essence...Only once we have isolated both can we then see how each is reproduced

[148] Roberts defines *mechanism* as follows; '...mechanisms focus our methodological attention upon how a social context, or social form, gains a degree of stability through modes of regulation...mechanisms should prompt us to explore how a social form manages to momentarily suspend specific contradictions and thus to suspend crisis-tendencies in the social form in question' (2006: 98). Commensurate with a complexity-based epistemology as represented by the concept of 'dissipative structure' (chapter 1), the heuristic of mechanism is useful in representing change, movement and process as axioms of social forms. Furthermore, it points toward an examination of those essential system attributes which function to confer 'stabilities' necessary for productive activity, or, as recast in chapter 3, 'resilience'.

> into more concrete, complex and contradictory forms of existence' (Roberts 2006: 69-73)

This hedge against reification thus forces engagement with a stratified conception of reality in order to distinguish appearance from reality (i.e. as with the fetishisation of value-form under capitalism) by explicating the abstract determinants of social form. In the case of primitive communism, the dualism of communality and individualism, and transhistorical metabolic engagement through the labour process, have here been offered as such preliminary concepts. A similar approach to research is mandated by critical realism based on its critique of positivism; since social systems are essentially 'open' according to critical realists, methods and epistemologies grounded in the scientific practice of 'closed experimentation' cannot adequately grasp complexity and contingency by necessity of their recourse to observation. Instead, in the course of investigation, critical realists resort to a procedure of 'retroduction' or rational abstraction;

> "This method of abstraction isolates the necessary and internal properties of an object, namely its generative or causal powers. Once identified the diverse but contingently combined determinations of those properties can be examined at a more concrete level...only then will we be able to establish the activation of the causal mechanism in question. In this way a precise definition of the object can be arrived at so that when a move is made back to the concrete one can gain a more accurate understanding of the object's interaction with a diverse range of elements...The more specific term that critical realists give to this method is 'retroduction'. According to critical realists, once a phenomenon is detected which requires us to identify and explain the mechanism responsible for its existence then it is necessary to build a model of the mechanism via the cognitive materials of knowledge about the phenomenon already gained. Information is collected about the mechanism which, if it was to exist, would account for the phenomenon in question" (Roberts 2006: 70)

Finally, these critical-realist insights may be situated within a mixed-methods research strategy by distinguishing between *extensive* and *intensive* methods; this important distinction does not preclude forms of investigation such as 'variable' oriented sociology (Ragin 1987) from complementing other forms. In short, although one may begin at the level of statistical regularity through quantitative method, this *extensive* method constitutes an inadequate abstraction insofar as it neglects deeper causal processes revealed by *intensive* methods; '...in order to think about these causal processes we must, first, abstract the causal powers and mechanisms of an object under investigation and think *conceptually* about how they operate. This methodological procedure involves an *intensive* research methodology, which 'is primarily concerned with what makes things happen in specific cases, or in more ethnographic form, what kind of universe of meaning exists in a particular situation' (Roberts 2006: 73-74). This potential excess of abstraction in variable-oriented approaches derives from what Ragin refers

to as a precedence of generality over complexity, which results from a desire to test general propositions, rather than to unravel '...the historical conditions that produce different historical outcomes' (1987: 54-55)[149]. Commensurate with a complexity-based approach, this contextualised methodology of extensive and intensive operation emphasises not abstracted relations between variable sets, but rather a more focused investigation of which context-specific combinations of variables may give rise to similar outcomes; '...in realist research...we are not looking to whether programmes 'work' as such, but whether which 'family of mechanisms' work best in which circumstances...Again, the key in understanding this realist method is to note that real social relations and their associative causal powers are the object for empirical enquiry, and not merely hypotheses or statistical regularities' (Roberts 2006: 74-75).

Finally, Roberts' important methodological contribution tempers critical realism's insistence upon conceptualising systems as open, by introducing the critical dimension of historical specificity or 'historical domain';

> "By insisting that mechanisms are mediated through qualitatively distinct social forms, themselves a refracted form of more abstract historical determinations, it follows that the social world is not in fact open in the manner suggested by critical realists. Certainly it is true to say that many objects that exist within capitalism are contingent to the extent that they are not strictly necessary for the reproduction of capitalism. But it is nevertheless the case that these objects develop and function within the limits of historical social relations. Thus a system like capitalism essentially constrains and defines how objects operate. Obviously this is not a straightforward functionalist and reductionist relationship, that is, objects can simply be reduced to the functional requirements of capitalism" (Roberts 2006: 97)

This important modification, by which the specifics of history impose constraints upon the manifest (empirical) structures and regularities which may emerge from generative mechanisms defined by concepts at other levels of the real, thus paves the way for speaking about causation in a non-reductionist and non-deterministic manner. This mode of analysis is commensurate with more concrete complexity-based approaches such as that of Byrne (1998) who has suggested that complexity must not revert to a simple search for, or expression of general laws

[149] Esser (1996) casts this difficulty in terms of an 'explanatory deficit' according to which quantitative models are incapable of contextual 'explanation' beyond the mechanistic boundaries of model fitting summaries. This is both a misrepresentation of the inherent limitations of quantitative modelling, and a case for mixed-method inquiry under a broader definition of explanation. Typical measures of explanatory power such as r-square, or pseudo r-square in multiple regression offer little inherent explanatory power (in any sociological sense of the term), and are merely de-contextualised measures which distil proportions of explained to unexplained variance into easily interpretable figures. There is nothing *a priori* or by default, limiting about this mode of operation; it is merely one of many investigative techniques to which *explanation* is accorded a narrow, mathematical definition. It is the responsibility of the analyst to broader this definition through mixed-method contextualisation.

of motion, but engage with causality in a concrete manner through the use of comparative method (2005: 96).

Consequently, Roberts' prior suggestion that analysts should not merely seek what 'works' but rather what 'family of mechanisms' work in certain circumstances, may be taken as indication of a need to work at a more concrete level than the abstract concepts Marxism alone implies. Indeed, the essence of a complexity-based critique of 'variable' sociology is precisely that differing configurations of variable values across sets of cases may engender similar outcomes; similar abstract determinants may give rise to manifold concrete variations in system identity. The methodological key here is in defining the nature of cases; the case, in the context of this thesis is the rundale system, which by Ragin's definition of 'case' may be interpreted as a particular configuration or combination of characteristics (Byrne 2005: 106). Thus the goal of an empirical, case-oriented comparative approach, contextualised through a Marxist/critical realist process of abstraction should seek to '...investigate the nature of this range of possible transformations and the configuration of factors responsible for the fact that, of all the possibilities, only this one is materialised (Elias 1970 cited in Byrne 2005: 106). Consequently, this is not a 'simplistic complexity' approach which invokes abstraction as an attempt to derive essential 'laws' governing the emergence of complex social forms (as with analytical Marxism's reduction to the economic), but rather a more modest attempt to move beyond such confines of nomothetic causation toward explanation.

By way of example as to how this empirical engagement may proceed, Castellani and Hafferty (2009) and Castellani et al (2011) suggest that, assuming ones' possession of suitable materials, data reduction techniques such as cluster analysis, and methods of a more qualitative orientation such as Qualitative Comparative Analysis (QCA) may be used to operationalise this 'reduction' of complexity across sets of cases in order to reveal distinct 'families of mechanisms' or system variants[150]. Harvey and Reed (2004) have also outlined a range of methodological procedures such as ideal-typical modelling which may be employed in order to represent systemic constitution and contingency. Such an orientation toward systems-as-cases is entirely consistent with pronouncements on the concept of identity as a tool for assessing systemic constitution and change outlined in chapter 3, whereby an assessment of change in complex social-ecological systems proceeds through the operationalisation of system identity. Combining these various informants and levels of engagement, a preliminary outline of how this methodology may be implemented is provided below in table 5.1.

[150] The specifics of these respective methods are dealt with in subsequent chapters as analyses are reported

Although this table is constructed with the specific subject matter, and empirical limitations of this thesis in mind, its utility as a general model for engagement with social-ecological complexity – subject to case and context-specific modification - is here argued. As may hopefully be gleaned from table 5.1, a diverse range of related concerns implicated variously throughout this thesis are addressed by this preliminary template; (1) outline of a model for movement between the abstract and the concrete, (2) methodological pluralism, (3) consideration of micro/macro-emergent systemic properties, (4) introduction of middle-range heuristics and non-reductionist approach to systemic structure, (5) assessment of quantitative variation and qualitative changes of state, (6) retention of modernist promise through a rejection of excessive relativism by assuming ontological pre-existence of structure, (7) ability to generalise and engage with historical contingency and causality, (8) recognition of emergent complexities and dialectical relations between the physical, social, biological and individual, (9) retention of agency (Dean et al 2006: 8).

Roberts (2006) has suggested that the three domains of critical realism's stratification of reality (real, actual, empirical) require modification through addition of the historical as a domain through which social forms, mechanisms, events and experience are refracted. The historical is not a distinct domain however, but is rather an intrinsic property of systemic complexity, and an essential domain permeating every stage of methodology, given that a complexity-based account must inherently remain local. As Byrne states; 'The trajectories of systems are the histories of cases' (2005: 105). 'History' should not therefore be compartmentalised (however 'dialectically' the domain of the historical it is depicted in relation to other domains of the real). Knowledge of systems must be grounded and localised; this is inherently a historical exercise.

In such a manner, this method depicted in table 5.1 of what might be termed 'grounded abstraction' permits a realist engagement with questions of causality (as mediated through specific historical contexts) without reducing *explanation* to the realm of the empirical as merely a reified manifestation of social forms, which are here depicted as emergent from mechanisms (defined within the parameters of modes of production) at the level of the real;

> "...it is plausible to adopt a 'multi-causal' theory of history in the sense that a number of complementary structures and different agents are seen to move history forward...it is possible to identify the abstract starting points of the economy, state, ideology and so on. Each one of these starting points contains its own causal powers which cannot be reduced to the other. It is only when we retroduce further levels of concrete determinations from each starting point that we can begin to grasp how they interact with one another" (Jones 1997 cited in Roberts 2006: 78)

Isolating a specific mechanism or category (i.e. between stages 1 and 2 of table 5.1) such as communal governance, or the labour process and subjecting it to further enrichment at advanced stages of methodological engagement thus proposes to reveal how '...a social context and mechanism are themselves contradictory' and that '...one or more contradictions in the outcome of a mechanism' should therefore be expected (Roberts 2006: 85), in a manner consistent with a Marxist method of investigation and exposition which prescribes the necessary conditions of movement between the abstract (real) and the concrete (actual-empirical). Thus, although the concept of labour may suffice at stage 1 to distinguish abstract variants of respective modes of production, informants such as that of metabolic rift and resilience may be implicated at later stages of methodology in order to explain manifest outcomes at the level of the actual-empirical. As this chapter has demonstrated, invoking such concepts as metabolic rift does not constitute an *a priori* subjective imposition; since metabolism is implicated as a generative mechanism across all modes of production (state 1 – real, abstract), metabolic rift constitutes a property of historically-specific social forms, whose tendencies are expressed through multiple levels of the social-ecological system as a complex whole, and whose emergence is grounded in contradictions revealed in the abstract. Employing other techniques and heuristics at stages 4 and 5 therefore allows for examination of the differential manifestations and consequences of this rift in various local contexts, through the use of a range of research methods and middle-range informants.

More concretely the question may be asked; how might Benton's charge that Marx's over-reaction to Malthusianism resulted in a retreat into excessive constructionism be reconciled with the evidence outlined in this chapter of his advanced ecological prescience, as revealed by the archaeological trawls of others through his pronouncements on metabolic rift? As Daly (1999a) revealed in his comments dismissing the significance of the laws of thermodynamics for short-term economic modelling, the question of 'limits' (ecological, natural or otherwise) is dependent on how one approaches the concept of system, and questions of scale. What is instead required for the assessment of such potential limits are elements of both constructivism (as historical context) and realism; the question of limits requires contextualisation and specification, and what may constitute *constraint* or *collapse* is both a local and trans-local question. In the context of this thesis, these properties are revealed at later methodological stages through the concept of resilience, which in terms of its regulation through the metabolic profiles of modes of production, may only be understood in the context of specific formations. This property is in turn mediated through local adaptive capacity. Thus, we may speak in terms of regularity and causality without recourse to reductive-nomothetic conceptions of law; 'Like

natural science...social science should look for the reproduction of ‘regular closed essences’ but do so in a way that explores connections between abstract historical determinations and their more ‘open’, concrete and contingent forms’ (Roberts 2006: 98).

To conclude this thesis, the following chapters present a modest attempt at implementing this methodology in the context of a specific form of agricultural system in nineteenth-century Ireland. The application and development of this methodology of progressive descent sketched in table 5.1 thus begins with a consideration of the parameters of the study system of this thesis as a distinct case.

Table 5.1. Preliminaries of a complexity-based approach to the study of social-ecological systems

Research Stage	Level of Real (Benton / Critical Realism)	Empirical Engagement	Methodological Informants / Heuristics	Research Methods
1. Abstraction to isolate internal or generative-causal properties / mechanisms	1 / Real	Limited	Abstraction, mode of production, labour process, metabolism	Theoretical construction
2. Grounded abstraction to explicate historically specific social form	2 / Real-Actual	Progressive	Systematic abstraction, categorical exposition, social form, ideal type	Progressive historical-empirical enrichment
3. Construction of ideal-typical concrete 'system identity'	2 / Actual	Significant	Ideal-type, identity, attractor, panarchy	Case-comparative, qualitative, archival
4. Analysis of macro-complexities of state space in which systems are located	3 / Actual-Empirical	Extensive	Regime, resilience, attractor, rift, panarchy (macro)	Case-comparative, quantitative, cluster analysis, qualified variable-oriented
5. Qualitative examination of system reproduction and trajectories	3 / Empirical	Intensive	Resilience, adaptive capacity, rift (micro)	Qualitative-archival

6

Rundale in Ireland: social form, historiographical complexity, and identity

Building on the conceptual foundations established in chapters four and five, the following begins to engage with materials specific to Ireland; preceding articulations of the concept of *mode of production* are here operationalised, in order to explicate the essential social form of Irish communality - or rundale in Ireland. Although this exercise entails a necessary degree of abstraction, a more formal application of historical method is here attempted, in order to provide a robust working construct with which to advance more substantive empirical and theoretical work in chapters six and seven. Before engaging with the initial stages of the methodology proposed in table 5.1, an attempt is first made to situate this template more specifically within current debates on comparative methodologies in the social sciences, beginning with an assessment of current theory and practice concerning case-based comparative methods, which here serves as an essential methodological link between the general epistemology established by complexity and critical realism, and the variety of Marxian and human-ecological informants developed throughout preceding chapters. The forthcoming chapter thus advances an articulation of the social form of Irish communality and its position as one of multiple organisational forms and panarchical levels with the broader socio-economic matrix of nineteenth-century Irish society, which has variously been conceptualised as feudal, and capitalistic. Having established such a critical basis, discussion move toward a number of influential informants typically brought to bear on the phenomenon of rundale by existing scholars, which have tended to reproduce varying degrees of restrictive determinisms, counter to the complexity-based approach developed within this thesis. To conclude, an ideal-typical model of the essential components of rundale identity is derived on the basis of foregoing discussions, in order to provide a working cocneptual framework for more formal applications of method across the concluding chapters.

6.1. The ‘case’ of Irish communality: a methodological note

To date, applications of systems and complexity theory and, to a greater extent human ecology, have tended toward a quantitative orientation. In conventional or ‘variable-oriented’ methodological terms (Ragin 1989, 2000), researchers are accustomed to thinking about cases as individuals or containment units whose attributes provide us with measurement data (Byrne

2009a). Working with ecological units in the quantitative tradition, aggregate summaries of individual data points are manipulated, and interpreted as offering insight into the properties and dynamics of designated collectives. Extending the general critique of linear modelling first outlined in chapter 1, this dominant 'frequentist' approach, and its concomitant methodologies pose a number of problems, due to their emphasis on '...value distributions of variables rather than on cases as combinations of values, patterns of relationships between value distributions that are covariational, linear and, for the most part, additive,' the net effect of which is an inability to detect, elaborate or demonstrate asymmetrical or causal relationships, or to 'handle causal complexity in complex systems' (Kent 2009: 187). Such a level of operation, according to Ragin, serves to 'disembody and obscure' cases by emphasising macro-level effects and relationships amongst variables, rather than '…studying how different features of causes fit together in individual cases' (1992a: 5).

Such an approach reflects a number of classical tenets of the Newtonian-reductionist programme, which views emergent properties as reducible to the properties of individuals, and *net* causal effects, in the absence of control or interaction, as essentially linear and additive across cases (Byrne 2002, 2009a; Morin 2005). Furthermore, in certain unqualified deployments, such a variable-oriented perspective on cases invokes implicit assumptions regarding the objectivity and validity of measurement operations as reflections of 'real' properties external to perception, reifying the complex dynamics underpinning the production of manifest attribute values. In short; variables, despite their explanatory power once appropriately contextualised and qualified as both object and construct – '...describe properties of cases but the real things are the cases, not the traces of them which we measure as variables' (Byrne 2002: 2). In terms of methodology, attention is therefore drawn to the nature of cases, the tenuousness (but ultimate necessity) of measurement and representation, and the limitations of established linear modelling, the implications of which force a revision of existing conceptions of 'cases', which serve not merely as units of reduction or containment, or the atomised subjects of measurement, but as entities embedded within complex systems (in the case of individuals), or as complex entities in themselves (in the case of aggregate or 'containment' units). Consequently, given the intuitively systemic nature of the research problematic of this thesis, its methodological framework must conceive of 'cases,' and their exploration, in terms of emergent systemic complexity and 'multiple conjunctural causation' (Ragin 1987: 98), rather than individualist reduction. Despite the quantitative allusions of this outline critique, this is a project which must employ multiple methods and sources owing to limitations in available data; fortunately, much work exists arguing this case-oriented approach as a pluralist methodological foundation for complexity-based inquiry.

Byrne (2002) elaborates a critique of 'variable' sociology, which he supplants with a critical realist conception of variables as traces of system attributes, with systems characterised by time-specific assemblages of parameter values located in n-dimensional state space (as discussed in chapter 1 regarding the concept of attractors). Of note is the particular way in which Byrne equates the concepts of 'system' and 'case,' such as they mutually inform questions of measurement and representation;

> "Given that we must avoid reifying 'variables' and abstracting from real systems / cases, then we have to measure the systems / cases...The dynamic systems which are our cases leave traces for us, which we can pick up. We can, as it were, track them, and we can infer from the traces what it was that left them. From the traces we can reconstruct a version of the real entities *and* of the relationships among those entities *and* of the emergent forms which are the product of and producers of the relationships among those entities. We can glimpse the entities and the systemic relationships among the entities...So what we measure are the systems / cases and we do so by measuring traces with a view to classifying and establishing the trajectories of all of the individual cases, ensembles and classificatory sets" (Byrne 2002: 35-36)

Bringing the concepts of *system* and *case* in dialogue in this manner, demonstrates a critical point of unity between epistemology and methodology, according to which the theoretical informants outlined throughout this thesis thus far, may be brought into dialogue with the conventions and requirements of comparative-historical investigation (more of which presently). This heterogeneous conceptual merging thus captures the diversity of meaning inherent in the concept of 'cases' which may be conceived as '...data categories, theoretical categories, historically specific categories, substantive categories, and so on' (Ragin 1992: 217). By initially conceiving of systems as cases or classes designated according to multiple parameters in n-dimensional state space (an approach eminently compatible with the concepts of identity, panarchy and regime of resilience ecology), the necessities and practicalities of investigation may be reconciled with a realist epistemology of complexity which points toward consideration of such cases / systems as amenable to measurement, comparison and generalisation, without succumbing to the reductionist trap of interpreting 'cases' as merely the atomistic bearers of aggregate measurement values (i.e. according to the classical 'variable' approach above, which has featured prominently in accounts of transitions between modes of production, more of which in section 6.3)[151]. Such a perspective in turn points toward the

[151] Byrne elaborates on the distinction between variable and parameter such as it relates both to the fallacy of reifying variables at the expense of emergence, and to conceptions of systems as complex assemblages in state space; 'I have very deliberately used the word 'parameter' rather than 'variable' as the name for the co-ordinate dimensions of state space. Here the term parameter means a measure of an aspect of the system as a means of describing the condition of that system and as a means for comparing it with other systems. But the system, not the parameter is the thing' (Byrne 2002: 33). In statistics texts,

adoption of an approach which emphasises the particulars and nuances of the cases or systems themselves, rather than emphasising relations and potential associations between abstracted variables.

This proposed approach is eminently compatible with the process of dialectical exposition outlined in chapter 4, which operates according to a multidimensional engagement with the abstract and concrete, with the exposition of system dynamics as its objective (an inherently case-oriented proposition). As per the table 5.1, application of *method*, in a conventional sense, relates to its deployment at the level of the actual-empirical, according to critical realist stratification. *Methodology*, as a broader concept, invokes considerations of the researchers' logical approach to investigation and exposition; the interpretation and explanation of manifest empirical tendencies is therefore, according to figure 5.1, augmented with informants gleaned through processes of abstraction at preceding stages[152]. Since it is through abstraction that the formulation of more rigorous theories of association and causality may be attempted, by identifying abstract determinants of system dynamics giving rise to mechanisms and institutions at more concrete systemic levels (thus avoiding empiricist reduction), it is essential that research data be marshalled through a set of methods, and logical framework of inquiry, which best approximates such complex systemic dynamics and constitution. It is here argued that such requirements may be met specifically by the *methods* of cluster analysis, qualitative comparative analysis, heavily qualified and restricted uses of linear modelling, ideal-typical modelling and conventional qualitative-archival methods as mandated by authors operating within the complexity tradition (Byrne and Ragin 2009). *Methodologically*, the question of 'casing' must be examined in a little more detail before commencing this task, in order to

a convention is often invoked in explanations of statistical inference, which distinguishes a *parameter*, as a population value, from *statistic* as its estimate based on sample data (Agresti and Finlay 2009). To avoid confusion, the term *parameter* is invoked throughout the remainder of this thesis according to Byrne's interpretation. Given that the chosen numerical data in chapters seven and eight are aggregate population data, inference, in terms of its conventional probabilistic usage as an estimator of sample error is irrelevant in the context of this thesis. It is curious to note however, that the usage of inference through the specification of alpha-levels in coefficient testing based on population data is relatively commonplace (Byrne 1998). The 'heuristic' inclusion of such figures in this thesis is qualified in subsequent sections as required.

[152] This does not imply that abstract explication is devoid of methodological consideration (quite the opposite); the manner in which the material within this thesis is presented, and indeed the chronological order in which this research was carried out suggests otherwise. Empirical work was conducted at the initial stages of research before delving into the theoretical informants outlined in chapters one through four; the explication of social form contained within this chapter, and the derivation of an ideal-typical identity model is therefore informed by this initial data collection. 'Application of method' here refers to the more formal processes of empirical enrichment reported in chapters seven and eight, although naturally, explication of social form must consider questions of the nature of the case of this research, its 'boundaries', and the epistemological problem of ideal-typical representation.

address the ontological question of the identity, and 'boundaries' of the system which constitutes the empirical focus of this work[153].

Both Byrne and Ragin employ complementary conceptual devices across their various pronouncements on methodology and case; Byrne's consistent use of the concept of state space as a means of conceptualising case diversity and systemic complexity (outlined above), is similar in many respects to Ragin's adoption of Paul Lazarsfeld's concept of property space (Ragin 2000). The principle dimension along which these respective concepts differ appears to be the formers' (state space) affinity with conventional data reduction techniques such as cluster analysis, which Ragin claims offer 'polythetic' classificatory schemes, antagonistic to the principles of configurational thinking mandated by comparative researchers (2000: 77). Such schemes, and the methods by which they are executed, according to Ragin, engender numerous difficulties due to the relative invisibility of clustering algorithms throughout the clustering procedure, and the inherent ambiguity of their output, which renders reliable validation of what are (ostensibly) inductive typologies, elusive[154]. Despite these variations, both concepts offer a useful means of thinking through formalities of case classification and comparison, by mandating an initial emphasis on the outlining of key dimensions or attributes according to which similar system variants may reside. The concept of state space has been afforded sufficient attention in chapter 1; elaborating Lazarsfeld's interpretation of property space, Ragin states;

> "Lazarsfeld argued that most "type concepts" involve sets of attributes that make sense together as a unitary construct, for example, Weber's (1978) specification of the ideal-typic bureaucracy. He noted further that too often social scientists use type concepts without analyzing them – that is, without examining their component attributes. He argued that it is important to identify the component attributes because they provide the

[153] Harvey offers a characterisation of this endeavour, depicting three interrelated levels which must be considered in order to satisfy the criteria of successful casing - those of *philosophical*, *scientific* and *social* ontologies; 'Philosophical ontology deduces from the structure of speculative thought the fundamental nature of the entities that constitute our everyday world. Scientific ontologies are nested within philosophical ontologies to the extent they flesh out the local details of a terrain in a way philosophical ontology cannot…social ontologies are nested within scientific ontologies in that they deal with the elemental entities and dynamics sociohistorical formations must exhibit if they are to sustain themselves over time' (2009: 15-16). Harvey thus affirms the practical necessity of dialogue between the abstract and concrete, in the demarcation of systems as ontologically stable and 'bounded' (i.e. cased) entities. These directions offers a more nuanced perspective on case boundary demarcation, which Kenneth Bailey, as indicative of a more formalist-structuralist tradition of systems theory, has mechanistically characterised as 'defining and operationalizing' the system (2008: 587).

[154] Certain aspects of this position will later be challenged; Ragin's comments reflect an interpretation of clustering algorithms applied in isolation from the methodological frameworks in which they are justified and contextualised. Clustering is an indespensible technique in complexity-oriented research by nature of its ability to address both the mechanics of data reduction, and configurational issues of typification which are inherently theory-driven (see Byrne 2009c and Uprichard 2009).

> basis for elaborating a full typology, based on the different logically possible combinations of attributes that make up a type concept. In this approach, the attributes of a type concept constitute a "property space" with as many dimensions as attributes. Each combination of attributes is a specific location in the property space. Each of these locations, in turn, may constitute a different type" (Ragin 2000: 78)

Retreating one logical step previous, the concept of property space here offers a potential means for overcoming a key epistemological difficulty observed across various chapters of this thesis; the question of demarcating a particular systems' boundary (typically an exercise with spatial referents in ecology)[155]. As this thesis has consistently argued, this is not an exercise usefully approached through a search for objective referents alone (i.e. empirical or static spatial-temporal), although the intuitive, spatially-bounded nature of such agrarian systems renders this an inevitable point of departure at later stages of empirical examination. Indeed, one of the foundational pronouncements on rundale in Ireland elaborated by Desmond McCourt, begins by rejecting the very possibility of such a degree of empiricism; '...to get a proper picture of the Irish open-field system, it is best not to think of a homogeneous population at a given time, but of one exhibiting manifold features of variation inside a framework of broad similarity' (McCourt 1947: 1). The rundale system thus defies such a narrow, spatially-oriented approach to its typification, owing to the presence of communal governance institutions, and myriad internal relations, as key loci of its identity.

Clearly, an alternative strategy is initially required as, although this configurational logic will later prove instrumental throughout more formal applications of method, a relatively stable, conceptual demarcation of the study system of this thesis is required as a point of departure. Ragin (1992b) has loosely characterised this somewhat more abstract endeavour as a process of 'casing,' and it will presently be argued that this may usefully be augmented by viewing the initial stages of methodology as the explication of an ideal-type, which in turn defines the parameters of state, or property space (or indeed, identity, as is addressed in section 6.5), as a primer for subsequent investigation. Consequently, it is this abstract 'framework of broad similarity' as alluded to above by McCourt, which constitutes the provisional basis and confines of the present case study, and this chapter subsequently addresses itself to this task, by engaging substantively with stages one to three of the methodological outline of table 5.1.

On the question of casing, Ragin offers a typology of 'cases', based upon their conceptualisation as either empirical units or theoretical constructs, and whether these in turn

[155] On the issue of 'what is a case,' Ragin writes; 'Comparative social science has a ready-made, conventionalized answer to this question: Boundaries around places and time periods define cases' (1992a: 5).

may be defined as general or specific (1992a). Describing a continuum between realist and nominalist interpretations of cases, contributors to Ragin and Becker's (1992) volume '*What is a Case?'* thus exhibit four distinct orientations to cases as either *found, objective, made,* or *conventional* (ibid: 9)[156]. This level of compartmentalisation is somewhat limiting for present purposes however. Outwardly, Wieviorka's (1992) conception of *cases as made* fits a number of outline requirements mandated by the mode of investigation established in preceding chapters; as a nominalist view of 'casing' as a form of theoretical construct imposed on cumulative empirical evidence throughout the research process, it describes a form of non-deterministic inductivism which, for current purposes, confronts prior applications of systems theory as a structural device imposed *a priori*. This alone is a problematic position however; as agrarian systems possess clear spatial referents which appear to point toward a realist imposition of case boundaries as manifest and *objective*. Furthermore, the possibility of delineating an abstract 'framework of broad similarity' is one which should not be ignored, offering as it does an essential starting point for the organisation of empirical data. Both Ragin (1992a) and Harvey (2009) emphasise this point, concluding that multiple interpretations and orientations toward cases may present throughout an individual piece of research. Harvey, drawing upon a transcendental realism inherent in his and Byrne's appropriation of complexity, goes further in his recommendations, claiming that this fourfold classification '...never directly addresses the social ontology of the case-object itself, i.e. the possibility that the case-object is, in and of itself, a complex entity with autonomous claims of its own. Instead, the act of casing and its case-object are both approached as if they were social constructions posited during the research act' (2009: 21).

Deferring to a complexity-derived conception of multilevel organisation reminds us that methodology must, of necessity, incorporate elements of both nominalist and realist extremes; there are components indespensible to a particular systems' identity such as cultural norms and institutions of governance which defy spatial referents, just as concrete 'expressions' of the components of modes of production as historically specific social forms are evidently spatial. Unfortunately, it is difficult to emphasise the necessity of this form of casing, or 'construct coalescence' *prior* to the forthcoming empirical exposition; as alluded to numerous times thus far, limitations of data, and the necessity of multi-site and source triangulation render such a degree of inductive casing essential. Chapter 5 has already implied that this form of casing might more usefully be defined as one of systematic categorical exposition, whereby initial categories and constructs are progressively, and recursively enriched and revisited at various

[156] See also Harvey's *mapping of sociological conceptions of cases,* derived from Ragin's (1992a) categorisation of case conceptions (Harvey 2009: 21, figure 1.1).

stages of investigation – the suggestion of concretising this as the explication of an ideal type, or state-space parameters may be made, albeit one which is foregrounded with an outline of the social form of Irish communality, as mandated by the concept of mode of production.

As both Becker and Ragin point out, a pervasive openness to the question of 'what is a case' is therefore required; 'What *it* is a *case of* will coalesce gradually, sometimes catalytically, and the final realization of the case's nature may be the most important part of the interaction between ideas and evidence' (Ragin 1992a: 5-6). The necessity of this openness is underscored by the very nature of complex systems as metabolic, dissipative entities, as outlined in chapter 1; 'Under propitious circumstances, complex systems can undergo irreversible *phase transitions*. Such sudden perturbations not only induce changes in the material and structural composition of the system itself but, on occasion, such changes actually entail the qualitative transformations of the evolutionary phase space itself' (Harvey 2009: 27). Throughout the lifespan of a particular system, not only may alterations occur in key system parameter values which engender a critical loss of systemic identity, but the parameters which constitute the phase / property space of the system may themselves be subject to evolutionary change as a product of '...the contradictory 'push and pull' of agency and social structure [which] form the sociological source of the case-objects proactive innovations' (ibid: 29).

Although this prospect of evolutionary change does not simplify the task of casing, chapters one and five have already elaborated a number of informants which offer practical direction, insofar as they delineate the essential evolutionary, metabolic nature of systems-as-cases. Elaborating on the concept of dissipative structures, Harvey's comments offer a most useful point of reference for such a grounded ontology;

> "Whether as organisms, symbiotically integrated ecologies, or sociocultural structures, dissipative systems are material embodiments of organizational complexity. Taken as systemic totalities, dissipative formations are concrete, spatio-temporal sites in which the dialectics of entropic decay and negentropic structuration constantly play off one another...Case-objects may be provisionally likened to ontologically complex entities that live off their material and social environments and thereby risk entropically degrading their relations with each. As dissipative entities, case-objects are 'unstable' in the sense that they are driven by boundary-testing engines that perpetually explore their evolutionary options. When the case-object evolves, this shift may be precipitated as much from within as from without" (Harvey 2009: 28-29)

Evident within the above comment is a necessary recognition of ontological complexity, which in turn bridges conceptions of cases along the divisive continua of nominal-real, and object-construct. Although somewhat allegorical - insofar as it addresses itself to the problem of

conceptual stability - it bears an intuitive transference and more literal interpretation in the context of agrarian systems. Crucially, it appears to point toward the necessity of resolving this conceptual impasse, by viewing such dissipative formations as 'concrete, spatio-temporal sites.' A provisional solution, therefore, is to move between the general and the particular, which is precisely what has already been explicated in chapter 4; by defining the nature of the abstract categories of modes of production, and suggesting a need to subsequently examine their manifestation as myriad concrete social formations. Such modes, as outlined in chapter 4, are fundamentally distinguished according to the manner in which labour is socially organized, and physical labour is executed (i.e. relations and forces of production). It must again be emphasised, that this does not constitute a reaffirmation of the nomothetic project, nor does it constitute the imposition of a preformed case construct, but is instead presented as a means to advance a case-based explication, by offering some preliminary, yet inherently malleable contextual heuristics.

In this sense, the concept of mode of production, as a concept operating at the level of the real, serves the function of congealing an abstract 'case boundary', according to which the obduracy of the social formations of substantive interest to this work may be established. In short, the cases of this study are free initially to progressively present and constitute themselves - as alluded by Byrne - as loosely bounded spatio-temporal sites, without resorting to an ANT form of naive inductivism without objective referents; '...we accept that the real in the form of generative mechanisms and the actual as the contingent consequence of those generative mechanisms have form before we shape that form as the empirical in our construction of knowledge from the materials of reality' (2009a: 9)[157]. This pervasive and continual process of casing – in so far as it is a process of progressive approximation which continues at all stages of methodology and presentation – may be presented according to table 6.1 below.

[157] To complete this criticism of ANT's shallow epistemology; 'Representations are made from something, not reified from nothing' (Byrne 2009a: 9)

Table 6.1. Progressive 'casing' of historical social-ecological systems			
Mode of representation	**Epistemological level**	**Ontological status**	**Case**
Ideal type / Identity / State-Property Space Parameters / Case-Object Construct	Mode of Production	Abstract [Real] ↓ Concrete [Empirical]	Primitive communism
	Social Formation		Rundale in Ireland
Conventions of Formal Method /Statistical Model / Truth Table / Presentation of Data	Macro-Systemic Context		High-density rundale regions
	Micro-Systemic Dynamics		Specific rundale settlements

As may be gleaned from the above diagram, this orientation toward casing maps particularly well onto the proposed methodological model outlined in table 5.1. The above should therefore be read as both a complementary clarification on the manner in which Ragin's proposed plethora of realist-nominalist orientations toward cases may be resolved (1992a: 9), and as an indicator of the empirical ordering of the remainder of this thesis. Beyond a simple question of boundary demarcation through casing, the orientation depicted in the above table captures the central utility of thinking through cases in such a manner, insofar as it clarifies an appropriate relation between theory and data. According to Ragin, the initial role of theory is to offer a starting point for empirical investigation, but it is not enough merely to theorise; 'ideas and evidence are mutually dependent; we transform evidence into results with the aid of ideas, and we make sense of theoretical ideas and elaborate them by linking them to empirical evidence. Cases figure prominently in both of these relationships' (Ragin 1992b: 218).

Consequently, 'casing' as an initial methodological step, is viewed by Ragin as offering '...operational closure to some problematic relationship between ideas and evidence, between theory and data' (ibid). The goal of this component of the research process is both to elucidate the ecological dynamics of the rundale system, and to explore the utility of the previously developed investigative model in doing so. This process of casing depicted in table 6.1 is an essential methodological component which, of necessity, seeks to '...limit the uniqueness and specificity of the empirical world...the continuous web of human social life must be sliced and diced in a way compatible with the goal of testing the generality of theoretical ideas, and comparable objects of research must be established so that boundaries can be placed around measurement operations' (ibid: 219). The various stages of casing depicted in column four of table 6.1 thus represent a form of progressive descent, corresponding to a continuum of

generality–specificity (abstract - concrete), whereby 'casing' is both a product of theoretical concern, and empirical referent. Cases thus develop and emerge from an initial interest in the *mode of production of primitive communism*, of which the *social formation of rundale in Ireland* presents as a subset, leading progressively toward the *micro-systemic dynamics of rundale settlements*, as specific subsets of preceding case categories. Each stage engenders its own progressive mode of casing, contingent on both theoretical and substantive requirements. The system is thus 'bounded' at each stage by a form of inductive operational closure, and cases are both *found* and *made* (Cillers 2001: 140)[158].

Finally, a note is required on the form of representation and modelling involved in this explication, which necessarily entails certain judgements on the part of the researcher concerning their modelling strategies, resulting in an inevitable degree of simplification. For projects of singular methodological orientation, certain referents and benchmarks abound according to convention, by which the analyst may assess the extent of information loss or explanatory power engendered by their mode of modelling or representation[159]. For the quantitative analyst, markers such as goodness of fit measures, and methods of graphing data point residuals, offer some objective means of quantifying the magnitude of information loss due to simplification (disregarding inherent epistemological problems with the 'disembodied variable'). Similarly, qualitative researchers may defer to referents such as 'saturation', or 'points of diminishing return', as indicators that certain thresholds of data volume have been reached. Regarding case based research strategies, Harvey has suggested that all procedures of 'casing' necessarily invoke a dialectical tension, conferred by the ontological autonomy of the

[158] Cillers refers to Maturana and Varela's concept of autopoiesis (discussed in chapter 1) as a means of depicting this operational closure as both ontologically prior to, and yet contingent upon, processes of autopoietic demarcation; 'For a system to maintain its identity, it must reproduce itself (internally)...The boundary of a complex system is not clearly defined once it has "emerged". Boundaries are simultaneously a function of the activity of the system itself, and a product of the strategy of description involved' (2001: 141). In essence, systems are constituted physically, as concrete entities by the specific manner in which matter-energy exchange proceeds, but must also be represented and reduced by the analyst.

[159] Such a distinction is invoked purely for illustration; no endorsement of a polarised 'methodological manifold' is implied. This division is itself merely a restrictive consequence of sociology's pervasive anti-ontological stance or 'natural attitude' which has congealed over disciplinary divisions, with antecedent roots in the separatist origins of the discipline – which as was observed in chapter 2, resulted not only in this methodological divide (Harvey 2009: 24), but also an innate hostility to the prospect of resolving the natural-social dichotomy. Ironically, such methodological divisions are often founded on both theoretically and empirically flawed bases; opponents of quantitative reasoning typically begin with either a diatribe against mathematical abstraction, or by constructing a straw positivist epistemology, which is subsequently mapped onto the totality of practice and reasoning associated with quantitative work. This caricature is reportedly concerned with advancing law-based propositions concerning the functioning of the social world, a model typically criticised for its inability to cope with subjective meaning and context. The irony resides in the fact that sociology's most prolific approximation of such a model of law-like generality (Parson's *The Social System*) was itself both entirely abstract, and practically devoid of empirical – let alone quantitative – content.

case-object, the result of which '...is such that *whenever a casing construct goes into its case-object, some aspect of the object is left over*' (Harvey 2009: 16, emphasis in original). More worrying still is Ciller's claim that; 'The underlying problem with models of complexity is, however, even more serious. No matter how we construct the model, it will be flawed, and what is more, we do not know in which way it is flawed' (2001: 137).

In essence, all forms of representation and modelling involve the use of ideal types. Although this concept is typically (loosely) understood in sociology with reference to Weber's ideal-typical model of bureaucracy, Harvey and Reed (2004) see fit to single out ideal typical modelling as a distinct representational strategy. Their comments are worth reproducing;

> "Scientists who employ ideal-typical modeling in their research are not interested in structural commonalities. Quite the contrary, they are interested in the singularities that create deviations from homogeneous patterns...Those engaged in ideal typical modelling also gather as many different empirical examples as possible. They also seek commonalities among the class of objects surveyed and, like the structuralists, construct from those commonalities a logically pure type that captures the essence of the class of entities under study" (Harvey and Reed 2004: 312-313)

Similarly, Wieviorka (1992) refers to the function of the ideal-type in case-based research as follows;

> "...a case may serve to signal the presence, in a historical experience, of a simple element or particular characteristic that the social scientist wants to bring to light and that constitutes an analytical category... From this same approach, a case may also...be selected for what it represents in an abstract or theoretical construction. For example, a concrete case may be the starting point for building a Weberian ideal type... The intent is either to interpret the case with a sociological tool (the analytical category hypothesized as present) or to use the case at hand to develop a tool for handling other cases as well" (Wieviorka 1992: 161)

Consequently, it appears logical for now, to couch the initial stages of the mode of investigation here attempted, in terms of an ideal type. As Harvey and Reed suggest above, an ideal type is initially formed from sets of observed structural commonalities which in turn capture the essence of the system in question. Others have referred to this process of approximation, or discovery of 'simple common elements' as similar to Mill's method of agreement, although unlike structuralist analysis, the goal is not to emphasise the abstract construct, but to employ it as a point of departure for subsequent investigation[160]. The ideal type elaborated in this chapter through the informants and procedures discussed above thus

[160] Comparisons with Mill are prevalent in discussions of QCA and configurational analysis.

provides such a ‘framework of similarity’ or more formally, parameters of state space, by which systems may be identified and located at subsequent stages of explication, as depicted in table 6.1. Ultimately, it is difficult to offer an objective benchmark of appropriate representation, and it therefore falls to the reader to conclude from the extent of bibliographical sources, and logical consistency of this approach, whether these discussions are sufficiently convincing.

Byrne (2002, 2009a) alludes to a further condition of validity however, in depicting complexity-based inquiry as essentially hermeneutical, or ‘...concerned with the establishment of a true representation, which must include an account of the causal processes in the context and actions being interpreted’ (2009a: 4). Discarding the excessively post-modernist ‘hermeneutics II,’ Byrne states that classical hermeneutics, as encapsulated in the preceding quotation, implies ‘...there is a social world to be known and accounts of that social world can be ranked in terms of the degree of accuracy of their representation of it’ (Byrne 2002: 3). This is not a position allied to a particular methodological hierarchy, but one which reaffirms our capacity to measure (although not necessarily to analyse, according to Byrne) a social world independent of human perception. This reaffirmation of ‘classical hermeneutics’ therefore implies that measurement, and the elucidation of cause need not be discarded, predicated on an excessively relativist notion of constructivism, and that a valid account must of necessity consider *causation*, *context* and *action* as related elements of valid representation. Addressing these related dimensions therefore offers some loose preliminary guidelines for achieving valid representation.

This task begins with an explication of the social form of Irish communality, developing from the abstract outline of the mode of production of *primitive communism* offered in chapter 4. As stated above, this chapter thus begins to congeal a relatively stable, but ultimately ideal-typical *case-object construct* around the system of interest to this thesis, drawing upon informants outlined and defended at various points throughout this thesis, as tabulated in tables 5.1 and 6.1. The essential goal here is to characterise rundale as a distinct social-ecological system, and to examine its essential ecological dynamics (i.e. its *distinct* modes of organisation and execution of productive-reproductive activity which are central to all human societies). Approaching the system in this case-oriented manner establishes a firm basis for subsequent comparative and evaluative work incorporating the informants and heuristics of resilience and metabolic rift.

The material in this chapter subsequently addresses a number of deficiencies in existing pronouncements on, and approaches to, the study of rundale in Ireland; within existing research at least, what '*it* is a case *of*' bears close alliances with disciplinary convention. Although it may appear illogical to begin by outlining the social form in this manner before discussing existing pronouncements, it is better to establish a working definition in this manner, in order to clarify the logic underpinning subsequent criticisms of over-determination levelled against certain authors in section 6.4. As ever, the key objective in doing so is to demonstrate the utility of the framework for social-ecological investigation developed in this work, beyond the empirical confines of this thesis, and this critique is here enacted in order to demonstrate the logical consistency of such a methodology, and its ability to identify and address various forms of reductionist reasoning. In doing so, a primer is thus established for more concrete discussions within chapters seven and eight.

6.2. The essential social form of communality in Ireland

A number of existing works - Slater (1988) and Slater and Flaherty (2009, 2010) – have previously sought to apply a mode of production approach to rundale in Ireland. These works have also established, through eliciting published comments and subsequent discussion[161], a degree of consensus on the social form of communality in Ireland, or more specifically, the essential elements of 'Irish communality' which constitute it as a stable entity[162]. Although numerous allusions to rundale as a complex social-ecological system have been made throughout this thesis, the dominant manner in which rundale has been approached – certainly within formative debates on the topic throughout the mid twentieth century – is by interpreting it primarily as a variant of nucleated settlement. In this manner, the social relations characteristic of rundale have often been conflated with its physical concomitants of infield-outfield cultivation and clustered habitation, which lend themselves more readily to systematic

[161] Benton 2009, Downes 2009, Mac Cárthaigh 2009, Mathur 2009, Ó' Muraíle 2009 – see sections 5.4 and (specifically) 5.5, for a discussion of these criteria.

[162] It is worth pointing out – lest the position of this research be misrepresented – that current debates on rundale beyond those cited above do not engage with the phenomenon in such Marxian terms. Although prominent Marxists such as James Connolly referred extensively to Celtic systems of communal ownership (Connolly 1944: 3), his deployment of the concept is quite different to the manner in which the tenets of historical materialism are here invoked in a more investigative manner (see Lloyd 2008 for a detailed discussion of Connolly's writings on Celtic communality). Although Peter Gibbon's contributions take a decidedly Marxist slant, he does not discuss the rundale system specifically, although some inclusion of his insights into class complexity and differentiation is offered further on (Gibbon 1973, 1975). In Irish academic discourse at least, such a Marxian approach to rundale in particular, remains marginal – more of which in section 6.4.

identification in both historical and cartographic record[163]. Although more detailed discussion is offered within section 6.4, it is important that this outline qualification be established; namely that existing debate has tended to partition – and to a certain extent, overemphasise - the physical characteristics of rundale over its social. Consequently, rundale in Ireland has frequently been tackled as a spatial oddity, requiring interpretation in the context of a landscape of other physical-geographical settlement forms and patterns exhibiting varying trends of continuity and change according to place and time (Johnston 2007).

Such concern with physical form has manifested in a variety of ways in existing research, with some addressing the problematic and uneven penetration of the estate system under successive waves of Irish plantation, and its role in shaping various forms of settlement and regional boundary demarcation. Therefore, although authors such as Jones-Hughes have argued that the imposition of the estate system in many regions resulted in an obliteration of previous settlement forms, others have argued that the plantation process was considerably more nuanced (Proudfoot 1993: 223). Citing the Ulster plantation of 1610, Proudfoot observes how Gaelic units of division such as the *ballybetagh* and *ballyboe* were retained in order to accommodate incoming planter groups, resulting in an adaptive rather than obliterative pattern of colonial settlement, which saw the coexistence of both pre and post-plantation settlement forms into the eighteenth century (1993: 222-223). Duffy further complicates this reading as one of a relation between secular entities, by observing how the ballybetaghs of late medieval Monaghan were subsequently amalgamated into ecclesiastical parish units, drawing attention to the multilayered nature of colonisation, and the role of numerous agents in its execution (2007: 55). Recent studies such as Clare (2004) have shown how, as a consequence of progressive colonisation, the legal concept of commonage solidified under the Anglo-Norman manorial system, with parallel modes of customary rights of access evident within early Irish law tracts. The subsequent enclosure movement, by which peasant commonage came progressively under private control, thus offers another layer to this complex pattern of physical change.

[163] Such clustered habitations are commonly referred to by the non-native term of 'clachán.' Unlike typical Irish villages, clacháns were usually comprised of lower-standard housing in haphazard layout, and lacking in functional entities such as churches and public houses (Evans 1967: 48; Whelan 1995: 23). Although the term 'clachán' is itself problematic as a non-native descriptor, its use within existing literature is well established; 'The unit of settlement and the social nucleus in Rundale society was the 'clachan', or cluster, of cottages, containing the related families of the joint farm' (McCourt 1955b: 49). The word 'rundale' itself was never in common use in Ireland, and was instead imposed from without by agricultural commentators (although it may be attributable to the Irish words *roinn* and *dáil*. Arthur Young remarked, on his tour through Mayo in 1776; 'Farms are generally let in partnership, but the term *Rundale* not known' (1892: 259).

In close dialogue with studies of colonisation processes, others have approached the question of Irish settlement in terms of its spatial form and distribution, emphasising the salience of specific typologies. Building on the seminal works of Seebohm and Meitzen, Estyn Evans (1939) was amongst the first to suggest, contrary to the former's emphasis on dispersed or *Einzelhof* patterns of settlement as a long-standing feature of Celtic society associated with pastoralism, that both nucleated *and* dispersed forms of settlement could be traced to the iron age, with evident continuities in the recent past (McCourt 1971: 127). Although Evans' hypothesis – and to a greater extent, his methodology – engendered receptions ranging from critical to hostile, his pronouncements established a paradigm-altering foundation from which subsequent debate on historical-geographical settlement forms would proceed within Irish academia. Rife with ideological and revisionist undertones, and partisan epistemological defences, subsequent debates concerning the presence and extent of nucleated settlements, and their concomitant modes of communally regulated infield-outfield cultivation, have not been a simple exercise of cumulative empirical approximation[164].

Despite the contested nature of these debates, a degree of consensus abounds concerning the essential *structural* features associated with the rundale system. Exhibiting continuity with previous conceptualisations of the openfield systems of Ireland, O' Sullivan and Downey (2008a, 2008b, and 2008c) have recently outlined a number of essential diagnostic criteria associated with post-medieval 'compact farm clusters,' which they suggest consist primarily of a *clachán*, as their characteristic pattern of physical settlement, with *rundale* as their associated farming system. Furthermore, ambiguities over the status of rundale as a relic of the distant past, and disagreements over the niceties of its longevity and extent, must inevitably contend with data attesting to its substantial prevalence across many regions of Ireland throughout the nineteenth century. Desmond McCabe (1991) has estimated that up to 58% of the total area of County Mayo was held in rundale in the 1840's. Data at lower levels of aggregation from the

[164] McCourt observes how H.L. Gray's 1915 work *English Field Systems* was largely overlooked due to his problematic use of the term 'Celtic' to denote West British infield-outfield systems (1971: 127). In one of many critical allusions to Evans' work, John Andrews remarked how; 'Many people in this country have felt themselves as exiles from an Irish garden of Eden... They long to find back there at the far end of the historical rainbow, a crock of twenty-four carat genuine Irish gold... The idea of a single Irish settlement type with its clacháns and rundale laid out as if it were for all eternity in some platonic heaven is a pervasive one' (Andrews 1977 cited in Johnston 2007: 13 - see also Doherty 2000). The field of Irish historical geography, no less than the discipline of political history, bears the imprint of revisionism in its output; in this sense, argument over an essentially 'Celtic' (indigenous) form of ancient settlement, found expression in a political climate where such exceptionalism offered profound justification for nationalist claims of native autonomy, contrasted with unionist claims of self-determination (Graham and Proudfoot 1993: 4-5). Proudfoot (1993) refers to a number of revisionist works, such as those of Malcomson and Vaughan, who have argued that absenteeism amongst the landlord class was less prevalent than previously surmised, and that rackrenting, tenurial insecurity and eviction were less prevalent than implied by previous authors.

Devon Commission[165] shows that for the Co. Mayo unions of Westport and Ballina in the year 1845, 83% and 68% of lands respectively were held in common or joint tenancy. Comparable rates are evident within many unions across Ireland, such as Dunfanaghy, 42% (Co. Donegal); Ennistimon, 53% (Co. Clare, and site of Arensberg and Kimball's fieldwork); Scariff, 71% (Co. Clare); Kenmare, 50% (Co. Kerry), and Skibbereen, 43% (Co. Cork)[166]. So resilient was rundale in particular regions into the late nineteenth century, that William Henry Smith saw fit to retain, in his 1882 update of Richard Griffith's instructions issued during the tenement valuation of 1853, specific direction on the enumeration of rundale holdings[167]. In short, despite

[165] *Devon Commission. Appendix to minutes of evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland.* Part IV. 1845 [672] [673] xxii, Appendix 94, pp. 280-282

[166] Calculated from figures contained in Appendix 94 (op. cit), tabulating 'Area of Union in Statute Acres', and 'Total Number of Acres held in Common or Joint Tenancy.' Figures at union level exhibit greater variation than those reported in previous studies such as Almquist (1977); when aggregated to County level, such variation is lost, owing to significant differences in the extent of *recorded* communal tenure within individual Counties. For example, despite 50% of the lands of the union of Kenmare, Co, Kerry being noted as held in common, the union of Caherciveen – also falling within Co. Kerry - shows none. McCabe (1991) has questioned the precision of these figures however, given that acreages of joint tenancy were reported to the Devon Commission by Poor Law Union clerks working from union rate books. McCabe's suggestion that joint tenancy was consistently under-enumerated appears to be borne out by comments from the Clerk of Caherciveen: '*Land in this union not being let by the acre, and there being no survey showing the acreable extent of each holding, the answers to the queries cannot be given…The holdings are stated to be held at bulk rents, not at acreable rents; under the circumstances, the particulars required have not been ascertainable from the Union officers*' (*Devon Commission…*, Part IV, appendix 94, p284). This is a curious comment in light of the union's recorded figure of 0 for acreage held in common, considering that the presence of 'bulk rents', which likely indicates collective payment by townland, points toward the presence of joint tenancy rather than holding in severalty – although this joint payment may itself have remained merely as a formality, concealing the gradual devolution of communes into individual holdings, owing to the length of the lease in question. McCabe confirms as much, by offering his estimate of 58% of the county of Mayo as held in common, working from tithe applotment and ordnance survey namebooks indicating townlands liable for rent in bulk (1991: 501-506). Although this figure matches Almquist's (1977) aggregation of union joint tenancy estimates for the County of Mayo sourced from the Devon Commission (also 58%), his methodology nonetheless reveals – encouragingly – that specific forms of joint tenancy may have survived into the nineteenth century, above levels previously surmised. Furthermore, it adds another layer of rigor to existing estimates of the extent of common tenancy in nineteenth century Ireland, such as McCourt's clachán distribution map compiled from first edition six-inch ordnance survey maps (1971: 138-139). Consequently, although no objective or systematic arithmetic criterion exists permitting adjustment of these figures (i.e. as with K.H. Connell's revisions of Petty's seventeenth-century population estimates), the consistent use of rate books in the production of these figures suggests a homogeneous level of error distributed across respective unions may be accepted, permitting systematic comparisons - albeit at a consistent level of deflation.

[167] *Copies of the instructions issued by the late Sir Richard Griffith in the year 1853…* 1882 [144]. Paragraphs 30 and 32 of the instructions to valuators and surveyors indicate that each occupier of a rundale settlement was to be enumerated separately. However, documents from Griffith's valuation of 1852 for the Barony of Aran indicate this was not always possible; the townland of Inisheer, comprising 84 individual occupiers, was here enumerated as a single joint unit comprising 1400 acres, under immediate lease from Peter and Henrietta Barfoot. Such difficulties lend further weight to the possibility of under-enumeration of rundale, owing to potential inconsistencies in the manner in which rundale settlements were recorded. Unfortunately, more precise investigation of the organisation of production at settlement level – an examination of rent rolls and leases – remains patchy, and as McCabe has indicated above, may not in itself indicate the presence of communal cultivation, merely a residual formality of payment by townland or in bulk. See Reilly (2003) for further notes and examples of rundale enumeration in Griffiths valuation (according to Reilly, Griffith's field staff held to the convention of bracketing joint tenants in their final returns – a practice Reilly accepts as indicative of rundale. Unfortunately, it is difficult to surmise from the forms alone whether a settlement reporting such joint occupation or bulk

considerable ambiguity over its origins, conceptualisation and developmental trajectory, sufficient evidence abounds permitting us to speak both of a concrete rundale system, and to treat it as a substantial component of the social and geographical history of Ireland.

Physical identification offers limited insight however. As discussed in chapter 4, Marx had sought to explicate within Grundrisse, the essential, albeit highly abstract dynamics of the mode of production of primitive communism within his broader historical-materialist apparatus of epochal change, according to which various antecedent modes of production yielded (in a non-linear and non-deterministic manner), to the pervasive imperatives of primitive accumulation and private property. Invoking the concept of a dualism of communality and individualism as a crude typological device, it was subsequently suggested that this device offered a means of locating various forms of agrarian commune along a continuum, ranging from an archaic mode of collectivism characterised by absence of nominal shareholding and collective appropriation of communal produce, to an individualised form based on private holding, and permanent boundary demarcation.

This abstract device alone does not provide a useful representation of the dynamics of the Irish commune however, as ultimately, the evolution, and eventual dissolution of communal property in specific historical instances is not determined merely by a community's haphazard location along such a continuum. Nor is the formal dissolution of specific modes of production determined, as will be argued in section 6.3, by the mere monetarisation of tribute, or introduction of money as a medium of exchange, as others adhering to the prominent commercialisation model have repeatedly emphasised (Wood 2002). Although the presence of a cash nexus may imply an encroachment of commodity form into the production process, this does not necessarily imply capitalisation, or the real subsumption of pre-capitalist forms[168]; the

payment was likely to exhibit classical 'diagnostic criteria' of rundale (see section 5.5 of this thesis), such as communal regulation by council, or periodic redistribution).

[168] Quite the opposite, according Slater (1988); the presence of peripheral (individualised) commodity production within the rundale system imbued it with a flexibility and resilience to market competition. In light of the inherent tendencies of rundale toward increasing fragmentation through subdivision; commodity production (spinning, weaving, eggs, and illicit distillation) acted as a hedge against this potential depreciation of the means of production, by offering a viable alternative source of income and subsistence. The extent of this peripheral commodity production belies the popular myth that such lower-class settlements were characterised by subsistence alone – they were in fact, by the mid-nineteenth century, substantially integrated into the global economy. On this point, Gray notes over 50% of all occupied women in Donegal, Galway and Mayo were spinners, according to the census of 1841 (2005: 52). Substantial growth in agricultural exports throughout the Napoleonic wars reveals the extent of market responsiveness prevailing at this time, as local producers responded to soaring grain prices with a rapid surge in tillage output. The scale of this increase in demand is revealed by Solar's agricultural price index, which shows a growth in cereal price of 92% between 1780-1784, and 1810-1814 (O' Grada 1994: 28). By the end of the wars, the share of grain crops in total exports had risen from one-tenth in 1780, to one-quarter (ibid). Although a strict subsistence model cannot readily be applied to many such

concept of *mode of production* is more complex, and requires that examining both the manner in which production is organised, and the conditions under which surplus product is distributed and appropriated, not merely the reified receptacle (money) in which exchange value manifests. Slater and Flaherty (2010) have therefore suggested that looking not only to the internal dynamics of the commune itself, but also beyond. In conducting such an examination, the concepts of property and ownership feature prominently;

> "…it seems that the crucial determining factor of change within the agrarian commune does not reside within the dualisms identified, nor is it the emergence of exchange-value, as this merely 'undermines', 'dissolves', 'erodes' etc.; neither of them 'causes' the balance within the dualism to swing one way or the other. However, since the transition involves a property relationship, which in turn is about changing the usufruct of a spatial entity within the communal lands (Marx stated that it 'leads first to the conversion of the arable into private property'), it must be determined by changes in the customary rights of land-holding through the social mechanism of the communal council or the intervention of an external power to enclose the communal lands (the state or a landlord), or both" (Slater and Flaherty 2010: 8)

Consequently, in order to understand more clearly the ecological dynamics of the Irish agrarian commune as a unique form of social-ecological metabolism, its social form must first be explicated, by examining the specific nature of communal ownership such as it prevailed in the Irish context. This discussion requires examining the nature of such rights and modes of collective landholding under the provisions of Brehon law, and later conditions of partnership leaseholding[169], given that such an avenue of empirical inquiry represents both a category of significant utility and relevance to the identity of rundale, and one most amenable to historical examination, by virtue of available source materials. Ultimately, an understanding of the reproductive dynamics of rundale, as an articulated combination of relations and forces of production, and distinct mode of surplus appropriation, requires that examination of the conditions under which access to the means of production itself is organised; explicating the

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settlements, the conditions under which the surplus of the tenantry was appropriated often left little more than was needed to meet basic requirements; 'The system demanded, through its very structure, that Irish tenant farmers could expect little return on their labour beyond mere subsistence' (Ryder and Orser 2006: 28-29).

[169] This sensitivity to multiple communal forms is essential, as Anderson (1995) has suggested that earlier forms of kinship grouping (perhaps more readily identifiable as potential survivals of kin-based communal tenure) and more recent forms of collective leaseholding, both gave rise to the physical manifestations recognisable as rundale. Currie (1986) has emphasised this point by outlining a number of later, 'functional' circumstances through which rundale emerged in Co. Derry: '… (iii) the need for co-operation in clearing, enclosing and draining land which would have been beyond the technical and financial capacity of the individual tenant, despite the fact that contemporary leases lay the responsibility for such work on the lessee and not the landlord; (iv) the abundance of marginal land especially mountain, bog, and natural meadow which was 'conducive to exploitation by the communal methods of rundale' (Currie 1986: 100).

specific forms of property relation prevailing within the mode of production itself, is therefore an essential starting point;

> "Property – and this applies to its Asiatic, Slavonic, Ancient Classical and Germanic forms – therefore originally signifies a relation of the working (producing) subject (or a subject reproducing himself) to the conditions of his production or reproduction as his own. Hence, according to the conditions of production, property will take different forms. The object of production itself is to reproduce the producer in and together with these objective conditions of his existence. This behaviour as a proprietor – which is not the result but the precondition of labour, i.e. of production – assumes a specific existence of the individual as part of a tribal or communal entity (whose property he is himself up to a certain point)…" (Marx 1964: 95)

As suggested in the preceding passage, productive activity is necessarily conducted under particular conditions of access to the means of production; the form, in which such legal conditions of access manifest must however, be understood in economic context. According to the above quotation, Marx is cautioning against conceptions of law which reify such legal provisions as ahistorical manifestations of abstract logic; property must be understood dialectically within its socio-economic context, as an essential component of an articulated mode of production, in which the physical reproduction of labourer and community simultaneously involves the reproduction of the conditions of their work (Slater and Flaherty 2010: 9). The concept of mode of production therefore describes a 'double relationship', in which '…the individual is a member of the community, and in which this social relationship mediates his relationship to the land' (Sayer 1987 cited in Slater and Flaherty 2010: 10). Employing such an approach, which seeks to contextualise property in this manner, thus edges discussion closer to historical specificity, and permits the examination of empirical instances of rundale as differing concrete manifestations of the mode of production of primitive communism. This exercise begins by assessing a number of exhibits which suggest that Marx and Engels were indeed aware of the significance of Irish social structure and landholding both in their political works, and particularly in their later ethnological writings.

6.2.1. Marx and Engels on Ireland and the Irish agrarian commune

Marx, and to a lesser extent Engels' various pronouncements on Ireland are typically couched in terms of their implications for revolutionary praxis. According to John Rodden (2008), their interest in Ireland was shaped not only by their personal connections[170], but by their view of

[170] On first arriving to Manchester, Engels met an Irish girl named Mary Burns in the mills of Ermen and Engels, with whom he subsequently resided in a cottage on the outskirts of Manchester (Engels later visited Ireland for the first time in 1856, and enjoyed a close relationship with Mary until her untimely

Ireland as a catalyst for socialist revolution in Industrial Britain vis-à-vis the Irish agricultural proletariat, a reading borne out by numerous citations attesting to their concern with the place of the Irish peasantry relative to other international labour movements (Anderson 2010: 122). Such views were augmented early in Marx and Engels' intellectual careers by declarations of the Chartist movement in 1842 calling for repeal of the act of union - a movement itself buoyed, according to Engels, by the support of 'two million brave and ardent Irish' (Engels 1848 cited in Hazelkorn 1981a: 1). In an article published after the abating of Chartism, in the July 11th 1853 edition of the New York Tribune, titled *Irish Tenant Right*, Marx criticised numerous inequities in the conditions of the Irish tenantry under British landlordism, such as a lack of remuneration in the form of rent reduction for capital outlay, concentration and monopolization of land tracts, tenurial insecurity in the form of tenancies-at-will, and the role of the colonial legislature in the suppression of industry[171] (Marx 2007 [1853]: 123-129).

Such criticisms of landlordism appear warranted, albeit with qualification, as O' Grada (1994: 29) cites research suggesting that, contrary to the traditional stereotype, landlords in many instances acted as improvers and efficiency maximisers (such was the case in the classical account of Lord George Hill of Gweedore, Co. Donegal, whose memoirs provide a critical source of insight into rundale in the north-west - Evans 1971). Nonetheless, indebtedness was rife amongst many estates prior to the passing of the Encumbered Estates Act in 1849, and reports of extravagance and absenteeism, as well as considerable cruelty abound within travel accounts and commentaries of the time. In contrast to the progressive redistribution and productivity-incentivising schemes of Hill, Rev. Nixon of North West Donegal is remembered as one who regularly '…dispensed large and unadulterated doses of tyranny on an unsuspecting people' (Mac Aoidh 1990: 45). Upon assuming title to the Copeland estate in 1844, Nixon promptly annexed extensive tracts of mountain land in order to graze a prolific breed of sheep, disrupting long-held grazing rights of the tenantry who were accustomed to boolying their livestock on the mountain commonage, as an essential component of their seasonal rotation. Similarly, in response to favourable market pricing in the post-famine years,

death in 1863). Marx's daughters Jenny, Eleanor and Laura, who were friendly with Burns and her sister Lizzie, later became adamant supporters of Fenianism (Rodden 2008).

[171] In response to the fears of British industrialists concerning the effect of cheap Irish imports on domestic price, early efforts at suppression included a bill which came before Irish parliament in 1697 proposing to exclude Irish woollen products from foreign trade. In 1698, a less punitive act was passed (the Woollen Act of 1699), imposing a duty on Irish woollen exports, which remained in place until its repeal in 1739 (Cullen 2009a: 131). In 1709, an ultimately unsuccessful proposal was debated concerning the barring of Catholics from engaging in trade, by preventing existing merchants from taking apprentices, or from moving amongst towns. While not fully barred, Catholics were denied full merchant guild membership, although in practice their status as 'quarter-brothers' offered little restrictions on trade (Simms 2009: 20).

Lord Leitrim retained for his personal use 1130 acres of mountain commonage for sheep grazing, subsequently raising rents on his tenants' arable plots (Mac Cnáimhsí 1970: 188). Further south, mass evictions were carried out on the lands of John Walsh in the Mullet of Mayo in December of 1847, actions subsequently reported upon by Belmullet Poor Law inspector Richard Hamilton; '…I visited the village a month ago, and found the greatest destitution existing in it; but on going there again the day before, I was not a little astonished to find nothing but the walls of the houses remaining, the inhabitants being scattered through the country seeking shelter where they could best find it' (Yager 1996: 30).

In either case, the 'rational strategy' (from an economic perspective of surplus maximization) was not, as O' Grada claims to '…eschew short-term predatory behaviour, while ready to evict the lazy and incompetent tenant' (Ó' Grada 1994: 29), but rather to maintain a critical mass of direct producers yielding an increasing absolute surplus in the form of additional rent payments (Slater and McDonough 2005). The prevalence of such a regime is borne out by figures on the extent of fragmentation in the pre-famine years; according to the census of 1841, 45% of all enumerated holdings of this period fell below five acres (Connell 1950b: 284)[172]. In parts of Leinster and Munster throughout the eighteenth century, farm consolidations and enclosures for the creation of grazing tracts, as on the Nixon estates of Donegal, led to the elimination of subdivision in many districts. Fragmentation continued largely unabated in Western regions however, owing in part to the presence of middlemen, whose chief concern was not with reform or rationalization of holdings, but with maximizing absolute rent returns. Following the

[172] The famine years of 1845-1852 presented an ideal opportunity for many landlords to clear such densely populated estates, a process conducive to the elimination of rundale. Following the Ballykilcline (Co. Roscommon) rent strike of 1834-1847, the visitation of blight in 1848 made it impossible for the tenants to meet their arrears; eviction and levelling soon followed, resulting in near depopulation of the townland (Ryder and Order 2006). Backed by legal precedent, such landlords, in the absence of payment in arrears or refusal on the part of the tenantry, could either distrain or seize a tenants property, or evict – in which case, local sheriffs often employed the services of 'crowbar brigades' who would remove the roof of the offending cabin (Orser 2006b: 179-180). Estimates of the extent of famine-era evictions stand at between 200,000 and 250,000 individuals (Orser 2006b: 180) and, according to Vaughan, 'Around 37,286 evictions may have occurred between 1846 and 1849 alone, with somewhere around 16,400 houses being levelled' (ibid). Indicative of the extent of this fragmentation, and its continuity beyond the famine years, an 1890 bill for the provision of funding for land purchase under the auspices of the Congested Districts Board (CDB) and the Land Commission, requested 'one million five hundred thousand pounds,' for the amalgamation, relocation, or assisted emigration of occupants in regions considered subject to excessive population density (*A bill to provide further funds for the purchase of land in Ireland, and to make permanent the land commission; and to provide for the improvement of the congested districts in Ireland.* 1890-91 [111], pp. 11-12). The first annual report of the CDB lists counties Donegal, Leitrim, Sligo, Roscommon, Mayo, Galway, Kerry and Cork as meeting the congestion criteria of regions where '…more than twenty per cent of the population of a County…live in Electoral Divisions of which the total rateable value, when divided by the number of the population, gives a sum of less than one pound ten shillings for each individual…' (*First annual report of the Congested Districts Board for Ireland.* 1893-94 [C.6908], pp. 3-4). Furthermore, the work of Cousins has also demonstrated that '…the kind of society which the Famine had supposedly destroyed was largely intact in the west of Ireland in the late nineteenth century' (1964, cited in Goldstrom 1981: 157).

introduction of poor laws in 1837, landowners subsequently became financially liable for the welfare of their pauper tenantry, thus offering an incentive for redistribution, although such measures were not uniform throughout the country (Buchanan 1970: 153). Indeed for Co. Mayo, not only did subdivision remain entrenched for many decades after the famine years, the total county area under cultivation continued to expand, and population later began to increase according to the census of 1871 (Gibbon 1975: 137).

In light of prevailing conditions of the time, it is therefore unsurprising that Marx and Engels took such an interest in the potential of a class-conscious Irish proletariat to strike at the 'soft underbelly' of capitalist England. Furthermore, Marx repeatedly endorsed Fenianism as a grassroots proletarian movement, and in his condemnation of the Clerkenwell bombing on December 13, 1867, he expressed dismay at the effect this incident would have on the possibility of developing dialogue between the working classes of Britain and Ireland; 'The latest Fenian exploit in Clerkenwell is a great folly. The London masses, which have shown much sympathy for Ireland, will be enraged by it and driven into the arms of the government party. One cannot expect the London proletarians to let themselves be blown up for the benefit of Fenian emissaries' (MECW 42: 501 cited in Anderson 2010: 130). Ireland, for Marx and Engels, thus represented a critical proving ground in the translation of revolutionary theory into practice.

Although this current of thought looms large within Marx of the 'early and middle period', the later writings of Marx, and more substantively, Engels, demonstrate an alternative strand of concern with Irish society[173]. So discrete was this temporal break with Marx's previous endeavours that Donald Kelley remarks how these latter works suggest '…that the very old Marx seems to have been in transit from *Capital* to a possibly even grander project' (Norman Smith 2007: 74). In essence, Marx's later writings were concerned primarily with questions of ethnology and anthropological theory, specifically the status of primitive communism and clan based forms of social organisation as further empirical corroborations of his epochal model of societal development as discussed in chapter 4. In context of the broader apparatus of historical materialism, Marx and Engels thus found, in the ethnological works of Lewis Morgan and

[173] Hazelkorn's bibliography of the writings of Marx and Engels lists over two hundred excerpts, comments and pieces of personal correspondence referencing Ireland, which predominantly address political topics (1981a). An edited volume of their major pronouncements was previously published in 1978 under the title *Ireland and the Irish Question* (Marx and Engels 1978). Conway accords Marx's various comments - as the only of any classical social theorists to address Ireland - a particular significance in accounting for the prominence of Marxism in Irish sociological discourse throughout the 1970's (2006: 10-11).

Henry Sumner Maine[174], a corroboration of their view that clan-based organisation had constituted the essential basis of a significant proportion of antecedent forms of human society (Shaw 1984: 215)[175]. In the latter years of his life, Marx filled fifty notebooks with excerpts from his ethnological readings (Norman Smith 2007), a series of notes which included a ninety-six page commentary on Lewis Henry Morgan's *Ancient Society* which would later form the basis of Engels' influential *The Origin of the Family, Private Property and the State*[176]. Accordingly, this renewed emphasis on what E.P. Thompson referred to as 'the projects of his Paris youth,' served to reorient Marx's thinking substantially;

> "It was only after reading Morgan that anthropology, previously peripheral to Marx's thought, became its vital center. His entire conception of historical development, and particularly of pre-capitalist societies, now gained immeasurably in depth and precision. Above all, his introduction to the Iroquois and other tribal societies sharpened his sense of the living *presence* of indigenous people in his world, and of their possible role in future revolutions" (Rosemont 2009: 16)

Although Morgan's interpretations tended toward excessive linearism – and indeed, wrought an enduring legacy of ethnocentrism and modernism in social thought - both his and Marx's ideal-typical models of pre-capitalist modes of production allude to the possibility of disjointed transitions between modes, and in many instances, coexistence;

> "Accordingly, he [Morgan] allows that different tribes may exist in variegated conditions at the same time, that any given society may be the consequence of various alien, exogenous influences, and that social forms may appear exceptionally at a stage of society to which – within limits – they do not correspond, either as remnants of an old period or as germs of the new…Marx's theory of history, too, draws a similar distinction

[174] Marx did not uncritically accept their propositions of determinate succession, particularly in the case of Maine whom he referred to in his notes as 'blockhead Maine.' The source of his ire is revealed by Marx's remarks on Maine's uncritical acceptance of the inevitability of the state; '…the apparent supreme independence of the state is itself merely show, and in all forms it is an excrescence of society. Hence it disappears again as soon as the society has reached a stage not yet reached' (MacFarlane 2002: 7).

[175] Morgan suggested that '…the elementary unit of social structure in every part of the world, throughout most of history, has been the clan or gens' (Norman Smith 2007: 73). Just as Darwin's discovery of the laws of natural selection drew their admiration, so too did Morgan's evolutionism, which held that all societies necessarily progressed through successive developmental stages; 'Since mankind were one in origin, their career has been essentially one, running in different but uniform channels upon all continents, and very similarly in all the tribes and nations of mankind down to the same status of advancement…All the facts of human knowledge and experience tend to show that the human race, as a whole, have steadily progressed from a lower to a higher condition' (Morgan 1877 cited in Shaw 1984: 217). Although more nuanced than Morgan's' insistence upon unilinearism, Marx nonetheless held to a similar interpretation; 'The archaic or primary formations of our earth consist themselves of a series of layers of different age, superimposed upon one another. Similarly, the archaic structures of society reveal a series of different social types corresponding to progressive epochs' (Marx 1952 cited in Shaw 1984: 217).

[176] Engels purportedly authored this work as 'the fulfilment of a bequest' following Marx's death, although he later acknowledged his product was 'but a meager substitute' (Rosemont 2009: 5). Rosemont suggests that Engels publication reflects largely his own, rather than Marx's reading.

> between theoretical models and historically specific societies. The stages identified by historical materialism are basically idealizations or theoretical abstractions from actually functioning social formations. Thus, a specific society for Marx may comprise several distinct modes of production" (Shaw 1984: 219).

In light of previous discussions of Marx on pre-capitalist modes of production and social change in chapter 4, it is unsurprising that he should take so adamantly to a body of work which served both to corroborate and enrich – if only implicitly - so critical a proof of the scientific promise of socialism. Such recognition of evolutionary complexity, as is evident within the preceding quotation, is doubtless critical to the Irish case also; as this discussion has begun to outline, the history of Irish settlement, and the organisation of productive activity, is not one which readily fits a pre-ordained model of linear succession. On this point, Engels clearly saw traces of residual 'gentile mentality' in the peoples he encountered during his travels in Ireland;

> "During a few days spent in Ireland, I realized afresh to what an extent the country people still live in the conceptions of the gentile period. The landed proprietor, whose tenant the peasant is, is still regarded by the latter as a kind of chief of the clan whose duty it is to manage the land in the interests of all, while the peasant pays tribute in the form of rent, but has a claim upon him for assistance in times of necessity…One can understand the complaints of the political economists and jurists about the impossibility of making the Irish peasant grasp the idea of modern bourgeois property; the Irishman simply cannot get it into his head that there can be property with rights but no duties" (Engels 1978 [1884]: 160-161).

Engels further remarked on how this mindset, explicable as a form of residual communality manifesting as an aversion to notions of private property, could be traced to 'the oldest Celtic laws,' which he interprets as residing '…at least instinctively, in the consciousness of the people, after the English forcibly broke it up' (Engels 1978 [1884]: 156). Although Engels initially sought to locate communality at the level of peasant mentality, it is clear that both he and Marx took a more substantive interest in the presence of communal institutions amongst the Irish of their time. Marx had already encountered the Irish rundale during his readings of Henry Sumner Maine's *Lectures on the Early History of Institutions* (Marx 1973), and comments in the *Ethnological Notebooks* suggest he '…seems to be reinterpreting Maine's description of the rundale by challenging his use of the legal term of severalty to explain the relationship of the communal members to their arable land. Marx, in *Grundrisse*, described this as a form of individual possession…rather than private property, which the legal term of severalty would suggest (Slater and Flaherty 2010: 10)[177].

[177] According to MacFarlane, Maine initially conceived of communal ownership as a baseline state from which all societies had evolved, which in its most stable form, constituted a system of 'temporary rights

On this distinction, and with reference to Indian village communes, Maine had previously suggested that communal property itself constituted a category apart from formal-legal conceptions of ownership, a category to which such communities could not relate; '…there was no concept similar to the modern Western one of inalienable human rights in the traditional village community. 'Nor in the sense of the analystical jurists, is there **right** or **duty** in an Indian village-community; a person aggrieved complains not of an individual wrong, but of the disturbance of the order of the entire little society' (MacFarlane 2002: 11, emphasis in original). Thus it is here observed how reproduction of the conditions of production is dialectically bound with the reproduction of its social and legal conditions of organisation and access, as in the preceding passage Maine suggests that notions of possession, rather than proprietorship, are reinforced by a form of negative feedback, insofar as transgression inevitably punishes the collective, rather than the individual[178].

Maurice Godelier, commenting on a series of letters in which Marx castigated Georg Maurer for ignoring the ancient Celts in his remarks on the universality of communality, suggests that Marx was, at the time of writing these notes, intrigued by the '...vitality of the primitive communes and their multiple capacities of evolution' (Godelier 1970 cited in Anderson 2010: 139)[179]. Furthermore, Engels' extensive commentary on the work of Morgan - itself an

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of usufruct, impermanent shares in a common resource' which was characteristic not only of Asiatic societies, but of Scotland and Ireland into the seventeenth century (2002: 18). Maine was clearly aware that such a system, based on share allocation by collective lottery which he identified as rundale, had existed in Ireland throughout this time (ibid). The various states of devolution in which communal property obtained across various societies was accounted for by Maine by the uneven development of feudalism, which itself was premised on growth of the political power of lords over their demesnes, and other factors such as the practice of written wills and transmission of 'land by book' to religious bodies (ibid: 19). Under feudalism, rights of ownership and conveyance based on formal contract developed from rights of access based on inherited status or membership, according to which land came to be viewed as a commodity to be disposed of privately. Maine states, in his *Early History of Institutions*; 'The origins of private property thus arose from the ever increasing authority of the chief, first over his domain and booked land, and secondarily over the tribes lands…The chiefs or kings then granted benefices, or permanent, indivisible blocks of land to others' (Maine cited in MacFarlane 2002: 22). Rosemont concurs with Marx's reading of communal organisation as germane to such differentiation, stating; 'In this area as elsewhere, Marx discerned germs of social stratification within the gentile organization, again in terms of the separation of "public" and "private" spheres, which he saw in turn as the reflection of the gradual emergence of a propertied and privileged tribal caste' (2009: 8).

[178] As will be outlined in the following section, such sanctions were also evident in the Irish Brehon legal code.

[179] Anderson (2010: 139) claims there is no evidence to suggest that Marx viewed Irish communal forms as persisting into his own century within Ireland - although this does not diminish the theoretical importance of his comments. Anderson cites other incidental notes from Marx on ancient Irish law concerned with gender equality, egalitarianism and divorce, but does not mention any dealing substantively with questions of contemporary communal ownership or social organisation.

amalgamation and continuation of notes previously taken by Marx (Norman Smith 2007: 73) - contains the most concrete (albeit brief) discussion of rundale in Ireland;

> "Even today we find some village fields held in so-called rundales, which were very numerous 40 or 50 years ago. The peasants of a rundale, now individual tenants on the soil that had been the common property of the gens till it was seized by the English conquerors, pay rent for their respective pieces of land but put all their shares in arable and meadowland together, which they then divide according to position and quality into parcels or *Gewanne*, as they are called on the Moselle, each receiving a share in each *Gewanne*; moorland and pastureland are used in common. Only 50 years ago new divisions were still made from time to time, sometimes annually. The field-map of such a rundale village looks exactly like that of a German *Gehoferschaft* [peasant community] on the Moselle or in the Hochwald… In some districts, by the way, the members of the gens still live pretty much together on the old territory; in the thirties, the great majority of the inhabitants of the County Monaghan still had only four family names, that is they were descended from four gentes or clans" (Engels 1978 [1884]: 159-160).

Previously, Engels had suggested that this Germanic form constituted the basis of medieval European feudalism, a communal form which was historically prevalent not only within Germany, but in the north of France, England, and Scandinavia (Engels 1882 [1989]: 441). What is evident from the preceding quotation is not only a profound understanding of the complexities of the Irish form, but that it may be located within a broader category of historical materialism; the Irish rundale is here clearly identified as a concrete social form of the mode of production of primitive communism. Engels' comments thus underscore the utility of a mode of production approach in its ability to cope with complexity; although Irish lands fell gradually under British control through plantation, Engels suggests above that in many cases, underlying social structures of communality remained stubbornly resilient. Indeed, based upon evidence cited throughout this thesis, survivals of rundale were not limited to the fifty years prior to Engels' writing, but remained long into, and in some cases, beyond, his own lifetime.

The conclusion may therefore be drawn that Marx and Engels were both aware of, and had made some preliminary attempts to integrate into their theoretical pronouncements, the empirical niceties of Irish communality. What marks this strand of thought apart as such a critical disjuncture in accepted readings of Marx and Engels on social change, is that their comments emphasise a profound understanding both of the complexities of transition with respect to the Irish case, and of the multiple concepts of property and ownership prevailing throughout much of the nineteenth century amongst the Irish peasantry[180] (and indeed in

[180] Engels' comments demonstrate an awareness of how communal ownership was capable of persisting under conditions of feudal indenture, whereas Marx's notes on Maine's use of the term 'severalty' suggest a sensitivity to the nuances of legal terminology at play in the Irish case; accordingly, as outlined above, Marx challenged the term severalty (as one denoting private ownership) on its inability to explain

contexts beyond). Marx and Engels thus begin to 'flesh out' in their ethnological writings, the emergence of private property and class differentiation through processes of individualization, which gradually subsume their communal bases, according to local circumstance, or in the Irish case, under the differential influence of the colonial apparatus. As will be outlined in the following section with respect to Ireland however, indigenous modes of social organisation and property were not outright eradicated under the provisions of English common law and the penal code. Indeed, it may be argued that Engels was partly correct to suggest that continuities of collective holding and subdivision could in part be traced to certain practices and legal codes of Gaelic origin.

Illuminating as the preceding comments are in the context of Marx and Engels' theoretical work, their development of the case of Ireland remains limited both empirically and theoretically. Although the preceding pronouncements offer some means of integrating such complexities of social form into a mode of production approach (in which essentially feudal relations of production, or an underlying system of landlordism constitutes the essential relation of surplus appropriation dominant within Irish society throughout this time period), both Marx and Engels are deficient in their ability to fully develop the case of Irish communality in its specificity as a particular mode of social-ecological metabolism. Although, as Anderson (2010) claims, they offered no indication of an awareness of the existence of Irish communal property into their own lifetimes, the significance of the preceding discussion must be inferred in terms of its ability to integrate both substantive and theoretical concerns, according to which the case of Ireland functioned not only as a testing ground in political theory, but also as a further avenue of ethnological insight. In short, it permitted them to locate the existence of communalism not only as an abstract universal precondition of class differentiation and private property, but as a concrete form of social organisation capable of coexisting under broader conditions of feudalization, rather than a discrete developmental state experiencing inevitable subsumption under the encroachment of capitalism. Although this somewhat permits exploration of the dynamics of the Irish commune, a clearer picture of the property relations underpinning its existence is still required, in order to fully 'articulate' the social form of Irish communality as a historically specific variant. An examination of the provisions of indigenous Irish law, such as they relate to later manifestations of collective holding, will provide this clarification of the essential relations of production, or conditions of access to the means of production characteristic of the Irish commune.

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communal property in Ireland as a form of possession, not of fixed ownership. Periodic rotation and redistribution were here central to maintaining this notion of possession under the social form of rundale in Ireland (Buchanan 1958, McCourt 1947) and as such, the rundale system readily defies the legal connotations of severalty alone (Slater and Flaherty 2010).

6.2.2 The social form of communality in Ireland: communality and communal property

According to J.C. Wylie (1975), Irish land law, more than any other branch, has resisted the progressive encroachment of English common law and retained its 'particularly Irish characteristics.' Current land law thus owes its composition to a number of historical informants, including principles of English common law grounded in Norman feudalism, and English statute law enacted both by devolved Irish parliament, and by Westminster subsequent to the Act of Union in 1801 (ibid: 7-8). For the historical sociologist, conditions of land tenure in eighteenth and nineteenth century Ireland must therefore be interpreted in context, as a cumulative product of successive waves of colonial influence, the inconsistent eradication of indigenous legal codes governing landholding, transmission and succession, political conflict, and changing local administrative structures. It is therefore difficult to advance a simple representative model of the dominant historical structures of Irish land law, as local conditions of tenure were subject to profound variation, as a consequence of ongoing interaction amongst the preceding factors. Furthermore legal practice, particularly throughout the early nineteenth century, was compounded by the administration of law both by institutions of the crown, such as justices of the peace, magistrates, and assizes, and by those of the manor courts, the latter of which did not administer English common law, and quite often sought restitution within the provisions of local customary code (McCabe 1991). As will be established in the forthcoming section however, a number of core generalizations may be extracted through a broad examination of the development of land tenure under the dual influences of indigenous Brehon law and the colonial apparatus, which permits conceptualisation of the essential conditions of communal landholding which present under the rundale system.

Following the ascendance of James I to the throne of Britain in 1604, a proclamation was issued in 1605 by lord deputy Arthur Chichester declaring all persons of Ireland subjects not of their lord or chief, but of their British king. Crucially, this proclamation outlawed the indigenous Irish system of partible inheritance known as gavelkind, and the practice of tanistry as a means of reckoning succession to chiefdom under Gaelic law, through a declaration by judges of the king's bench in Dublin that neither should be recognised or enforced in the king's court (Kinealey 2008: 82; Wylie 1975: 19). According to Irish law texts of the seventh and eighth centuries, indigenous landholding centered on kin-groups known as *derbfine* ('true kin') which exerted legal power over their members, according to which each legally competent male of the kin-group was entitled to some degree of responsibility in the kin-land, or *fintiu*

(Kelly 1988)[181]. Indicative of the subservience of individual to collective, members were not permitted to sell shares of land against the wishes of their kin group, and in certain instances of transgression, the kin-group could be held liable for the offences of individual members (ibid: 13). Sir John Davies, in his *Lawes of Ireland* (*c*.1610) offers the following account of how land division was conducted under the auspices of tanistry and kin-group, according to the provisions of gavelkind;

> "…The rest of the lands being distributed among severall septes every sept had a cheefe or *canfinny* [Irish *ceann fine*] as they called him with a *tanist* [Irish *táiniste*] of that sept both which were chosen by the chiefe lord or captione of the countreye. All the rest of the landes except the porcions of the cheefes & tanaistes discended in course of gavelkinde & were partible among the males onlye in which division the bastardes had their porcions as well as the legitimate. The partician was ever made by the *canfinny* or cheefe of the sept and was made to continewe sometimes for 3 yeares, sometimes for 7 yeares & for shorter or longer tearmes which being ended they made a newe division & seldom or never did they make a division in perpetuity. This custom of gavelkinde…doth argue that the iland was inhabited by the Old Britaines...which custome the Walshmen have reteyned until this daye". (Davies 1610 cited in Kelly, 1997: 430).

The provisions of Brehon law thus ensured continuity in local political power, and reckoning of kinship through a clear line of succession, by which property was apportioned between eligible males of the kin-group. At higher levels of regional governance such as that of the lordship; tanistry, or the process of nominating a chief's successor known as a *Tánaiste*, resided within the *derbfine*, a practice which ensured succession to political power on the basis of seniority, by individuals meeting the criteria of 'eldest and worthiest' (Nicholls 2003: 28). In practice however, such criteria were often supplanted by political and military might, and rival factions could often assume succession by such means. Nonetheless, despite the prevalence of such conflict, legal codes of the time empahsise abstract principles of egalitarianism and consensus in the nomination of successors (ibid).

Common to both Welsh and Irish law of the time was a provision permitting access to shares in the kin lands by illegitimate or affiliated children. A text on inheritance known as the *Maccslechta* indicates three classes of son with such rights of inheritance; '…recognised son…son of a pure women…and the son of a betrothed concubine' (Kelly 1988: 102). In some instances, rights of inheritance were conferred upon adopted individuals under contract, subject to ratification by the head of the kin-group (ibid). Although further provisions discussed by

[181] Daniel Coghlan also states that '...among the ancient Gauls, and among the so-called Celtic peoples, the territory of the clan was common property to which no member had any special individual right' (1933: 36). Under the later rundale system, Whelan observes how allocation was reckoned not by measure, but by the principle of abstract entitlement or *cuibhreadh*, '...which was determined by a balance between kinship affiliations, lease obligations and environmental constraints' (1995: 25).

Kelly indicate some degree of collective sanction on illegitimacy, it is clear that the system of gavelkind offered precedent for the accommodation of new members both through extension of the immediate kin-group by birth, and through the introduction of members from beyond the *derbfine*. Nicholls further describes the system of gavelkind, and its prevalence in alternate forms across wider Europe as follows;

> "The word 'gavelkind' was of course an English term originally denoting the custom of inheritance which prevailed in Kent – where the rule of partition between sons instead of primogeniture survived – and borrowed by sixteenth-century writers to denote the system of inheritance which existed in Wales and Ireland, by which lands were 'parted and partible amongst the issue male of any dying possessed thereof'. The formal legal phrase used here was 'custom in nature of gavelkind'. Although the rule of primogeniture may have seemed the norm to later English observers, it was far from being the universal or even general practice of Europe;…at a lower level of society partible inheritance was almost everywhere the norm outside England" (Nicholls 2003: 67).

Similar forms of collectivity and partible inheritance were noted by Coghlan (1933) who remarked on the Romanian body of customary law, or *jus valachorum*, which bound tracts of land to individual villages as the collective property of their residents. Taken together, the preceding comments, including those of Kelly and Davies, suggest that not only was such a system of collective holding and partible inheritance characteristic of many pan-European forms of kin-based social organisation (of common Celtic origin in the cases of Ireland and Wales), but that it also involved periodic division and cyclical reallocation (Kelly 1997: 430). On this latter element, allocation under gavelkind thus exhibits notable similarities with later practices of periodic rotation of shares under the rundale system. In parts of Antrim and Cork at the end of the eighteenth century, Arthur Young remarked on the existence within these regions of 'change-dale,' a practice which involved annual rotation of arable plots amongst community stakeholders, with contemporary accounts suggesting similar practices of rotation were in operation across certain regions of the Western seaboard, and in parts of Kilkenny and Fermanagh (McCourt 1955a: 373-375). Although a tenuous proposition owing to source prestige bias, Young's observations at least suggest that the practice of gavelkind appears to have survived with some prevalence amongst the lower classes in customary form, following the eventual submission of the Irish nobility to primogeniture under British colonization (Morris et al 1939: 290)[182]. Consequently, the practice of periodic rotation in certain districts, as observed by Young in the late eighteenth century, is suggestive not of an institutionalized

[182] Sigerson suggests that attempts to eradicate partible inheritance, by offering claim to all lands by the last surviving tenant were largely ignored by the Irish; 'The great inducement which the English law of joint-tenancy held out for its destruction, by giving the surviving tenant of a partnership the right to claim all, was steadfastly refused. They were never known to take advantage of it, but were always seen to "suffer the father's part to go to the sons." (1971: 162).

system of private holding, but rather of a co-existing mode of collective holding and share entitlement or usufruct, which Engels argued was a feature of Celtic survival.

Writing in 1682, Henry Piers remarked on such a system of division undertaken by the inhabitants of a Westmeath townland, who allocated shares in both their arable and pasture by lottery;

> "Every townland held by them is grazed in common, that is, every mans flock goes indifferently over all the pastures of the town…they divide usually one field into two acres , half acres, flangs, that is roods; and of these they make so many lots or equal shares as there are ploughs in the town…and they will take upon them to be judges to an extreme nicety of the ground…they lay a large acre, stang, or half acres to a lies (nor matter where it lies) and on a good, a worse, in all this pretending the greatest indifference imaginable…while every man hopes the worst will not fall to his lot; and now at last they proceed to cast lots for their shares" (Piers 1682: 115-117)

Great care was taken in judging the quality of plots from which an individual's shares would be selected, with each receiving a set of scattered shares drawn from plots of varying quality. Once markers were laid by a child or stranger; 'a scrap of iron, a shred of cloth or rag…from which proceeds much argument over the quality of the ground allocated' (ibid). Piers also reports a surviving provision of Brehon law by which landlords, on refusal or inability to provide or organise co-operative labour may have opted to provide seasonal seed instead; 'This custom they call 'the law of Owen with the beard, who was one of their antient Brehon judges' (Piers 1682: 119). Over a century later, Peter Knight remarked on a similar process of collective division observed in the townland of Killmore, Co. Mayo;

> "In the whole of the peninsula, there are few farms divided, though the custom laterally is gaining much ground; the usual system being commonage both in tillage and pasture. In the tillage, lots are cast every third year for the number of ridges each person is entitled to after the usual rotation is over. Potatoes the first year, then barley or oats, after which new lots must be cast for the new potatoe ground. The holdings are by sums or collops, which originally meant the number of heads of cattle the farm could rear by pasture, but as some tillage became afterwards necessary, they divided the crop-ground into collops also as well as the pasture, and each farm then had its number of tillage collops and grazing collops. The tillage collop is supposed to be capable of supporting one family by its produce. In many instances, poor families have no pasture to correspond with their tillage collop; and even of this they may have only a half, or quarter called a geerla. This may be placed in different parts of the farm, so as to equalise the quality among the whole,-a ridge in a good field, one in an inferior, and one in a worse one. The prices of these collops vary according to the quality of the farm: the average is about one guinea. The pasture collop is the grass of a horse, or a cow, or two year-old heifers, or six or eight sheep" (Knight 1836: 46-47)

This process of subdivision, with its specific attention to equality, was presided over by a headman, or Rí; 'There is a headman, or king appointed in each village, who is deputed to cast the lots every third year, and to arrange with the community what work is to be done during the year' (Knight 1836: 47-48). Furthermore, it was the duty of the king to preside over subdivision of the communal lands every three years, to arrange various maintenance works throughout the year including possible reclamation, and to set the 'bin,' or limit to the number of cattle each individual could graze on the village commons, according to their arable holdings as reckoned in 'collops.' Knight further establishes continuity between his observations in 1832, and antecedent modes of Brehon administration in a footnote where he is informed, under the authority of local antiquarian Mr. Hardiman, that the term Rí, or *Raigh* as he encountered it in Killmore with reference to the local king, derived from the term 'Kanfinne,' or 'head of the local tribe according to the Brehon administration' (Knight 1836: 48).

On this basis, it may be concluded that although the object of Chichester's 1605 declaration, and subsequent crown plantations was to supplant the existing Gaelic order by undermining its indigenous legal code, it is clear from the preceding examples that there remained within the later rundale system, a remarkable degree of similarity – if not continuity – in local modes of land administration, tenure and transmission which bear striking resemblance to tanistry and gavelkind such as they operated under Gaelic law. It appears that the eradication of the existing Gaelic order was therefore decidedly uneven, a condition which Nicholls (2003) has attributed to difficulties in preceding centuries of appointing crown judges to rigorously enforce common law in practice. Subsequent attempts at the imposition of British common law were arguably more successful however.

Continuing with the introduction of the penal code 1695, further measures were taken to legally undermine indigenous social and political influence, through legislation directed against Catholic freedom of education, religion and property. Although the penal laws largely succeeded in solidifying the influence of the protestant ascendency by forcing conversion upon Catholic landowners who wished to retain title to their lands, the strength of their application and enforcement was not uniform. Whereas Catholicism exhibited marked resilience against restrictions on practice and observance, the popery act of 1704 introduced far-reaching sanctions on property ownership and transmission;

> "It prohibited a catholic from buying land or from leasing it for more than thirty-one years; a lease had to be at a rent of at least two-thirds the yearly value. At his death his estate had to be gaveled, that is, divided amongst all his sons, unless the eldest turned protestant, in which case he got the whole estate. 'Protestant' within the meaning of the act meant conforming to the Church of Ireland. A father with a protestant heir was reduced to the status of tenant-for-life. No catholic could be a guardian, and the 'protestant' guardian appointed by the court was required to do his utmost to educate the minor in the protestant religion" (Simms 2009: 19)

Such measures thus served to augment amongst the lower classes, earlier attempts at subinfeudation pursued through plantation, which had instituted across all of Ireland a system of feudal leasehold tenure under crown centralization. In terms of administrative structures, the influence of the British legal system was also gradually becoming institutionalized throughout the seventeenth and eighteenth centuries. By this time, many local civil and criminal cases were adjudicated by courts of 'quarter sessions' presided over by justices of the peace, and at the courts of 'petty sessions' presided over by magistrates (Ó' Tuathaigh 1972: 87). These amateur judges were typically selected from the local gentry under seal from the lord chancellor (McCracken 2009: 69), and twice yearly, common law judges were sent on circuit to try major civil and criminal cases at assizes in county towns (ibid: 67). Under the auspices of this legal framework, various courts continued to operate under existing royal seal, such as those of the charter towns and manors, under which a litany of local boundary disputes would later be heard in the West of Ireland, as a consequence of division under rundale (McCabe 1991). By the close of the eighteenth century, the British-Irish legal system had further solidified its influence however, with extensive jurisdiction over domestic cases in the form of the four courts (chancery, king's bench, common pleas and exchequer), and a bar of over 400 practicing members (McDowell 2009: 707).

As argued above, amidst these complex administrative structures in various stages of development and devolution, there remained notable indigenous elements of some resilience. Although Brehon law had begun to yield to the influence of *ius commune* (European common law) by the late medieval period, according to Kenneth Nicholls (2003: 50), its longevity was previously asserted by Frederick Gibbs, who suggested an historical link between the provisions of Brehon law, and the rundale system of the nineteenth century;

> What traces did Brehon Law, though abolished by the Judges and the Lord Deputy, Sir Arthur Chichester, leave in the habits and sentiments of the people, and can any of those traces be observed at the present day? Of the custom of Tanistry we hear no more; but the custom of gavelkind long survived, reappearing, under English law, in the form of tenancy common down to the early part of this century; and it may still be traced in the

> love of holding property in families, in the tendency to subdivide the land, and in an unfavourable shape, in Rundale, where the tenement is made up of a number of scattered patches of each particular quality of the land (Gibbs 1870 cited in Slater 1988, and Slater and Flaherty 2010: 12)[183]

The continued presence of gavelkind is not difficult to comprehend in light of remarks offered in the preceding section concerning the profit-maximisation imperative under which many landlords, estate administrators and agents operated. In order to maximise return, long leases were initially granted to tenants, some up to hundreds of years, or leases renewable for three lives, under which subdivision held free reign (Wylie 1975). Under such conditions, customary modes of transmission could thus continue amongst the tenantry uninhibited.[184] A sixteenth century deed discussed by Nicholls underscores further the historical complexities of Irish tenure, by indicating how modes of partible inheritance and primogeniture had already begun to intermingle in legal code prior to Chichester's declaration, by distinguishing between inherited land subject to clan influence (*feineachas*), and private acquisitions bequeathed by will (*solathar*) (2003: 64). In terms of legal structure, such a configuration maps well onto Marx's typological variant of the Germanic commune, in which individuals' occupied determinate parcels as their immediate homesteads, whilst dividing their arable lands amongst all commune members. Estyn Evans recognised this configuration, and the associated practice of plot scattering, as characteristic of the Irish communal form;

[183] Wylie also affirms this continuity; 'Gavelkind, in its Irish sense, should not be confused with the system of succession of the same name formerly known in parts of England, especially Kent. Such a system of frequent redistribution of the land has survived down to recent times in Ireland in the shape of the 'rundale' system prevalent in the Western counties. Under this system, rights of pasturage continue to be owned in common by many landowners, while rights to arable land are periodically redistributed amongst the farmers of particular neighbourhoods. It should also be noted that rights of pasturage in respect of mountain land seem to have been enjoyed in common by several landowners in many areas of the country and some such rights still exist' (1975: 12 [1.15]). Tom Yager contentiously hypothesised, of the village of Faulmore Co. Mayo in the late twentieth century, that its 'palpable collective spirit led me to suspect that a more thorough-going communalism lurked in the past' (2002: 154). A folklore commission interview with Pádraig O' Byrne of Donegal suggests that the very terminology of Brehon code had survived into living memory, with reference to the supervision of share allocation under rundale; 'This division also necessitated the appointment of a "brehon," but the process had ceased long before Pádraig's, or perhaps his mother's remembrance' (Morris et al 1939: 290). George Sigerson also introduces his *History of the Land Tenures and Land Classes of Ireland* (1871) by drawing attention to the continuing significance of indigenous legal code; 'The ancient laws and customs of Ireland are not singularities to be stared at and written down, but active forces which have influenced the nation continuously and deeply to the present hour' (Sigerson 1871: 2).

[184] Throughout the eighteenth and nineteenth centuries, owing to a comparative absence of tenurial security such as that endowed by common law in Britain, leases became progressively shorter, the result of which in many cases, was that no leases were issued at all, and the tenant instead held his lands under 'tenancy at will' (Slater and McDonough 2005: 33). Such a system of long leasing obtained until the immediate pre-famine era when tillage prices fell, and grazing – engendering as it did, consolidation of large land tracts – offered an incentive to issue shorter leases in order to facilitate clearances and eviction. Consolidation thus pushed production and reclamation under rundale to increasingly marginal, less fertile areas, in order to make way for more profitable livestock grazing (Crotty 1966: 43).

> "These self-sufficing communities were held together by blood ties and by the exchange of services under the Irish open-field or "rundale" system of cultivation. Around the house-clusters were small walled gardens and haggards, but the arable land was an unenclosed open field in which each holder had his scattered patches, averaging perhaps a quarter of an acre in area. There are cases on record where 29 partnership-peasants shared 422 plots of ground, where one man held 32 different patches, or again where 26 people had shares in a field of half an acre. In some districts it is known that the plots changed hands periodically" (Evans 1967a: 50)[185]

Eamonn Slater has since argued the conceptual significance of this intermingling of possession and usufruct in typifying property relations under the social form of rundale. Accordingly, Slater suggests 'the rundale system of farming is not merely a system of commonage but a specific system of land tenure, which is determined by the inheritance patterns of gavelkind' (Slater 1988: 4). This particular conceptualisation, which interprets the rundale system as a mode of temporary occupancy mediated through the concrete practices of gavelkind and changedale, thus maps well onto Marx's model of the Germanic variant with its characteristic dual modes of communal and private possession (Slater and Flaherty 2010: 12).

6.2.3. Social form and ecology

This particular system of tenure and transmission exhibits a number of unique ecological and legal characteristics which warrant further conceptualisation. Under Brehon law, such arrangements which mandated subdivision amongst eligible male heirs, and a combination of individual and joint occupancy constitute a 'semicommons' in legal terminology. As suggested in chapters three and four, semicommon property arrangements with concomitant customary legal codes (i.e. communal regulation of access to the means of production), and intermixing of individual holdings as scattered strips, play a particular role in mediating social-ecological resilience. According to Smith (2000), semicommon property regimes, as exemplified by openfield agrarian systems, resolve a number of ecological difficulties engendered by the problem of collective exploitation, which has so occupied rational actor-oriented human ecology (Ostrom 1990). Within English, Swedish and German openfield systems of the seventeenth and eighteenth centuries, similar practices of strip dispersal as those observed in Ireland prevailed, according to which each individuals 'holdings' (themselves merely temporary manifestations of usufruct) were scattered in a series of intermixed strips throughout

[185] Evidence of Mr. Williamson to the Devon Commission in 1845 identifies a joint holding of 387 acres, in which 167 acres of arable were held by 110 tenants. (*Devon Commission. Digest of evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part I.* 1847 [002], p. 419). George Hill of Co. Donegal reports in his memoir *Facts from Gweedore* (1887) of a tailor holding his farm in forty-two separate plots (Evans 1971).

the joint lands of the village. Such a system was interpreted by Seebohm as bound with requirements of grazing, whereby the size of each temporary holding was determined by the number of oxen contributed by each tenant to the village or manorial plough team (Goransson 1961: 83). Such a mode of reckoning was identified in the West of Ireland by Knight (1836), in the practice of share allocation by 'collops,' as a measure of potential ecological output reckoned by the total number of livestock of each occupant, rather than fixed measurement units.

Although some have been quick to idealise such arrangements as an archaic form of altruistic communality, others have pointed out that such scattering and redistribution under semicommon property regimes functioned to permit combined tillage and grazing - otherwise impossible individually, owing to land and labour requirements -, by maximising the grazing area available to the community after harvesting (Janssen et al 2007). The mechanisms of subdivision and plot scattering thus imposed collective ecological sanctions on excessive individual exploitation[186];

> "In the open-field system, peasants had private property rights to the grain they grew on their individual strips of under 1 acre, which were scattered in two or three large fields around the central village. However, during certain seasons, peasants would be obligated to throw the land open to all the landowners for grazing their animals (especially sheep) in common, under a common herdsman. This enabled them to take advantage of economies of scale in grazing and private incentives in grain growing (with no important scale economies). The semicommons allowed operation on two scales simultaneously. To address the incentives to overuse the common-pool resource (the potential ''tragedy of the commons''), many aspects of the operation such as the numbers of animals and times for grazing were strictly regulated on a communal basis. But a semicommons such as the open fields (here with private ownership for grain growing of pieces of the same land as used communally for grazing) presents further potential costs. In particular, if peasant holdings had been consolidated, there would have been…an incentive for strategic behavior as a commons user to favor one's own plot with extra ''goods'' like manure and to injure others' private plots with excess ''bads'' like trampling by sheep. Given the number of users and the close relationship between the uses, common and private, of the same asset, this strategic behavior would be very difficult to monitor or deter directly" (Smith 2000: 132)

The above characterisation of semicommon property regimes thus implicates the Irish rundale not as an inefficient consequence of path-dependent institutional lock-in, existing in the

[186] The case of openfield agriculture further underscores the shortcomings of a strictly rational actor approach to singularly account for the complex mediation of collective action. A neglect of both context and agency, and the employment of methodological-individualist heuristics thus ensured that neoclassical approaches, viewing users as merely short-term maximisers, inevitably reached the conclusion that government regulation, or the imposition of private property regimes on common pool resources were the only means of mitigating resource overuse (VanWey et al 2005: 42).

nineteenth century merely as a devolved provision of Brehon law (i.e. a stubbornly resilient artefact of archaic communality), but as a particular mode of social-ecological metabolism which has here been characterised in terms of its regulation of access to the means of production by gavelkind, and its maintenance of notions of usufruct rather than private holding in communal lands through the mechanisms of changedale and scattering. Eric Almquist also surmised for Co. Mayo, that scattering served to minimise risk by equalising each tenants share in lands of varying fertility (1977: 118). Given that reclamation was particularly labour-intensive, and required significant stocks of lime and manure, subdivision and scattering thus addressed the conundrum of the free-rider, by incentivising collective participation under guarantee of equitable return[187]. This internal communal logic may provisionally be conceptualised at settlement level (and at a high level of abstraction and de-contextualisation), by means of a 'cost-benefit' interpretation of its capacity for functional adaptation; continued organisation on a communal basis was thus mandated insofar as such incentives *against* individualisation served to maximise collective ecological output.

Clearly, there exists at the ecological level a functional imperative in such systems of communal holding which is not readily accounted for by cultural propensity alone. Semicommon regimes in general, as may be gleaned from the preceding quotation, function in this case to dis-incentivise individualistic behaviour; an absence of private holding in arable land here renders practices such as hoarding manure on a single plot during grazing time, or directing cattle onto neighbouring plots to avoid excessive trampling impractical, given that such lands may be subject to periodic reallocation. Although derided as backward by agricultural commentators of the time, George Sigerson remarked on how such systems were ideally suited not only to mixed-farming, but to labour-intensive reclamation work, where the labour of a single individual would not suffice to bring sufficient ground into cultivation;

> "If it was of old found well adapted for the reclamation of a new country, it was now considered "not ill-suited to the imcumbrances of a poor tenantry, whose chief riches consist in their labour. Two or more families, each bringing a little, are thus enabled by combining their forces to accomplish what they were individually unequal to." By such a system were wastes of grazing, of moor, and of mountain lands reclaimed, and manures painfully brought from a distance, the seashore, or the ocean depths" (1871: 162-163)

[187] McCourt observes how the granting of leases to groups of partners in estate documents became more general in the eighteenth and nineteenth centuries '...when a union of labour and equipment was necessary to offset the want of capital so marked among the increasing number of small tenant farmers' (1955: 375-376)

Many have noted the propensity of rundale to spring up on marginal grounds such as mountain fringes and unreclaimed wasteland (Evans 1939, McCourt 1953), and it must be remembered that throughout the pre-famine decades, Ireland experienced significant population growth, necessitating the accommodation of ever-increasing numbers, a situation to which the rundale system was ideally oriented (Whelan 1995)[188]. The practicalities of co-operative reclamation work, accommodation of new members through subdivision, and the necessities of combined tillage and pasture thus engendered an inherent need to maintain notions of equality rather than fixed private right. Caution must be exercised however, lest such a configuration be interpreted as an ideal panacea; from a rational actor perspective, there is clearly some truth in the contention that semicommon regimes tended toward an equalisation of risk and maximisation of opportunity and labour returns, but conversely, an absence of fixity rendered it difficult to exercise permanent capital investment in improvements such as drainage without collective consensus. Nor did such regimes incentivise individual improvements on a single plot, lest another should enjoy its benefits on reallocation (Smith 2000: 145). The positive aspects of such systems were clearly not universal, and considerations of historical location and context are as ever, essential in countering the excessive abstractions of a strict rational choice model. Such concern with the consequences of continued subdivision was well articulated within the Devon Commission, as the following comments concerning a 205 acre townland in Donegal illustrate;

> "The whole was occupied in one farm two generations ago; it then became divided into two farms, and those two have been since subdivided into twenty-nine holdings, scattered into 422 different lots. The average arable quantity of each holding is four acres, held in fourteen different parts of the townland; the average quantity of pasture per farm is three acres, held in lots in common. The largest portion of arable held by any one man is under eight acres; the smallest quantity of arable in any one farm is about two roods...The district supplies no opportunity of contingent employment, and therefore the people are wholly dependent on these wretched, ill circumstanced lots for their existence."[189]

Such was the propensity toward exponential (density-dependent) growth as outlined heuristically in chapter 3, and it was not uncommon for such settlements to continue to expand unchecked in the absence of external intervention (see figure 3.6, chapter 3 as derived from Aalen, Whelan and Stout 1997). As rundale settlements transitioned through the respective initial stages of their adaptive cycle, additional biotic stocks became bound within the system

[188] As outlined in chapter 1, Irelands population grew fourfold between the years 1687 (2,167,000) and 1841 (8,175,124) with particular concentrations of growth evident toward the end of the eighteenth century, and the initial decades of the nineteenth century.

[189] *Devon Commission. Digest of evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part I.* 1847 [002], p. 422

as reclamation and expansion proceeded in response to population growth. Growth and reproduction under rundale was therefore inextricably bound with transmission through gavelkind, and the maintenance of share equality and ecological risk-minimisation through scattering, the net effect of which was an increasing complexity of individual shareholding. The reactions of the tenantry to a proposed consolidation and redistribution scheme within the aforementioned Donegal district serve to underscore the tacit importance of share equality;

> "The people, upon seeing what was proposed, felt all their prejudices outraged. They had been in the habit of subdividing their lands, not into two, when a division was contemplated, but into as many times two as there were qualities of land in the gross quantity to be divided. They would not hear of an equivalent of two bad acres being set against one good one, in order to maintain union or compactness. Every quality must be cut in two, whatever its size, or whatever its position. Each must have his half perches, although they be ever so distant from his half acres. And this tendency is attributable to the conviction of these poor ignorant people, that each morsel of their neglected land is at present in the most productive state to which it can be brought."[190]

Although greater attention is given to these technical aspects of production under rundale in chapter 8, the information provided in the preceding sub-sections serves to identify a number of essential characteristics which demarcate rundale in Ireland as a specific social formation within the mode of production of primitive communism. In terms of ecology, a simple grounded category has been arrived at, as mandated by the dialecticians discussed in chapter 4 (Arthur 2008), with which to advance a historically specific basis for understanding this particular natural-social relation – a relation which has previously been qualified as essentially metabolic. The conditions under which this metabolic relation is instantiated vis-a-vis the labour process (as yet to be dealt with substantively in the context of rundale), have here been explicated as essentially communal in nature. Accordingly, the concrete production process under rundale must be understood in logical context of this necessary maintenance of communality; Slater has suggested the essential social form of rundale, and its general law of reproduction may be summarised as follows;

> "The essential determination of this system is the reproduction of the individuals of the commune as equal free-sustaining peasants, whose production process is therefore geared essentially towards use-value rather than exchange value. But this essential feature of the rundale system, i.e. its communality, also created the material basis for its inability to develop the forces of production. This is so, because the maintenance of equality of membership determined, not only a massive growth in the population of the respective communes, but also a subsequent subdivision of the means of production. This means

[190] Owing to the condition of the facsimile edition of the Devon Commission consulted, it is not possible to reproduce the enclosed map which details the initial condition of the unenclosed townland, the landlords' proposed redistribution scheme, and the tenants' proposed remedy (ibid, p. 422-423)

> that any development of the means of production is determined by its ability to integrate into the social relationships of production" (Slater 1988: 30-31)

Crucially, this articulation defies an economic determinist reading, as is typically applied in the context of Marxian historical materialism (Cohen 1978, Doyle 2008), by exploiting multiple dimensions of the concept of mode of production beyond the economic, such as the organisation of labour, and internal regulation of access to the means of production. As Hindess and Hirst (1975), and David Harvey (2010) have suggested, the obduracy of a specific mode of production is determined by means of a 'matrix' construct, in which the relations of production present as dominant, but not determinate; 'The relations of production define a specific mode of appropriation of surplus labour and the specific form of *social distribution of the means of production* corresponding to that mode of appropriation of surplus labour (Hindess and Hirst 1975: 9-10, emphasis added)[191].

The conditions under which this *social distribution* occurs have here been qualified by the suggestion that they are determined by the customary practice of gavelkind, as a devolved provision of antecedent Brehon code, manifested in the concrete practices of subdivision and scattering (an examination of the forces of production remains forthcoming). Theoretically, this has accomplished the task of historical specificity outlined at the conclusion of chapter 2 (Benton 1996), and elaborated in chapter 5 (Foster 2008b, Wood 2008), and further demonstrated the inability of a conceptual approach embedded in separatist ontologies to comprehend this form of natural-social relation. Furthermore, it invites empirical engagement with the technical organisation of production under rundale, and to investigate contextual constraints on communal organisation, such as they impinge on the ability of productive (or indeed, eco-regulative) labour to proceed on this necessarily communal basis; '...this particular mode of production was essentially about producing people as its major 'product' of production, not just as 'dot-like' entities but as communal members or a particular agrarian commune, whose communality valorized itself in the need 'for the continued existence of the community' which required 'maintenance of equality among its free-sustaining peasants' (Slater and Flaherty 2010: 13). As implied in preceding quotations, the question of resilience must be dealt with internally as well as externally; by considering how such a system of communality inhibited development of the means of production, which in turn contributed to its crises of declining fertility exacerbated significantly by external factors throughout the pre-famine years. Concretely, the necessary reproduction of communality under rundale gave rise

[191] As discussed in chapter 5, Theda Skocpol (1977) also identified restrictive or deterministic interpretations of the concept of 'mode of production' (i.e. reduction of analytical primacy to the role of market relations or institutions) as a key deficiency in world systems theory.

to a unique mode of reckoning employed in the equal allocation of shares as observed above; ‘The principle of rundale was that each legitimate participant in the division should get not an equal *amount* of land in superficial extent, but an equal amount of land in *value*. If the farm lay on a hillside, each person in the division got some of the good land below and some of the poor land up on the hill’ (Morris et al 1939: 290).

In subsequent sections, the concept of metabolic rift may be augmented by assessing the impact of contextual constraints on this communal metabolism, in terms of their implications for physical productivity and systemic reproduction at settlement or system level, by employing a resilience approach. Therefore, although a rational choice model may function in a limited sense (as employed above heuristically to outline the abstract logic of share allocation and scattering) it is doubtless a poor substitute for substantive contextual work. Although such a model permits an examination of *logical* internal constraints on factors of the production process such as improvement works, fixed capital investment or consolidation, historical context is considerably more nuanced, and in many cases, disincentives to improve, and inducements to subdivision must be understood in the context of other social structures and institutions such as the estate system, tenurial insecurity or the position of land agents, an outline of which has here begun.

In terms of methodology, the task of dialectical exposition has been addressed, by elaborating upon initial characterisations of the mode of production of primitive communism advanced in chapter 4. As per directions outlined in table 5.1, discussion is ready to advance to stage three of its proposed methodology, which involves contextualising further empirical development with the presentation of a model of system identity. This has further been qualified above in section 6.1 as the progressive explication of an ideal type, which serves to congeal a working case-object construct or boundary (Ragin 1992b, Harvey 2009). Although this constitutes a further step in the mode of progressive casing as outlined in table 6.1, and offers a means with which to better assess this form of social-ecological metabolism in terms of the concrete organisation of productive activity, a number of issues require addressing before this task can proceed.

The current state of knowledge on rundale may be characterised by a number of dominant interpretive frameworks which have tended to empahsise, and to a certain extent over-determine, specific dimensions contrary to the dialectical approach endorsed throughout this thesis. Before these debates are summarily addressed however, an outstanding debate in historical sociology, which has attempted to characterise the economic structure of nineteenth

century Ireland as essentially capitalistic must be examined. A note of qualification is here required, as this issue speaks to broader disciplinary difficulties in the theorising of social change and transition between modes of production, a problem which has typically been addressed through the prominent, yet ultimately deficient commercialisation model. Assessing these arguments in turn permits a broader clarification of the complex structure of Irish society.

6.3. The coexistence of capitalism, feudalism and primitive communism: the complexities of 'modes of production' and an alternative to discrete transition

As discussed above, the progressive devolution of the institutions of Gaelic society may be located within Marx's dualism of communality and individualism, with antecedent forms of division and transmission by gavelkind tending toward the communal extremes of the continuum. Crucially, this haphazard devolution, outlined substantively in the preceding section, permits entertaining of the possibility that the rundale system constituted not only a mode of landholding conforming to the parameters of primitive communism, but that it was capable of coexisting comfortably under the rubric of Irish feudalism. In this manner, a commune could exist under conditions of joint or collective lease, as a primary stage of mediation between landlord and 'tenant as collective,' whilst controlling access to the means of production on the basis of such a devolved legal code. Organisation of access to the means of production here resides within the *community*, and such an understanding is thus critical for grasping the ecological dynamics of rundale. The following figure (6.1) offers a provisional outline of this systemic relation; it is panarchical (non-hierarchical) insofar as each level stands in dialectical relation to the other (i.e. we may conceive of the concrete forms of labour as contingent upon the effect of the world market or regional economy, albeit in a less intuitively direct sense than that of the communal council).

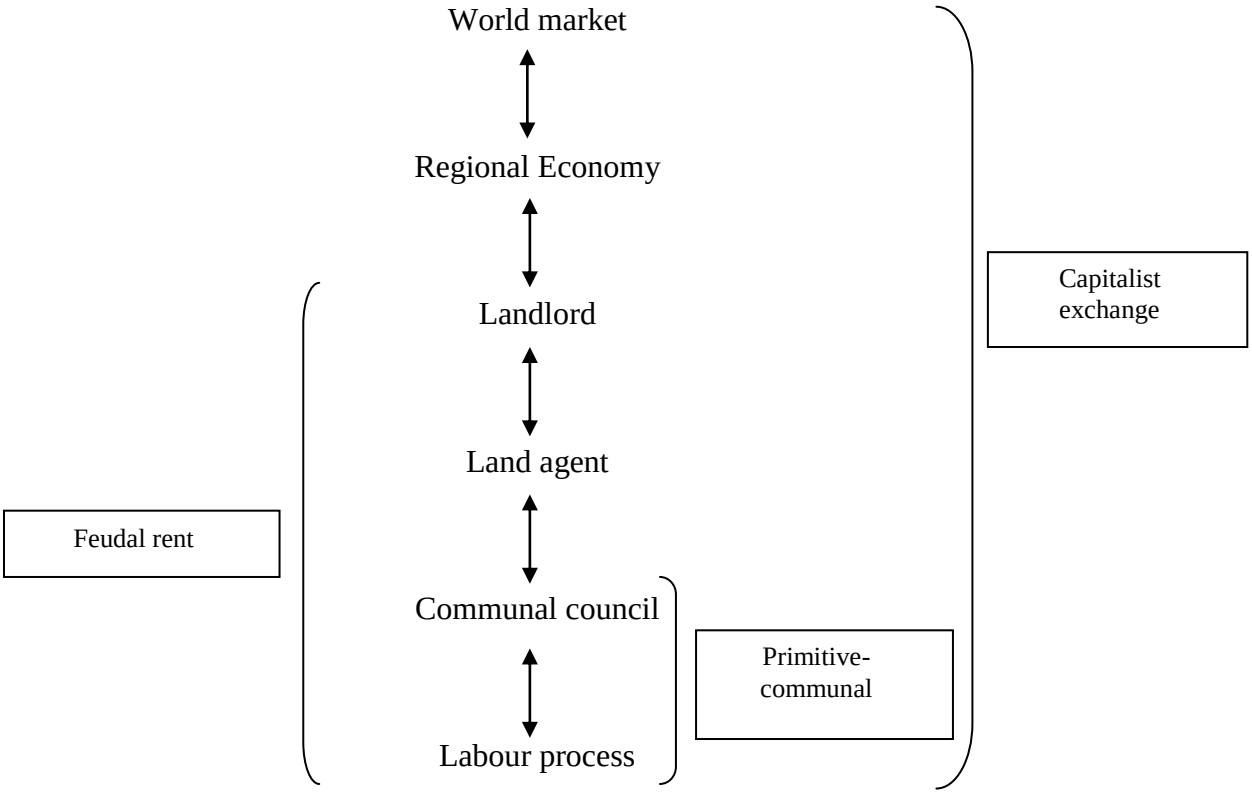


Figure 6.1. Panarchical mediation of the labour process under rundale

Such a conceptualisation of the complexities of nineteenth century Irish society thus brings us closer to the emerging consensus that what is found, in later Marx, is such an acknowledgement of the potential for various modes to coexist in respective states of development and devolution (Anderson 2010, Brown 2010, MacFarlane 2002, Shaw 1984). This has not prevented others from advancing differing propositions based on Marx's perceived interpretation of Ireland. For nineteenth-century colonial Ireland in particular, Ellen Hazelkorn (1981, 1983) is typically credited with forwarding a perspective emphasizing Marx's reading of Ireland's capitalistic nature throughout this period. According to Hazelkorn, Marx's most prominent commentaries on Ireland (those of volume 1 of Capital), centered on the question of Ireland's transition from a feudal to a capitalist mode of production, a process exacerbated in the post-famine years by demographic collapse, clearance and consolidation[192]. Hazelkorn's interpretation of Marx's reading of Ireland as one of a 'capitalist economy in the

[192] Post-famine consolidation in Ireland warranted consideration for Mark as structural consequence of the process of capitalist accumulation. In Volume One of *Capital*, Marx reported the following principal statistics; 'The number of inhabited houses fell, from 1851 to 1861, by 52,990. From 1851 to 1861 the number of holdings of from 15 to 30 acres increased by 61,000, that of holdings of over 30 acres by 109,000, while the total number of all farms fell by 120,000. This fall was therefore solely due to the suppression of farms of less than 15 acres, in other words it was due to their centralisation.' (Marx 1990 [1867]: 854)

making' centers on a number of key structural developments throughout the mid-nineteenth century;

> "(i) the dramatic shift in population which removed an otherwise latent surplus population from rural areas as a first step towards the formation of a rural and urban proletariat; (ii) the transference of agricultural priorities from tillage to pasture further reducing the necessity and livelihood of tenant-farmers; and (iii) the introduction of free trade in land [which] encouraged the concentration of land under an emergent rural bourgeoisie" (1983: 80-81)

According to C.D. Greaves, this apparent contradiction of the law of accumulation, by which surplus production continued apace against the backdrop of a declining economy in Ireland, is accountable for in terms of Ireland's unique relation with Britain, and Hazelkorn rightly points out that when considered as a unit, valorisation and accumulation continued beyond the borders of Ireland, owing to the appropriation of Irish surplus by Britain (1983: 81). Such a reading is affirmed by Mathur and Dix, who suggest, in agreement with Hazelkorn, that Marx's inclusion of Ireland under a discussion of the 'General Law of Capitalist Accumulation' in *Capital* served to downplay simplistic interpretations of Ireland's colonial relationship with Britain which emphasised the act of union as a formal determinant, focusing instead on how '…the transference of capital, foodstuffs, and labour from Ireland to England formed an integral and necessary part of their respective economic growth' (2009: 97).

Although largely an unproblematic rendering of prevailing structural conditions, such a reading engenders a number of conceptual difficulties owing to the predominance of the manner in which this surplus labour and agricultural produce were appropriated from the Irish tenantry. Although documentary evidence of the CDB cited previously within this chapter asserts the continuance of subdivision rather than consolidation long into the nineteenth century within particular regions of Ireland, the manifest characteristics of consolidation, economic dependency, proletarianisation or class differentiation merely belie the more fundamental and universal role of the rent relation as mediator between landowner and labourer. In short, Hazelkorn's three factors of structural change cited above are but one means of assessing the relative penetration of capitalism into Irish society, and but one set of levels according to which one may reckon the presence or dominance of a specific mode of production. Others have argued that such a reading was precisely forthcoming in Marx, and that the issue is perhaps not with his specific rendering of the agrarian question in Ireland, but the manner in which others have interpreted it (Mathur and Dix 2009: 99).

On this point, Slater and McDonough forward an alternative reading of Marx which emphasises the feudal nature of Irish social relations under landlordism. Their argument thus runs counter to that of Hazelkorn in their assertion of the extent and longevity of this essential relation;

> "Twenty years after the 1845 famine, about 2000 owners of landed estates, each with 2000 acres or more, owned two-thirds of the country's land surface. Indeed, half of that surface belonged to less than 800 individuals. These landlords enjoyed a gross annual rental in the region of £10 million. This was at a time when the total United Kingdom central expenditure on civil government amounted to 6.6 million" (Slater and McDonough 2005: 29)

The complete political and economic subjugation of Ireland thus rendered a feudal rent relation upon direct producers beyond the parameters of capitalist free contract, under which rent became not a surplus above wages and profit as per capitalist rent, but rather a surplus above minimum subsistence requirements without profit (Slater and McDonough 2005: 30). This extraction through extra-economic coercion[193] was in turn predicated upon the conquest of Ireland under colonisation, through processes examined in the preceding section such as the eradication of the Gaelic order, confiscation of lands under the estate system and erosion of tenurial security under the penal code. William Petty estimated the net value of Irish rentals in 1670 to be £800,000 out of a total national income of £4,000,000, rising to £1,200,000 in 1687 (Crotty 1966: 294). By 1779, Arthur Young had estimated a total yield of £5,293,000 for Irish rent (ibid). Under such a system, English grantees and their agents engaged in extensive leasing and sub-leasing in order to extract maximum rent returns, resulting in a '...rapid growth in Ireland of leasehold tenure to an extent never experienced in England' (Wylie 1975: 24).

In Ireland, rent was thus determined not by the vicissitudes of supply and demand (a moot mechanism given the extent of land monopolisation), but by the amount of intermediary sub-

[193] *Extra-economic coercion* distinguishes between coercion based on the direct exercise of control over the production process (or extraction under threat of violence), which may be contrasted with an alternative form of *economic coercion* under capitalism, where conditions of free contract 'coerce' labourers into entering voluntary relationships with their employers. Dobb's standard definition states how feudalism is; '...virtually identical with what we generally mean by serfdom: an obligation laid on the producer by force and independently of his own volition to fulfil certain economic demands of an overlord, whether these demands take the form of services to be performed or of dues to be paid in money or kind' (Dobb 1963 cited in Milonakis 1993-1994: 392). Ellen Meiksins-Wood characterises extra-economic coercion as '...direct coercion, exercised by landlords or states, employing their superior force, their privileged access to military, judicial, and political power' (2002: 95-96). In Volume I of Capital, Marx depicts the emergence of 'free-contract' as predicated upon expropriation and primitive accumulation, which in turn foster an economic dependence (i.e. economic coercion) upon the labourer to confront the capitalist with the intention of exchanging his labour for money. As Slater and McDonough affirm in the Irish case; 'The degree of subordination of the tenant in this relationship extinguished the possibility of contractual (formal) equality that exists between the capitalist landlord and tenant (2008: 164).

tenancies which, in practice, doubled rent returns according to each successive division and stage of mediation between direct producer and landlord (O' Neill 1984, Slater and McDonough 2005, Slater and McDonough 2008: 166). In many cases, rents were themselves merely nominal (Crotty 1966, Slater 1988). Following the legalisation of long leases for Catholic tenants in 1778, many lengthy leases were granted, with the lessees enjoying significant profits owing to an upsurge in tillage prices throughout the Napoleonic wars. Such was the profitability of tillage at this time that the estate of Lord Leitrim, let originally for £8000, was subsequently relet by middlemen for £64,000, under leases of thirty years (Crotty 1966: 43-44). In short, the rent relation featured prominently as a hallmark of Irish class structure, and a mechanism of surplus appropriation. The mere presence of cash however, is insufficient a conceptual basis with which to reckon the presence of a developed capitalist mode of production.

In Volume III of Capital, Marx attempts to outline the *differentia specifica* of capitalism in chapter 36, '*Pre-Capitalist Relations*', offering further clarification on the primacy of a dominant mechanism of appropriation in reckoning the presence of a particular mode of production. In the following passage, Marx downplays the ability of usury to subsume pre-capitalist social forms, drawing attention instead to the primacy of relations between producer and appropriator, and the continuation of underlying relations of exploitation through extra-economic coercion;

> "As long as slavery prevails, or the surplus product is consumed by the feudal lord and his retinue, the mode of production still remains the same even though slave owner or feudal lord fall prey to usury; it simply becomes harsher for the workers. The indebted slaveowner or feudal lord takes more out of them, since more is taken from him: Ultimately, he may be completely replaced by the usurer, who himself becomes a landowner or slave owner as the knights did in ancient Rome. In place of the old exploiter, whose exploitation was more or less patriarchal, since it was largely a means of political power, we have a hard, money-grubbing upstart. But the mode of production itself remains unaltered" (Marx 1991 [1894]: 731)

Furthermore, the mere emergence of usury is itself a necessary condition for the emergence of a capitalist mode of production, only insofar as it transforms the essential basis of ownership under which direct production operates. Here, Marx again empahsises the multi-dimensional nature of the concept of mode of production;

> "Usury has a revolutionary effect on pre-capitalist modes of production only in so far as it destroys and dissolves the forms of ownership which provide a firm basis for the articulation of political life and whose constant reproduction in the same form is a necessity for that life. In Asiatic forms, usury can persist for a long while without leading

> to anything more than economic decay and political corruption. It is only where and when the other conditions for the capitalist mode of production are present that usury appears as one of the means of formation of this new mode of production, by ruining the feudal lords and petty production on the one hand, and by centralizing the conditions of labour on the other" (Marx 1991 [1894]: 731-732)

Finally, as suggested in chapter 4 with respect to the general circulation of capital and its valorisation, Marx affirms the non-capitalistic nature of Irish agriculture in the following passage. His comments underscore the absence of valorisation - as an essential component in the reckoning of a capitalist relation - by pointing out how the Irish peasant's surplus is incapable of completing the necessary circuit of transformation which renders a return on surplus labour above that invested; 'The scattered means of production that serve the producers themselves as means of employment and subsistence, without valorizing themselves through the incorporation of the labour of others, are no more capital than a product consumed by its producer is a commodity' (Marx 1990 [1867]: 860-861, also cited in Slater and McDonough 2005: 34)

The question remains however, as to the role of the capitalist world market, in the extent to which it determines both the organisation of production at multiple levels of the panarchy depicted in figure 6.1, and the direct labour process under rundale. It is abundantly clear that historically, Ireland was integrated substantially into global markets; the introduction of the potato into the tillage of the Irish peasant, a crop which rose to become dominant in the diet of the agricultural labourer by the late eighteenth century, was itself predicated upon its alleged introduction by Walter Raleigh from Western British colonies in the late sixteenth century (Connell 1951, Cullen 1968). Consequently, although the assertion of market primacy in world systems theory has been critiqued as an epistemological fallacy in chapter 5 – here substantiated through foregoing contentions that questions of ecology must of necessity be more stringently contextualised – its role as a key influence on the organisation production at various levels of aggregation should neither be neglected, nor elevated to the status of prime determinant. On the empirical question of market integration, an examination of pre-famine British import data reveals something of the volume of Irish agricultural output consumed beyond its borders. Total weights of Irish grain imported into Great Britain from 1805-1840 are tabulated below (figure 6.2), at five-year intervals[194];

[194] Original quarter-weight units converted to metric tons for interpretation (2 stone = 1 quarter; 1 quarter = 12.7kg; 1000kg = 1 metric ton)

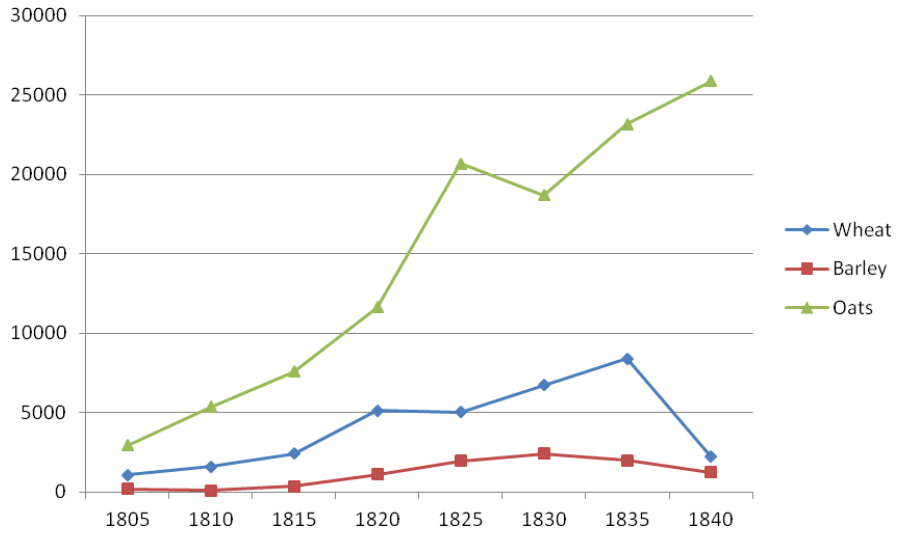


Figure 6.2. Grain of Irish growth imported into Britain, 1805 – 1840 (metric tons)[195]

Beginning from a base of 2411 quarters (30.6 metric tons) of oat and oatmeal imports in the year 1800, oats display almost consistent growth across the tabulated time period, peaking at 2,037,885 quarters (25,881 metric tons) in the year 1840. Peter Gibbon, in keeping with the contentions of Slater and McDonough, has characterised this removal of agricultural surplus as a key component of the Irish 'colonial mode of production' which facilitated British industrialization through the provision of foodstuffs, resulting in the preservation of a 'subsistence sector' within commercial Irish agriculture, and a retardation of the development of capitalist agriculture (1975: 134)[196]. Although the preceding figure illustrates real growth in the volume of trade throughout this period, with significant consistency across all categories buoyed in part by the presence of the protectionist Corn Laws, which exempted Ireland from import trade tariffs, the following figure tabulates Irish grain as a proportion of total foreign imports, thus allowing assertion of the relative contribution of Irish produce to British imports. Figure 6.3 below thus excludes English and Scottish grain processed through the Port of London over the period 1820–1840, permitting a cursory comparative assessment;

[195] *Further returns relating to the importation and exportation of corn, foreign and colonial; Of the Quantities of Grain of each Kind, distinguishing British, Scotch, Irish and Foreign, Imported into the Port of London, in each year, from 1820 to 1841.* 1842 [18-1] xl, p. 59

[196] The idea of a subsistence sector, as with other simplistic conceptual bases such as 'peasant society' is arguably insufficient; 'Peasant as a conceptual or theoretical category is undeveloped and often misleading, because it does not specify relations and / or conditions of production in the agrarian sector. In short, it is a general category with little or no explanatory power' (Braa 1997: 194).

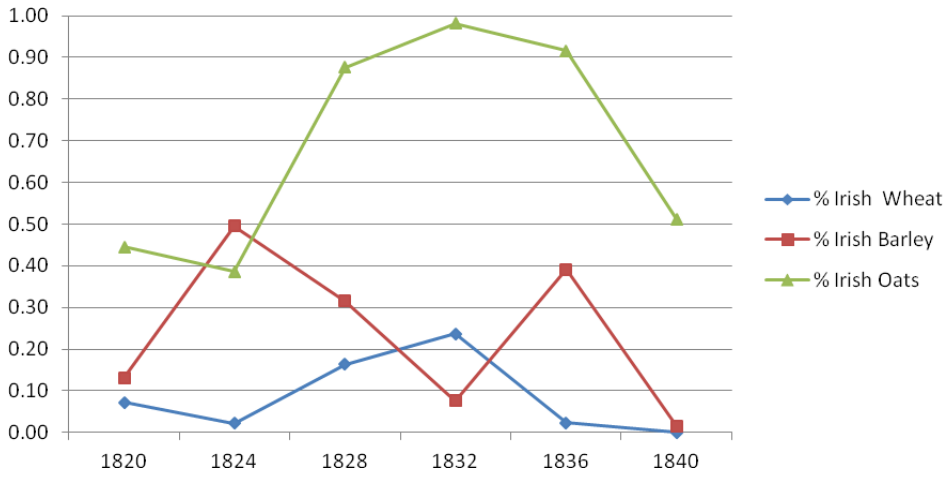


Figure 6.3. Irish grain as a proportion of total British foreign grain imports, 1820 - 1840[197]

Although the above figure proves somewhat more difficult to discern trends with, owing to likely year-on-year inconsistencies in import volume from colonies further afield, it may be observed that Irish oats comprised a peak proportion of 98% of foreign oat imports into Britain in the year 1832, with Irish barley peaking at 50% in 1824, recovering to 39% in 1836. Crotty's analysis of Irish export data between 1698 and 1818 also notes a burgeoning export market throughout this period in both tillage produce and livestock, to the extent that by the early nineteenth century, Ireland enjoyed a profitable trade in pigs and pig meat with locations as far afield as Denmark (1966: 276-279). Furthermore, significant responsiveness to market signification may be observed in the early eighteenth century shift from tillage to pasture in Irish agricultural production, a change which began following the contraction of the domestic British grain economy at the conclusion of the Napoleonic wars, signalling the end of wartime price inflation (1966: 293). In the period immediately following Ireland's formal colonization, marketisation began to take hold as evidenced in the growth of the port towns of Belfast, Derry and Cork, and an increase in granted authorizations to hold town markets and fairs, with over 500 taking place between 1600 and 1649 (Gillespie 1993: 137). Between 1616 and 1625, the amount of wool leaving Youghal rose from 4378 stones to 15716 (ibid: 138). In short, Ireland's integration into the global market vis-à-vis its close trading relationship with Britain, far from a phenomenon of the late nineteenth century, was a consistent hallmark of its political and economic union.

[197] *Further returns relating to the importation and exportation of corn, foreign and colonial; Of the Quantities of Grain of each Kind, distinguishing British, Scotch, Irish and Foreign, Imported into the Port of London, in each year, from 1820 to 1841*. 1842 [18-1] xl, p. 60. Such was the intimate, dependent relationship between British industrialisation and the transfer of foodstuffs from its colonies that the proportion of British population engaged in agriculture fell from 90% in 1698, to 10% by 1881 (Gibbon 1975: 132).

Such market-orientation under conditions of rental obligation exerted a clear influence on the productive activities of the tenant. Given that direct producers were necessarily bound by a feudal rent relation, such an imperative meant that each intermediary leaseholder, either as individual occupier or joint lessee under rundale, was obliged to offer their surplus in the form of rent in kind, labour, or money as a condition of their continued access to the means of production. Therefore, although rundale tenants could maintain some degree of autonomy regarding the physical organisation of their plots as per figure 6.1, they were also obliged to surrender a proportion of their produce for sale, in order to realise their rental obligations. In his analysis of a 1788 rent roll of the O' Donnell estate in Co. Mayo, Almquist noted 46 townlands held by common tenants, whose combined rental value accounted for almost half that of the total estate (1977: 83). Partnership rents on the O' Donnell estate averaged £47 per joint tenancy (ranging between £3 and £301), under leases typically granted for a duration of 31 years (ibid). Almquist's later account of production under joint tenure further discounts the notion that the rundale system was plagued with rent arrears through inefficiency and insularity, or that it was limited exclusively to subsistence agriculture; contrarily, arrear rates on the Sligo estates amongst joint tenants in 1784 were 13.3%, in line with the general rate for the rest of the estate, and in many cases, superior to those of its severalty tenants (1977: 122). Arrear rates remained constant on these estates until 1833, despite the pressure exerted upon land by substantial population increases.

Cash thus played an integral part in the productive activities of all classes of tenantry, and money was also variously required to meet obligations such as county cess, tithes and hearth tax, turbary levies (if applicable), and to purchase other necessities not available through direct cultivation. A Baseline Report of the Congested Districts Board for Clare Island Co. Mayo serves to illustrate the extent of this necessary trade, as shown in the following breakdown of income and expenditure for a typical poor family engaged in mixed farming;

Table 6.2. Receipts and expenditures of a poor family, Clare Island (1892)[198]

Receipts	£. s. d.	Expenditures	£. s. d.
Sale of 1 bullock	5 10 0	Rent	2 10 0
Do. 5 sheep	2 2 6	County Cess	0 9 0
Do. wool	1 0 0	Meal, 6 bags	3 18 0
Do. corn	5 0 0	Flour, 5 bags	7 0 0
Do. eggs	2 0 0	Groceries	6 10 0
Do. fowl	1 0 0	Tobacco	2 12 0
Do. pigs (profit)	4 0 0	Clothing	10 0 0
Farming in England	9 0 0	Household	1 0 0
Money from America	6 0 0		
Total	35 12 6	Total	33 19 0

Therefore, although a substantial proportion of the subsistence requirements of a typical family were provided by the produce of the land (potatoes and oats are noted on Ruttledge-Fair's report as being grown extensively in rotation), sale of produce and livestock was required in order to acquire cash for necessities such as rent, clothing and excess groceries, thus bringing the household budget into balance. Regarding the remotest parts of the rundale-dense barony of Erris Co. Mayo in the late eighteenth and early nineteenth centuries, both Arthur Young and James MacParlan remarked on how livestock trade and cash-crop sale formed an integral component of the local economy, thus bringing the occupants of this classical 'subsistence fringe' into contact with the vicissitudes of the market;

> "Visiting Ballina in 1780, Arthur Young never ventured into Erris's 'vast and impenetrable tract of mountain and bog', but he was told 'there is not a post-house, market town, or justice of the peace in the whole Barony'. Yet there were 'many herds of small cattle, and some sheep kept, which are sold from thence'. Cattle were driven into the market at Ballinasloe. In 1802 MacParlan wrote that 'in years when they escape a blast' the people of Erris 'plentifully supply the markets of Newport and Westport with potatoes and barley" (Yager 1996: 26)

[198] From data reproduced in Whelan (1999: 95). Original data sourced from CDB reels housed in Trinity College Dublin (Berkeley Fiche: 53). The remainder of Ruttledge-Fair's report, from which this table is sourced, indicates the survival of a system of equitable commonage allocation, spade husbandry, limited seasonal migration and significant dependence upon the produce of the land, all characteristic of production under rundale. Clare Island features prominently in existing literature on rundale, owing to its comparative resilience to 'modernisation', and the wealth of physical evidence attesting to its complex historical modes of landholding and share allocation (Praeger 1911a, 1911b; Whelan 1999; Wilson 1911).

Furthermore, in the context of extensive subdivision - engendered by the desire of agent and landlord for increasing rent returns according to the number of intermediary agents - and the inherent tendencies of rundale toward subdivision and parcellisation under partible transmission, the presence of the potato as a key subsistence crop facilitated an ever-increasing density of direct producers. Due to its prolific nature, its ability both to thrive on poor-quality soils, and to act as a primer for corn production (Clarkson 1981: 31), the potato yielded a sufficient stock of food to permit the tenant to produce his rental surplus in the form of cash-crops such as oats, on increasingly smaller plots;

> "…every land lord whose greed for rent could never be satisfied forced his tenants to seek their living from an ever-smaller proportion of their holdings and thereby he championed the prolific potato…In so far as these depressing results accompanied its dissemination it was because they, like the dominance of the potato, were a result of the new landlordism: enterprise and industry, not unnaturally, were less cherished when separated from their fruits. That the potato, as Cobbett said, was a 'lazy-root' was a cause of its ready welcome in the evil economy of Ireland: this attribute of the potato allowed the peasant's subsistence to be produced with a minimal expenditure of labour in the same way as the abundance of its yield allowed it to be grown on a minimal area of land. But the point of thus economizing in labour and land was to free these factors for the greater production of the grain or butter or beef which made up the rent" (Connell 1951a: 390-391)[199]

Such was the extent of this intensification of productive activity and market orientation that Gibbon refers to the presence of a 'dual economy', consisting in the extension of cultivated lands, and their division into export-oriented cash crop and subsistence zones (1975: 136). Although this distinction may be somewhat overdrawn owing to aforementioned evidence attesting to the internal diversity of farming under rundale (i.e. it is difficult to characterise even the most peripheral locations as strictly subsistence oriented), it is clear that the net effect of the profit imperative was to push rundale to ever-marginal locations as consolidation took hold in response to livestock price fluctuation in the early nineteenth century (Almquist 1977)[200]. This will soon prove a critical factor in forthcoming assessments of rundale with the informants of resilience and metabolic rift, given its effective constraint on expansion, and tendency to expose producers operating under such regimes to increased ecological risk through intensification, and loss of biodiversity. Despite this 'Malthusian drift' and tendency

[199] According to L. A. Clarkson Ireland's paradoxical economic stagnation and impoverishment throughout the early nineteenth century, despite its contribution to the emerging Atlantic economy, is accountable for by its exploding population, and resultant abundance of labour, which rendered the introduction of capital-intensive methods and widespread enclosures unnecessary, given that landlords could achieve greater output simply by applying more labour to cultivation (1981: 29).

[200] MacParlan noted as much in Co. Mayo (1802), where demand for land by graziers prior to the late 18th century tillage surge pushed rundale to the fringes; '...grazing drives the natives away from the fertile fields into the swamps and mountain' (cited in Whelan 1999: 78).

toward monoculture, the preceding evidence demonstrates quite clearly that the hierarchical integration of rundale remained largely intact, albeit with a concrete labour process not readily explicable in terms of market imperative alone. Nor does rundale conform particularly well to a rigid concept of 'capitalist' alone, given the necessity of considering both the pervasive rent relation, and the degree of autonomy exercised by the tenantry over the means of production.

The mere presence of a developed cash nexus at settlement level has unfortunately lured others to a deceptive acceptance of the presence of capitalist relations, and the work of Meiksins Wood (2002) is exemplary of this strain of thought[201]. Wood's broader argument addresses the prevailing interpretation of capitalism as a latent, immutable human tendency, existing in embryonic form throughout all of history. Accordingly, this dominant perspective holds that the history of capitalism is intimately bound up with the grand sweep of world history, which consists merely in the progressive removal of barriers to capitalism's full realization. In essence, Wood attempts to de-naturalize such accounts by demonstrating the historical specificity of capitalism as a comparatively recent social relation with origins in agriculture, rather than urban industry (Wood 2002). Although the necessity of this critique is not in question, the manner in which Ireland is treated in its overall narrative must be addressed. Initially, Wood establishes the specific mechanism by which capitalism penetrates rural relations, by suggesting the transition from feudalism to capitalism be reckoned in terms of a transformation of property relations through dispossession, and the institution of the market as prime mediator, which assumes '…an unprecedented role in capitalist societies, as not only a simple mechanism of exchange or distribution but the principal determinant and regulator of social reproduction' Wood 2002: 97). Consequently, the extent of this transformation implies a pervasive penetration of the commodity form into the immediate production and exchange processes. The result of this institutionalisation of market relations under capitalism is thus, according to Wood, '...a constant systemic need to develop the productive forces' (ibid).

With regard to Ireland, Wood draws a clear distinction between the attempts of the early sixteenth century plantations to institute a system of feudal subjugation upon the Gaelic order by military means, and later attempts of the Tudor monarchy to impose an alternative model based on revolutionising existing social relations;

[201] In general, a dichotomy may be described in the feudalism-capitalism transition debate, between those who emphasise external forces such as trade as a catalyst for change, and those who emphasise the agent of movement as residing with the class structure of the particular society under consideration (Milonakis 1993-1994: 390-391). The question of class complexity, particularly with regard to Robert Brenner's (1976) articulation of internal class differentiation as a mechanism generating macro-structural variability, is applied as an explanation of differential resilience in chapter 6.

> "In the late sixteenth century, England's Irish strategy underwent something like an instant transition from feudalism to capitalism. The Tudor state decided to embark on a more aggressive process of colonization. But this time, the effort to exert extra-economic control by a more effective military conquest was supplemented by an attempt to impose a kind of *economic* hegemony, using military force to implant a new economic system, as well as a new political and legal order" (Wood 2002: 153)

Consequently, Wood characterizes these later efforts as successful in instituting a new imperial project, which sought to '…subdue the Irish by transforming their social property relations and introducing agrarian capitalism' (Wood 2002: 154). In the context of the foregoing discussion, the limitations of this overly simplistic model are clear. In the first instance, Wood's distinction between successive waves of plantation, as models representing discrete breaks in organisational form, is very much overdrawn; as outlined in the preceding section, both waves of plantation were equally deficient in fully eradicating certain institutions of the Gaelic order, particularly in terms of customary transmission and subdivision. Secondly, consideration has here been given to how the laws of accumulation, with respect to colonial Ireland, do not compel a consistent development of the productive forces as under capitalism; quite the opposite, as a general movement towards extraction of rent through relative increases under consolidation and mechanisation arrived comparatively later in Irish economic history.

Alternatively, as Connell suggests above, converse trends of fragmentation were tolerated to a large extent, insofar as exchange-oriented cash crop production continued, facilitated by subsistence on the potato. Finally, as the model advanced at the beginning of this chapter has suggested (and since qualified), the question of locating a discrete point of transition with respect to the institution of market relations and the predominance of specifically capitalist relations is less illuminating a task than that of articulating the complexities of coexistences, in terms of multiple modes of production. The institution of market-oriented cash crop production in the context of figure 6.1 thus permits this articulation, by recognising that valorisation was achieved beyond the borders of Ireland through the appropriation of its surplus through extra-economic coercion (not through market imperative, post-1600 as Wood suggests). Furthermore, this model implies that underlying relations of production are themselves better conceptualised, in the context of rundale, as essentially primitive-communal, which themselves obtain under the auspices of essentially feudal rent. In short, there is little validity to the contention that 'The Irish model, then, represented a pattern of imperial settlement different from other European empires, a form of colonial domination that replaced existing property relations with new ones driven by market imperatives' (Wood 2002: 155), given that it glosses over the internal complexities of Irish social structure and social relations, as the mode of production approach employed here has revealed.

There is some further theoretical ambiguity in the manner in which the concepts of *capitalism* and *market* are deployed in such transition debates as discussed above. The tendency in the preceding critique has been to conceptualise change in terms of the dual presence of *capitalism* as a social relation between proprietor and tenant driven by accumulation, and *market* as a structure which determines the concrete organisation of labour and movement of goods through signification. Marx's theoretical development of the commodity form demonstrates the necessity of deeper clarity, further underscoring certain fallacies inherent in the preceding reduction of complexity. In *Grundrisse*, Marx was adamant regarding the necessity of capital to act as a pervasive determinant of the organisation of productive activity vis-a-vis the commodity form; the possibility remains, therefore, that the mere presence of exchange value is insufficient in itself to constitute a revolution in the mode of production;

> "Monetary greed, or mania for wealth, necessarily brings with it the decline and fall of the ancient communities [*Gemeinwessen*]. Hence it is the antithesis to them. It is itself the community [*Gemeinwessen*], and can tolerate none other standing above it. But this presupposes the full development of exchange value, hence a corresponding organization of society. In antiquity, exchange value was not the *nexus rerum*; it appears as such only among the mercantile peoples, who had, however, no more than a carrying trade and did not, themselves, produce" (Marx 1973: 223)

Given that preceding contributions have qualified the essential underlying relations of appropriation between labourer and proprietor as essentially feudal, it is thus difficult to conceive of such a capitalist relation obtaining amongst the majority of direct producers, given the inability of their surplus labour to accumulate and annex to itself, the labour of others; 'It is the elementary precondition of bourgeois society that labour should directly produce exchange value, i.e. money; and similarly, that money should directly purchase labour, and therefore the labourer, but only in so far as he alienates [*veraussert*] his activity into the exchange' (Marx 1973: 225). Such is the necessity of a broader attention to the multiple dimensions and theoretical levels implicit in the concept of *mode of production*, the neglect of which has here led to an erroneous subsumption of social-structural complexity beneath a simplistic, general model of capitalism[202]. This tendency was itself criticised by Milonakis in his review of

[202] Evidently, class structure was itself more complex empirically, and beneath the simple theoretical relation between proprietor and labourer on which the feudal mode of production is reckoned, further class strata may be discerned. According to Proudfoot (1959), the practice of conacre (the creation of a sub-tenancy in return for rent or labour) was widespread in areas of marginal farming, and proved particularly useful where sufficient labour within the household was not forthcoming. In some cases, subsistence plots were leased by smallholders, at nominal rents or for labour services, to what became known as the 'cottier' class (Hoppen 1977: 63). Often, such patches of ground comprised little over an acre, yielding sufficient food in potatoes to ensure their continuity (Cullen 1968: 75). In 1848, J. Pim wrote of the cottier; 'He obtained a bare subsistence by very severe labour, and rarely effected any improvement in his own condition. It was practicable, on account of the facility with which the potato

previous conceptualisations of feudalism; '...because, in them, the complexity of the feudal relationship is depicted only partially' (1993-1994: 393). With regard to the market, as argued in chapter 5, in the context of world-systems theory and ecology, such macro-informants as the histories of world markets are thus better contextualised in terms of emergent complexity, for which the market occupies but one position in a panarchical matrix within which individual holdings, or systems of settlement may be located.

This, of course, is but one level of determination to which potential accounts of rundale may be reduced (in Wood's case, this reduction occurs at a greater level of abstraction, as all organizational forms are implicitly subsumed beneath an overdrawn market model). Such a recognition of the complexities of the Irish social form, as advanced in the preceding section, is thus essential in order to appreciate the ecological dynamics of rundale; without this essential qualification of the feudal nature of Irish tenure, and its continuity throughout and beyond the famine years, any appreciation of the contextual constraints upon rundale remains insular, and incapable of factoring the effects of externally-induced commodity production, and enclosure and consolidation on the immediate production process. Before advancing to the final articulation of an ideal-typical model of rundale in Ireland, a number of existing pronouncements, which have tended toward similar determinations at levels beyond the distinction between capitalist and pre-capitalist, must be examined. What follows is a summary 'sociology of knowledge' which imposes conceptual order on the current state of empirical research, and the range of existing explanatory devices typically brought to bear on rundale in particular.

6.4. An outline of historiographical complexity: contrasting conceptualisations of academic scholarship on rundale and communality in Ireland

Existing pronouncements and interpretations of the rundale system in Ireland may be categorised under five headings, according to their respective employment or reproduction of specific determinisms; (1) *Demographic* (ecological-demographic determinist) (2) *Historical-cartographic* (spatial determinist); (3) *Anthropogeographic* (spatial-ethnological determinist); (4) *Ecological-adaptive* (environmental determinist); and (5) *Residual-communal* (cultural-

was cultivated; and it is very doubtful whether it be practicable with any other crop' (cited in Connell 1950c: 55). The cottier class, along with landless labourers, suffered worst throughout the famine, their numbers falling by 40% between 1845 and 1851 (Hoppen 1977: 63). Elsewhere, the domestic linen industry facilitated extensive fragmentation of holdings (without a corresponding decline in living standards), and farm servants were employed extensively on many smallholdings in Co. Derry, constituting yet further layers of class differentiation (Johnson 1959).

ideological determinist). A summary overview of this historiographical complexity is tabulated below in table 6.3. Column two, *Dominant ontological level*, thus designates the essential systemic level to which explanations of communal organisational forms are typically reduced by the authors cited under column six, *Representative works*. Before elaborating this summary model, it is important to note that the authors categorised according to this typology should not be conceived as mere straw determinists placed for validation of the approach employed within this thesis; each have offered their own substantial (in cases paradigmatic) empirical and theoretical contributions which continue to influence and inspire ongoing research[203]. This typology merely represents a number of possible logical pitfalls to which one may succumb by over-emphasising a particular system level or dynamic at the expense of its dialectical relation to others. In totality, the works of those individuals cited under *Representative Authors*, are in many cases extensive and diverse, although this table is defensible as a representation of certain dominant themes within their main pronouncements on rundale and communality. Furthermore, although the following is primarily a critical appraisal or 'sociology of knowledge' specific to the subject matter of this thesis, its significance should be read in terms of its applicability across other case studies, as a demonstration of the capacities of dialectics and systemic epistemology, such as they enable recognition of such fallacies.

A complexity informed epistemology here confronts such forms of determinist-reductionism by conceptualising such systems in terms of their combined social-ecological dynamics. Furthermore, a resilience-informed employment of the concept of *adaptive capacity* later restores a sense of agency to the influential *Ecological-adaptive* framework (4) which has dominated historical-geographical interpretations of the rundale system in recent years through its implicit employment of rational actor or 'optimal state' assumptions, which view organisational forms as the outcome of transhistorical biological imperative (more of which in chapter 7). Although this ecological imperative is doubtless a critical factor in the case of subsistence-oriented agrarian systems (indeed, the salience of such qualified heuristics was argued above), existing accounts have tended to overstretch this dimension of human ecology to the status of 'prime mover' at the expense of a deeper abstraction to social form, and a broader contextualisation of such systems as modes of production within complex panarchical state-space. Conversely, adoption of the informants of complexity and resilience here enables

[203] Indeed, many of the forthcoming authors have provided a substantial portion of the empirical material upon which this study is based. Furthermore, given the numerous dimensions of systemic complexity this thesis addresses – by necessity in summary form, in certain cases – such studies are essential for exploring specific factors and phenomena. Problems unfortunately emerge when such factors, and respective approaches taken to their measurement, are argued as determinate or constitutive of the system dynamic as a whole.

avoidance of the worst excesses of actor-network theory inductivism by retaining the explanatory power of the concepts of resilience, panarchy and mode of production. Proceeding in this manner facilitates the interpretation of individual actors and settlement units as more than passive receptacles of structural and natural signification, without resorting to an exhaustive terminology of co-constructivist particularism which ultimately inhibits generalisation.

(1) Demographic

The influential works of K. H. Connell initially sought to account for the extraordinarily rapid rate of natural increase in Irish population, in the context of deficient statistical sources (see figure 1.5)[204]. Dismissing hypotheses attributing such increases to low sterility (fecundity), increasing marriage rates (nuptiality), decreasing mortality (Clarkson 1981: 30-34), or a decrease in the deliberate restriction of birth, Connell concluded that pre-famine Irish population increases must be understood in the context of extended marital fertility; '…if fertility increased, the only possible mechanism was earlier marriage – that women were spending a larger proportion of their child-bearing years in the state of marriage, and that therefore, in the absence of contraception, they had more children' (1950b: 280). As a conundrum in demography, the question often beckons as to why birth rates are not higher, given a theoretical upper maximum of 40 births per woman over a potential reproductive range of 30 years (Bongaarts 1975)[205]. Consequently, such questions concerning differential fertility, and explanations of population change in terms of reproductive behaviour, are typically approached from an examination of barriers to conjugal union formation, given that age at marriage may be considered a principal factor affecting birth rates in populations without intentional birth control (ibid: 292). According to Connell, the explanation for Ireland's increase resided in the factors of potato dependence, and the swing from pasture to arable in the wake of rising wartime grain prices toward the end of the eighteenth century. As outlined above, such economic conditions incentivized landlords to maintain an ever expanding

[204] In his appraisal of Connell's work, L. A. Clarkson (1981) concluded that Connell's upward revisions of post-1750 growth rates were in fact too low, and that population increase was likely to have been much higher.

[205] According to Bongaarts, such a theoretical upper rate of natural fertility is inevitably constrained by demographic factors such as cultural variation in marriage practices and delayed cohabitation (resulting in a loss of 25% of reproductive years), and biological factors such as secondary sterility and postpartum amenorrhea, which prolongs birth intervals. Given that nutrition and breastfeeding are acknowledged as key determinants of the length of postpartum infertility (themselves accountable for in terms of social context), the totality of social and biological factors conspire to place women in pregnancy for approximately one-sixth of their reproductive lives (Bongaarts 1975).

population engaged in labour-intensive tillage, a population sustained largely by uninhibited subdivision and reclamation, both of which removed restrictions to early marriage;

> "By the 1780's changed market conditions made a grain-growing tenantry a more profitable proposition to the landlords than the pasture farmers who were then occupying so much of their land. To acquire a tilling tenantry smaller holdings were necessary; the provision of the smaller holdings led almost inescapably to an increase in numbers. It resulted in the sweeping away of the old restraints to marriage. The peasant's children could, and did, marry as soon as they pleased and the earlier a girl married, the more children she was likely to bear." (Connell 1950b: 289)

With regard to the rundale system in particular, Connell pays it little specific attention in his seminal *The Population of Ireland*. Instead, Connell depicts rundale as a system prone to inefficiency not through the imperatives of landlordism, but through its own cultural logic; '…it was otherwise with the partnership system: yield was kept down, but by the peasant's veneration for tradition, not by the landlords profit seeking' (1950a: 76). Furthermore, Connell's brief overview emphasises its liability not to maximize returns on labour through cooperation, but to induce conflict, '…fights trespass, confusion, disputes and assaults were the natural and unavoidable consequences of this system; these evils, in their various forms, were endless, and caused great loss of time and expense to the people attending petty sessions; and, of course, continued disunion amongst neighbours, was perpetuated' (ibid: 78)[206]. Connell does not, however, adequately connect his suggested mechanism of early conjugal union to the tendencies inherent in rundale; given the prevalence of rundale throughout many western counties, and the concentration of population growth in such regions (outlined by Connell himself), it is difficult to maintain such a separation, as the rundale system was ideally suited to the sort of labour-intensive tillage and reclamation work argued by Connell as a key component in his demographic model[207].

[206] This conclusion is largely substantiated by the work of McCabe (1991) who attests to the extent of conflict experienced under rundale.

[207] Whelan's account of rundale as a functional adaptation asserts such a connection; '…rundale villages acted as a mobile pioneer fringe; the spade and the spud conquered the contours as the limits of cultivation rose from *c.* 140 metres to *c.* 250 metres between 1650 and 1840. Given the extent of marginal land in Ireland – even in 1840 an estimated thirty per cent of the land area was uncultivated, and in 1855 Richard Griffith considered the one-quarter of the Mayo countryside was permanently unreclaimable – and given the efficiency of rundale villages as a means of colonising such land, the marginality of their distribution becomes immediately intelligible…This massive reclamation, the intense subdivision of shares within rundale systems and the exuberant expansion into previously unsettled areas were all features of the astonishing demographic profile of post-plantation Ireland' (1999: 78). As a case in point, the townland of Upper Beltany, Co. Donegal, as reported by McCourt, devolved over two generations from a single farm of 205 statute acres to 29 holdings scattered in 422 separate lots (1955b: 48). Whelan's heuristic of growth under rundale captures adequately such tendencies toward exponential expansion in the absence of spatial restrictions (Aalen, Whelan and Stout 1997, see also figure 3.6).

Furthermore, his account slips somewhat into Malthusianism, an approach much critiqued by Marxists as a crude abstraction devoid of historical-material context; '…it will be agreed that the Malthusian theory, freed of its mathematical strait-jacketing, had a precise relevance to Irish conditions – with the qualification that what limited the growth of population was not the overall supply of foodstuffs, but the supply from that area of land which the landlords demand for rent left available for the production of the people's subsistence' (Connell 1950b: 289). Therefore, although Connell engages in a degree of contextualization, it is arguably insufficient in its consideration of how the rent relation obtained under differing conditions of access to the means of production, therefore giving rise to differing outcomes in productive activity according to social form. In terms of variability in household organisation and family structure, Kevin O' Neill also noted, in his analysis of 1821 census data for the parish of Killashandra Co. Cavan, that many peasants were living under conditions which restricted the formation of independent family units, suggesting deficiencies in the ability of Connell's model to account for differences in regional context (1984: 126).

Despite the above-noted shortcomings, particularly an imminent need for greater regional contextualization, Connell's account remains an influential, albeit highly general model of demographic change. Clearly, there is a grain of truth in such Malthusian heuristics, but only insofar as they remain qualified as excessive abstractions; demography clearly played a significant role in shaping the resilience of population-dense regions locked into extractive relations with the colonial apparatus, which in turn wrought profound consequences for local ecology and biodiversity. It is worth acknowledging also, that the characterisation of Connell's approach depicted in table 6.3, ignores his employment of a range of historical sources beyond those of the statistical, and its depiction of his epistemology further belies his insistence on qualitative corroboration of issues such as the extent of pre-famine birth control, and illegitimacy. His generalizations as to the specific mechanisms of demographic variation do, however, constitute a potential logical pitfall toward which accounts of rundale may tend, were they content to view such a system as merely a consequence, or facilitator of such expansion. In this sense, manifest trends in fertility would reveal little in themselves about the internal logic, or dynamism of the system itself.

(2 & 3) Historical-cartographic / Anthropogeographic

To date, the most prolific debates on the rundale system have addressed questions of its origins (the widely contested notion of its antiquity), and of its place within broader patterns and typologies of historical Irish settlement, as discussed summarily in section 6.2. Given that both

of the above orientations have developed in dialogue with each other, it is worth treating them together as a set of cohesive, yet substantively divisive debates. In terms of epistemology, such debates have typically manifested as a profound disagreement concerning the validity of cartographic and documentary data, against that of ethnological and archaeological field data and theorisation. Given the public prominence of these debates, and their role in shaping the terrain of subsequent historical-geographical research and interpretation, a closer inspection of its contributors is warranted.

Institutional Irish scholarship on the rundale system and clachan owes it origins to the Queen's school of Historical Geography, most notably the contentions raised by Estyn Evans's 1939 paper *Some Survivals of the Irish Openfield System*. Exemplified by the work of Evans, Desmond McCourt and Ronald H. Buchanan, through the Institute of Irish Studies at the Queens University Belfast, its most prolific period extended from the 1940s to the 1970s, throughout which its pluralist methodology (incorporating cartographic data, qualitative fieldwork and oral history) succumbed to a series of damning critiques by John Andrews (1974, 1977). The result of Andrews' critical commentary was a discipline-wide dismissal of their generalisations regarding the antiquity and prevalence of homogeneous peasant systems of Celtic descent in Ireland, which Andrews claimed were insufficiently grounded in empirical evidence. Evans's prominence is thus reflected in Whelan's description of his rejection many years later by historical geographers as 'discarding some of the most venerable concepts in Irish geography' (Whelan 1999: 187).

In 1939, Evans first forwarded his divisive hypothesis concerning the origins and antiquity of communal agriculture in Ireland, establishing a contentious framework of interpretation which involved projecting recent observations into the distant past; 'It is now clear that throughout western Britain and in many parts of western and south-western Europe, some kind of communal cultivation is of great antiquity,' with recent survivals of rundale constituting '…the interest of archaeological fossils, preserving in an unimpoverished way many of the characteristics of ancient Irish society' (Evans 1939: 24). Writing some years later, Evans reaffirmed the capacities of such a mode of reasoning to account for the vagaries of Irish settlement beyond that provided for by cartographic and archaeological record;

> "There is no incontrovertible evidence for the existence of the single-farm system in pre-Celtic Ireland, but both literary and archaeological evidence shows that the raths, cashels and crannogs of the Gaels were the isolated homes of chieftains and freemen. Where then did the peasantry live? Neither history nor archaeology furnishes us with much evidence, but working back from the recent past, we can say that the traditional unit of settlement

> accompanying rundale or infield/outfield system was the hamlet or kin-cluster" (Evans 1976: 53)

Accordingly, Evans' work sought to remedy a perceived deficiency in historical-geographical research conducted under the confines of source-driven methodology, by hypothesising the existence of a form of clustered settlement (contrary to the prominent 'Einzelhof' pattern emphasised by Seebohm and Meitzen), on the basis of logic, and contemporary field data. Accordingly, Evans described his chosen methodology as a '...brand of anthropogeography' (1992: 1), rooted in the regional personality constructs of cultural geographers such as Carl Sauer and H. J. Fleure, under whose direction Evans had previously studied. Evans' contemporaries took particular issue with his methodology which, according to Kevin Whelan, served to cast Irish society in a monolithic peasant framework. Consequently, his inferences engendered a sense of an Irish peasant world as; '…fundamentally a timeless one, a little tradition which endured through the centuries, and with underlying continuities with remote pre-history…by studying these timeless survivals in the modern world, one could trace the whole sweep of Irish settlement history from its genetic origins in prehistory' (Whelan 2000: 187).[208]

The most public manifestation of this disagreement appeared in a series of papers critical of the Queen's school, delivered by John Andrews to the annual conference of Irish geographers in 1974 and 1977. In these papers, Andrews largely dismissed both their methodology and findings, arguing that such approaches that failed to consider more concrete source materials were ultimately deficient. Initially, Andrews took issue with their method of logical elimination which sought to account for rundale;

> 'Why have their theories gone so far beyond the facts? A possible answer may be found in the kind of ethnic determinism which, as we have seen, has fallen out of fashion in other countries. Villages are Norman, towns are Scandinavian, raths are Celtic. What can clachans and rundale be? On the ethnic hypothesis, the only people left to attach them to are the people who preceded the Celts' (Andrews 1974:7).

Such criticisms paint Evans' pronouncements in a decidedly negative light, citing ahistoricism and ethnic determinism as their fatal flaw. Ultimately, Andrew's dismissal is indicative of broader paradigmatic cleavages within human geography of the time, which although slowly

[208] Similar criticisms were advanced by Charles Doherty; 'However tenacious Irish custom and tradition may be, these attempts to span 1000 years and more can hardly inspire confidence as a method of demonstrating continuity in the existence of the clachan as a settlement form' (2000: 62). Ronald Buchanan later noted that, despite criticisms to the contrary, such formulations and frameworks were essential to 'make connections across great distances of time and space, to stress ecological settings…and to show the relevance of space-time relations in the evolution of culture (Buchanan 1984: 133).

coming under the influence of various cultural and Marxist critiques of its Cartesian methodology, was as yet exhibiting clear defence of its somewhat positivist parameters[209]. Consequently; 'Over-simple categorizations such as 'rundale' and 'clachán' (Andrews 1977:9) are seen as far too limiting, and in this respect, Andrews criticisms are directed at a specific sub-genre of historical-geographical inquiry (exemplified by Evans), contrasting sharply with established academic convention[210]. Ultimately, it fell to Evans' student Desmond McCourt to impose some conceptual order upon the debate. In doing so, McCourt emphasised the capacities of Irish settlement for consolidation and devolution in a complex pattern of waxing and waning, according to which clacháns were capable of evolving from single settlement over time, and conversely, single farmsteads were capable of consolidating from declining clusters[211].

In this respect, McCourt's consistent treatment of the rundale 'not [as] a homogeneous population at a given time, but of one exhibiting manifold features of variation inside a framework of broad similarity' (1947:1), and within its broader historical context as 'scattered dwellings and compact farm units… [with the] possibility of the former at any time evolving into or emerging from the latter' (1971:127) appears to be on steadier conceptual ground. McCourt, of course, is correct to emphasize the inherent dynamism of rundale, but as Slater and Flaherty have suggested that; '…it involves more than just physical settlement patterns – rotating from scattered dwellings to compact farms. If this is a feature of change within the rundale system, the conditions that allow such a strange pattern to emerge need to be investigated' (2010: 4). Such dynamism has here been framed conceptually by Marx's dualism of communality which, although deficient in its ability to represent and assess the dynamics giving rise to change, serves to impose a degree of theoretical order on the physical phenomenon of nucleation. Furthermore, McCourt draws attention to the ancient Irish law tracts, which suggest a potential mechanism for rundale formation in the first millennium, contrary to its depiction as solely a post-medieval settlement phenomenon; 'They tell of an

[209] It has been noted by various parties to this debate (Graham 1994: 184; Crossman and McLoughlin 1994: 80, 89; Nash 2005: 52) that critiques themselves are contested knowledge forms, constituted within particular parameters of appropriate academic practice. It is therefore worth locating this particular methodological divide within Kuhn's model of normal science as discussed in chapter 1; such a debate as outlined above therefore constitutes an attempt at demarcating disciplinary convention – lest either approach be interpreted as inherently superior.

[210] Andrew's expressed specific concern with the potential for such a methodology, with its attendant ethnic preconceptions to blunt '...the researchers awareness of whatever regional or chronological differences may exist within his ethnic continuum' (1974: 7).

[211] Such a position was also affirmed by Proudfoot, albeit over a much greater timespan, who suggested that the rath was capable of co-existing with a form of open cluster or 'proto-clachán' which left little physical trace (cited in Doherty 2000: 60-61).

ordered agrarian society broadly stratified into free and unfree elements, the former possessing private land and occupying single-family raths, the latter living on tribal common land, subject to periodic redistributions, and forming partnership groups ('comorbships') out of which Sullivan believed small 'villages' and rundale schemes arose' (1971: 152).

Despite its critical reception, there is much worth salvaging from the approach of the Queen's school. It is clear that Evans in particular employed a unique mode of reasoning with the explicit aim of overcoming what he saw as the 'arid minutia of an elaborate bibliographical apparatus' (Evans 1976: 15). In this respect, and as noted by Graham, subsequent historical-geographical criticisms, such as those of Andrews were notably deficient in their ability to cope with social structures and even more so, social processes, through an over-reliance on privileged documentary sources (Crossman and McLoughlin 1994: 87; Graham 1994: 194)[212]. Notwithstanding Evans's own inability to cope with the diversity of social structures in rural Ireland (especially class), his comment that 'one must admire these scholarly aims so long as curiosity is not stifled by technique, and the scaffolding does not obscure the building' (Evans 1981: 15) lends further credence to the argument for a theoretical, systemic development of the rundale, and a revision of the conceptual constraints implicit within critiques from an empiricist-spatial tradition. Therefore, although contributors such as McCourt had already qualified certain historical ambiguities in the concepts of clachán and rundale (suggesting they be understood pluralistically as local vernacular, technical, and conceptual frame), the ultimate determination of the 'clachan,' according to critics of the Queens school becomes its spatial form, occluding the possibility, at least within such a geographical-spatial framework, of its determination by, or understanding through the kind of approach advanced within this thesis.

(4) Ecological-adaptive

Prominent amongst recent pronouncements on rundale and communality are those of Kevin Whelan (1995, 1997, 1999, 2000), whose depiction of rundale as a functional adaptation to the specific ecological conditions of the Irish western Atlantic fringe has enjoyed much currency of late. Whelan's account is perhaps the most explicit in its rejection of the contentions of the Queen's school concerning the antiquity of the rundale system, which he locates firmly within

[212] Andrews himself claimed that the proper course of action rested not within theoretical elaboration or abstraction; 'The best prospect for putting the discoveries of Evans and his students in a historical context may lie, not in the 'cold facts of land and landscape' but in the more careful differentiation of socio-economic groups within successive Irish and Anglo-Irish populations' (1977:9).

the post-plantation era, with particular concentrations of growth throughout the eighteenth century. On rundale as a functional entity, Whelan states;

> "Rundale was a viable functional adaptation to a specific set of ecological and demographic circumstances. These ecological settings were overwhelmingly marginal, being on mountainous, hilly or boggy areas. The glacially scoured west-of-Ireland environment was characterised by a limited amount of arable land, a wet climate, high wind exposure, stone-infested thin drift, impeded drainage and excessive leaching...In the rock and rain of the west of Ireland, the use of a permanently cultivated infield surrounded by extensive commonage can be seen as an intelligent response to ecological conditions. It was an ingenious adaptation to an environment where fertile patches of glacial drift were frequently embedded in desolate expanses of bog or mountain" (Whelan 1999: 77)

Notwithstanding its appeal as a parsimonious explanatory device, there is arguably a question concerning the appropriate direction of causality in such an account; it is plausible, for example, that post-plantation westward migrations of evicted easterners may have established a demand for cooperative labour-pooling, rather than cooperation presenting as a necessary consequence of expanded fertility – although both mechanisms are arguably valid in context of the preceding discussions. John Andrews alluded to such a reading in his critical examination of the lineage and concept of rundale; 'But should, say, an old hamlet with infield and outfield system be treated as a package of this type [rundale] when it is so common for some parts of it to occur without the others? Is it not just as reasonable to visualise each small group of farmers making its own uniquely individual adjustment to local circumstances? (Andrews 1974: 7).

Considering the potential extent of westward migrations in the wake of the seventeenth century Cromwellian plantations, toward areas where the carrying capacity of such lands was insufficient to sustain such a mass of incoming cultivators (Braa 1997: 197), it merely requires an application of logic to appreciate the resultant organisational form of rundale. In this scenario, communal exploitation of such marginal conditions remains one of few viable prospects in the context of a demand for excess labour, as would be required for reclamation on such a scale. Equally, much evidence has been presented thus far attesting to the ability of rundale to devolve exponentially into pockets of high-density settlement over successive generations, and Currie (1986) has already corroborated such an account by suggesting the proliferation of rundale was bound with prevailing labour requirements. Whelan thus firmly dismisses a potential connection between the more modern rundale, and such archaic nucleations as were hypothesised by Estyn Evans; 'The west of Ireland was a zone of settlement discontinuity, not of continuity. It was not an archaic but a very modern society,

whose very existence was underpinned by a relatively novel development - the extensive infiltration of the ecological interloper - the potato' (Whelan 1995:24)

His general position is quite clear, however, in its essentially functionalist orientation;

> "Large swathes of this small-farm world were essentially new phenomena, a response to the surging demographic profile of Ireland between 1600 and 1840, which saw its population soar from 1 million to 8.5 million. This explosion necessitated massive reclamation, intense subdivision and expansion into previously unsettled area, aided by the potato's propensity to flourish even in wet, thin, nutrient-poor soils. Much of the drumlin and Atlantic regions were only heavily settled as an outreach product of unrestrained population growth. Some of the most classic small-farm communities can trace their origins to the eighteenth century" (Whelan, 2000: 190)

By way of a general critique, Steiner and Nauser identify a critical shift in human-ecological thought which bears directly on such a perspective, specifically; '…the shift from looking at society and culture as a kind of anonymous superorganism which tends to adapt itself to changing environmental conditions to a more differentiated perspective which recognizes that societies are composed of individual persons acting within given structures' (1993: 19). Accordingly, the authors suggest that significant theoretical advancements have been achieved by restoring a sense of agency to human-ecological modelling, by emphasising the co-evolution of nature and society; organisational form may thus be viewed as an emergent property of an historical, natural-social dialectic (i.e. the evolution of institutional space in which structures are recursively produced). The appropriate question to ask of a model as Whelan's is whether it permits such recognition of historical-systemic complexity, both in terms of the panarchy depicted in figure 6.1, and in terms of the necessary interplay between structure and agent. As per Steiner and Nauser's critique of unqualified instrumentalism, orientation toward ecological context must be understood as a social-ecological process, whereby rules and conventions governing ecological exploitation may change, adapt, or remain constant. Indeed, change is the hallmark of a complexity-informed epistemology of such systems, an understanding of which warrants neither excessive ecological, nor socio-cultural determinism.

In short, Whelan's perspective limits the kind of case based comparative work which is a staple of historical sociology, by inhibiting appropriate dialogue between agent and structure, and by downplaying the potential for evolutionary change within the commune itself. Such a model considers mainly the principle modes of ecological exploitation conducted under rundale (reclamation and share allocation), but in doing so, it merely posits rundale as a case of

biological logic pitted against specific environmental vicissitudes. Framing such systems within the concepts of mode of production and social form thus permits abstraction and comparison across contexts without reducing or 'essentialising' such systems to the level of biological signification alone. The heuristics of resilience and adaptive capacity - whilst they do not deny the significance of contextual constraints such as climate and disease, landlordism and enclosure as key determinants of the decline of rundale - permit an assessment of the integrity of such systems in terms of their unique capacities for adaptation without resorting to restrictive optimal state assumptions, as argued in chapter 3. In short, conceptualising such systems as metabolic entities permits a broader articulation of the essential dynamics of rundale beyond that engendered by such a functionalist heuristic alone.

(5) Residual-communal

Others have attempted to locate the essential determining structures of rundale within the mindset and mentality of its members, contrary to the adaptive determinism prescribed by Whelan's model. Writing on the village of Faulmore, Co. Mayo in 1976, Tom Yager commented that '…its palpable collective spirit led me to suspect that a more thorough-going communalism lurked in the past' (2002: 154). Elaborating on the nature of this communal mentality, Yager further claimed; 'It is safe to assume that co-operative work ties were cemented by a strong sense of neighbourly affiliation and a lively evening social scene, as I saw myself in Faulmore in the 1970's. Rundale was more than a technical arrangement; it was a way of life' (Yager 2002: 162). Yager thus concludes in his investigation into the origin and development of rundale, that a utilitarian 'group mind' formed the basis of the rundale system. In advancing such a proposition, Yager idealises and prioritises the superficiality of community spirit as a prime determinant, and somewhat overemphasizes the historical permanence of collective sentiment. Indeed, ethnographies of the West such as that of Brody (1973) had already claimed that much of the idealistic communality depicted by Arensberg and Kimball was declining before Yager's visit.

Yager was not the first to comment upon such a communal mentality; Engels certainly read traces of such a mentality amongst the native Irish in his *Origin of the Family…* (1884 [1978]), and K. H. Connell saw fit to distinguish communal tenure from severalty in terms of peasant mentality in his *Population of Ireland* (1950a). Nonetheless, despite the potential objective extent or potency of this communality, it remains an epistemological fallacy to prioritise such a phenomenon as constitutive of systemic cohesion, given that it is determined by underlying material structures. James Connelly was amongst the first to attempt to formally situate the

Irish common property regime in its material context, in the opening chapters of his *Labour in Irish History*;

> "It may surprise many readers to learn that up to the date above-mentioned [1649] the basis of society in Ireland, except within the Pale (a small strip of territory around the Capital city, Dublin), rested upon communal or tribal ownership of land. The Irish chief…in reality held his position upon the sufferance of his people, and as administrator of the tribal affairs of his people, while the land or territory of the clan was entirely removed from his private jurisdiction. In the parts of Ireland where for 400 years after the first conquest (so-called) the English governors could not penetrate except at the head of a powerful army, the social order which prevailed in England – feudalism – was unknown, and as this comprised the greater portion of the country, it gradually came to be understood that the war against the foreign oppressor was also a war against private property in land" (Connolly 1944: 3-4).

Connolly's account of colonization as a war directed against, in equal measures, Irish political and social order, resonates with Nicholls and Kelly's accounts of the difficulties encountered by the British in their imposition of new legal regimes in order to supplant the Gaelic communal order. Connelly thus seeks to place such a regime, as an antithesis of private ownership, in its material context. The resultant native mentality, for Connolly, is thus situated materially within the contradictions engendered by imperialist expansion, insofar as they artificially supplant the existing economic order;

> "Communal ownership of land would, undoubtedly, have given way to the privately owned system of capitalist-landlordism, even if Ireland had remained an independent country, but coming as it did in obedience to the pressure of armed force from without, instead of by the operation of economic forces within, the change has been bitterly and justly resented by the vast mass of the Irish people, many of whom still mix with their dreams of liberty longings for a return to the ancient system of land tenure – now organically impossible" (Connolly 1944: 4)

Although the above lapses somewhat into idealism, others have argued that for Connelly, nationalism and socialism were inseparable components of a possible Irish independence movement; indeed, the concept of antecedent communalism featured explicitly in Connolly's rhetoric; 'Nationalism without socialism – without a reorganization of society on the basis of a broader and more developed form of that common property which underlay the social structure of Ancient Erin – is only national recreancy' (cited in Lloyd 2008: 104)[213]. Indeed, far from

[213] Lloyd also argues that Connolly was hostile to ideological uses of communal stereotypes in nationalist movements, opting instead to emphasise their material and historical basis – although his empirical development of communal systems remained ambiguous (2008: 108). In any event, given the extent of litigation which attended later survivals of rundale, the extent to which the Irish peasantry may have idealised such a system remains doubtful – although Lloyd suggests the concept of a residual moral economy may account in part for certain latent traditions of communalism.

mere rhetoric, Emmet O' Connor has suggested that Larkin was quite taken with the potential for such notions of communalism to act as a basis for counter-cultural values, in opposition to those of bourgeois capitalism (ibid: 107)[214].

Others are less explicit in positing such a connection between materiality and mentality; Luke Gibbons has claimed that communalism constituted an essential basis for social order, which manifested outwardly in a form of altruism in times of need; '…far from being obsolete in Ireland, moreover, these sentiments formed the basis of the moral economy of the countryside as exemplified by the communalism of the "Rundale" system in Irish agriculture, and the close webs of affiliation through which rural townlands wove their identities' (Gibbons 1997: 253). Alternatively, Gramsci posited such an historical connection between past and present mentality in the form of folklore which, he claims, constitutes; '…not so much the survival of an alternative conception of the world as it is…the residue of traditional conceptions of the world…It belongs implicitly to the framework of a fossilized and anachronistic culture' (cited in Lloyd 2008: 117). In either event, it is insufficient to accord explanatory primacy to the role of ideas; the above explication of the social form of communality has demonstrated various complex interplays between culture, ideals, structure and environment, in a manner which precludes so restrictive a priortisation of mentality as a prime determinant. Consequently, it must be concluded that such assertions, insofar as they seek to penetrate beyond historical record and the post-plantation era on the basis of contemporary mentality, must remain a highly tentative proposition. Insofar as they abstract mentality from its material basis, it becomes difficult both to examine the dialectical interplay between structure and agent (in a manner diametrically opposed to that of Whelan's ecological determinism). In short, it restricts the capacity to demonstrate how the opposing tendencies of communalism and individualism '…do not just operate at the level of the psychological mind-set of the participants but are actually determinants of the diverse economic and social structures of this agrarian system' (Slater and Flaherty 2010: 5-6).

[214] Others are less sympathetic to nationalist notions of pervasive ancient communalism, a phenomenon which Eoin MacNeill (1921, 1937) views more as an emergent clannish mentality on the part of an already instituted ancient aristocracy; 'The political system of Ancient Ireland was no more communal than that of the Roman republic…The ancient Irish "clan system" or "tribal system" are very modern inventions…The dogmatic assertion that communal ownership existed seems to have intimidated or hypontised some writers' (MacNeill 1921: 144).

Table 6.3. Contrasting Conceptualisations of Academic Scholarship on the Rundale System

Perspective	Dominant ontological level	Interpretation of rundale	Methodology	Epistemology	Representative authors
1. Demographic	Ecological – demographic	Demographic regime of expanded fertility through early conjugal union, facilitated by potato subsistence and reclamation	Historical-demographic	Positivist, objective measurement, deductive logic, demographic / statistical sources	K.H. Connell
2. Historical-cartographic	Spatial	Nucleated spatial form of late medieval – seventeenth century origin	Cartographic	Prioritisation of cartographic data and formal historical record	John Andrews
3. Anthropogeographic	Spatial-ethnological	Social-agricultural system and spatial form of early historical origins and continuity (from iron age),	Archaeological-ethnological / field and source oriented	Flexibility in source validity – cartographic, physical and qualitative	Estyn Evans, Desmond McCourt, Ronald Buchanan
4. Ecological-adaptive	Ecological	Functional post-medieval adaptation to specific ecological conditions	Historical-geographical	Greater theoretical development, but reliance on cartographic and formal historical record	Kevin Whelan
5. Residual-communal	Cultural-ideological	Form of co-operation sustained by communal mentality	Ethnological-historical / theoretical	Interpretivist, validity of folk accounts, myth, legend and backward extrapolation of contemporary residual communal practice	Tom Yager, David Lloyd, James Connelly

6.5. Toward an ideal-typical model of rundale identity

A key concern in previous evaluations of structuralist approaches to systems theory and modelling throughout this thesis has been their assertion of its inability to holistically represent social-ecological systems schematically. Consequently, one of the key deficiencies of such a methodology is that it lapses into mere description and static representation without a sense of the centrality of movement, tension, contradiction and internal relatedness between components. The preceding material has outlined an alternative model, one which takes the labour process and its organisation in terms of access to the means of production, as its central category, upon which a depiction of rundale as a distinct social-ecological system, or mode of production has been advanced. In such a model, the interplay between nature and society in metabolic exchange has featured prominently, and preceding discussions have remarked on how such a mode incorporates a range of institutions and relations, which obtain together in varying stages of development and devolution according to space and time. At this point, it is therefore worth imposing some form of order upon the above ideal-typical depiction of the organisation of production under rundale, drawing upon heuristics outlined in chapter 3. To reiterate, Cumming et al (2005) have proposed the following four dimensions as key constituents of *identity*, in their attempt to situate the concept within a resilience framework;

> "... (1) the components that make up the system; (2) the relationships between components; and (3) the ability of both components and relationships to maintain themselves continuously through space and time... (4) innovation and self-organization; resilient systems will typically be capable of adjusting to a variety of exogenous conditions, although innovation can also reduce resilience...the performance of a particular function or set of functions may also be used to guide the choice of identity criteria (Cumming et al 2005: 976)

Accordingly, such an identity model may be advanced by means of table 6.4 (below) which empahsises, in particular, dimensions (1) and (2). Were more comprehensive data forthcoming, such components and relations as are depicted below could potentially form the parameters of a state or property space within which specific settlements might be located through measurement. In this manner, data from an individual settlement at a particular point in time could be tabulated according to its values on each dimension, and its trajectory mapped in terms of its movement within the property space defined by the same parameters. Unfortunately, such data are not available, and the table must of necessity act as an ideal type (a more comprehensive configurational analysis is offered in the following chapter using data on different macro-properties at higher levels of aggregation). Its utility is borne out by the

manner in which it acts as a representation of the essential form of rundale, as a multidimensional assemblage of components which contribute to its ecological integrity, by binding the system together. As such, it demarcates the rundale system as a cohesive, distinct entity without resorting to conditions of space alone – although critical spatial elements feature prominently.

Table 6.4. Critical identity components, relations and identity-loss thresholds of rundale

Components and relations constituting rundale identity	Identity state / value	Threshold of identity loss
Tenure	Joint tenure	Individuated holding
Property transmission	Partible inheritance	Primogeniture
Local governance	Governance by communal council / headman	Solitary decision making
Legal reckoning	Customary law, usufruct entitlement	Civil / common law, private property
Field system	Openfield (infield-outfield) system with communal share allocation	Enclosed fields, stable boundary demarcation
Spatial layout of individual holdings	Fragmented	Consolidated
Settlement density	High density, capacity to expand through reclamation	Low density, capacity to expand restricted through enclosure
Productive activity and composition	Simple – collectively maintained balance of subsistence and cash crop	Complex – encroachment of subsidiary industry and individual accumulation
Grazing allocation mechanisms	Soum/collop/cartron	Formal (trans-local) calculation of entitlements, fixed measurement
General topographical location	Upland / marginal land	n/a
Demography	High fertility, high subdivision	Restricted subdivision, high migration, impartible inheritance
Transhumance	Seasonal movement	Enclosure / individual herding
Style of building	‘Lower class’ building (see census criteria)	Sturdier constructions

According to existing theory and practice in resilience-based human ecology, the various attributes of identity depicted in the above table function to augment resilience by governing key system dynamics (Walker et al 2006). It has here been observed how the properties of usufruct entitlement, fragmented holding and seasonal movement of livestock functioned to permit combined tillage and pasturing in the absence of sufficient utilisable space or labour on the part of any one individual. Similarly, allocation of grazing entitlements by the qualitative Soum, and periodic rotation of fragmented arable shares acts as a hedge against individual accumulation, and therefore an undermining of the communality which constitutes the very basis of the system itself[215]. Consequently, emphasis is less on assessing change in terms of quantitative movement (i.e. systemic change or collapse may not be reckoned solely by thresholds of settlement size, yield output, or the magnitude of peripheral commodity production), but rather in terms of qualitative change. As argued in chapters three and four, change in social-ecological systems is not readily assessed in terms of mechanistic models which emphasise departures from key variable values; concern instead rests with assessing the persistence of identity over time as a measure of systemic resilience, an investigation which may be achieved quantitatively and qualitatively, by adopting the heuristic of adaptive capacity as a specific quality, mediating resilience. The forthcoming penultimate assessment must therefore explicate how the above components of identity function in unison to facilitate the reproduction of the system - both physically, and in terms of collective structure - and how endogenous and exogenous factors conspire to undermine the ability of the system to respond to perturbation;

> "...complex systems are defined by the nature of their main components, the relationships of these components to one another, and the maintenance of both spatial and temporal continuity, i.e., systems may move in space and inevitably move in time, but saltation in either instance constitutes a loss of identity. From this point of view, a complex system is a network of components connected by various dynamical relations that include inputs, outputs, and external constraints" (Cumming and Collier 2005: 4)

The scope for quantitative investigation is not yet exhausted however; there exists a range of aggregate data which permits some formal implementation of the configurational approach outlined at the beginning of this chapter. Given that ecological resilience, as opposed to engineering resilience, is concerned with the width of 'stability basins' within which such systems move (see figure 3.7), it becomes possible to examine macro-relations among key variable sets, which may indicate potential diminished resilience at settlement level. In short, the properties of particular regions may be explored in terms of their measurement on key variables in order to discern the potential presence of distinct social-ecological regimes, using a

[215] These properties, and those of table 5.4 in general, are developed further in chapter 7

variety of case-centred methods, and with qualified applications of linear modelling. By adopting a configurational approach, it becomes possible to examine relations amongst variable sets, and to explicate both the properties of rundale-dense regions, and the diversity of conditions under which rundale may exist. With reference to table 5.1, this brings analysis to research stage four, which invokes the concepts of regime and attractor in a case-oriented quantitative manner, in order to exploit such data in the manner mandated by Ragin and Byrne. In terms of table 6.1, consideration now turns toward a quantitative investigation of macro-systemic context.

7

The macro-context and ecological dynamics of communality in nineteenth century Ireland

The differential distribution of resilience, and variation in the mechanism of metabolic rift according to historical and local context, has featured as an imminent possibility in foregoing chapters. These discussions have suggested that in order to render local ecological dynamics intelligible, initial stages of methodology must attend to abstraction, in order to characterise the essential identity components and dynamics of the system in question, thereby providing a working ideal-typical template for further empirical elaboration. Having subjected the rundale to this abstraction in the previous chapter, emphasis now turns toward further operationalising the insights of complexity and resilience, in order to quantify the potential differential distribution of ecological risk across Ireland in the mid nineteenth century. This objective is pursued through two related routes.

The question of classification is first addressed by subjecting a set of aggregate data on pre-famine Ireland to an optimisation clustering procedure, in order to discern the potential presence of distinctive social-ecological regimes. The results of this exercise reveal both the distribution of ecological risk and diminished resilience across the state-space of Ireland, and the centrality of communality within the resulting regime typology. In the process of quantifying such regimes, a macro-context for subsequent investigation at lower levels of aggregation is thus established. Following contextualisation and specification of the mechanism of metabolic rift, such as it manifested under the rundale system, a series of regression models are presented which assess the contribution of various structural conditions to a range of crucial ecological outcomes between 1847 and 1849. These outcomes are selected in the context of their theoretical and conceptual relevance, and include variables implicated in existing narratives of metabolic rift such as productive activity, yield, and famine-era distress. These results suggest that areas of high communality were particularly prone to diminished resilience and ecological stress, an outcome which calls for interpretation in the context of heuristics and theoretical informants developed across preceding chapters.

7.1. A complexity-based approach to typology: deriving social-ecological regimes

7.1.1. Typologies and models of settlement & productive activity in nineteenth-century Ireland

In addressing the complexities and potential internal diversities of pre-famine Ireland, a range of existing typologies abound which have sought to reduce the undifferentiated unit of 'Ireland' to a number of distinctive zones or regions corresponding to particular economic, geographical, and demographic characteristics. Prominent amongst these endeavours is that of Kevin Whelan's four-fold typology of eighteenth century 'regional archetypes' (1991, 2000), with continuities extending into the nineteenth century as demonstrated by O' Grada (1994: 35)[216]. Whelan's division thus postulates a *pastoral* archetype, running from north-east Leinster to inner Connaught, driven by export price fluctuations, yielding patterns of periodic growth and decline. A *tillage* archetype of mixed farming may be observed extending across the Anglo-Norman coastlands from Cork to Wexford and northwards from Wicklow to Dundalk; this archetype approximating a form of mixed farming, experiencing pronounced periods of growth throughout the Napoleonic era of soaring grain prices, and subsequent contraction throughout periods of pre-famine price abatement. Thirdly, a *proto-industrialisation* archetype, spurred by favourable circumstances such as technological, infrastructural and competitive innovation may be observed, centred on key production zones of the Ulster linen trade (Whelan 2000). Whelan's fourth archetype of *small farming*, concentrated in a crescent running from Cork to North Donegal, is of particular interest in light of its problematic influence on Irish historical geography throughout the twentieth century, as the exceptionalism of this Western 'peasant fringe' has long featured as a recurrent theme in both academic and popular discourse (Evans 1957; MacNeill 1921).

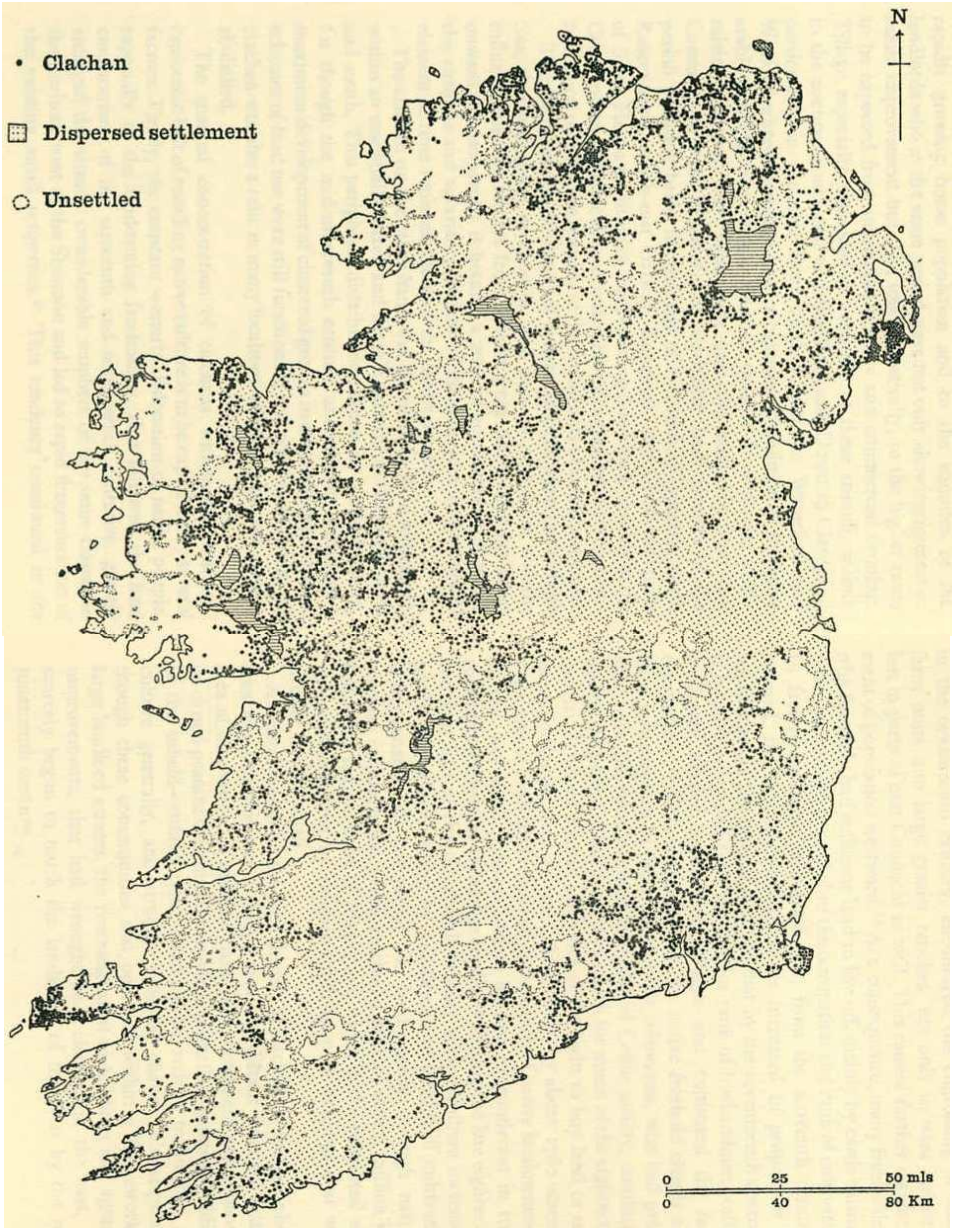
The contested nature of this *small farm* archetype owes much to the problematic reception of the work of the 'Queens' school' of historical geography, the specifics of which have been detailed in chapter 6. Much of this debate has centred on the widely contested notion of the antiquity and origins of the rundale system prevalent throughout this archetypal zone, its concomitant pattern of nucleated settlement, and associated institutions and practices. An erroneous over-generalisation of this archetype thus formed the basis of Evans' monolithic

[216] Other approaches to the concept of class include that of Samuel Clark, whose class framework emphasises relations of people to land (1982). Clark's scheme thus examines the proliferation of sub-tenancies, and the entrenchment of multiple mediating entities between occupier and landlord, as an essential characteristic of the class structure of nineteenth century Ireland.

'peasant subsistence' model of pre-famine Irish agriculture, which glossed over the internal complexities of Irish settlement distribution, social stratification, and agricultural-economic activity (Doherty 1999). Writing in 1939, Evans hypothesised that the rundale system constituted a system of great antiquity with potential origins in the Iron Age. In the decades since Evans' foundational pronouncements, many subsequent developments in historical geography and historiography, particularly the explanatory frameworks and regional typologies brought to bear on pre-famine Irish settlement, have proceeded in critical dialogue with the work of the Queens school, and its problematic hypotheses concerning the prevalence of such small, quasi-subsistence farming units.

There is much evidence to warrant a closer inspection of the characteristics of this Western *small farm* archetype. According to the work of Desmond McCourt (1980), the existence of a peripheral *small farm*, or distinctively Western archetype is substantiated by the first edition '6-inch' ordnance survey maps, which reveal a concentration of *clachán* settlement – the nucleated concomitant physical settlement form of rundale systems – concentrated within the areas bounded by Whelan's hypothesised *small farm* zone (see figure 7.1 below).

Figure 7.1



Rural settlement patterns, 1832-1840 (McCourt 1971: 138-139)

There is little doubt that this western crescent was subject to the worst effects of the famine between the years 1845 and 1852. Although systematic estimation and comparison of mortality rates is impossible, owing to an absence of mandatory civil registration before 1864 (Vaughan and Fitzpatrick 1978), O' Grada (1986) has outlined a series of existing estimates ranging from 800,000 (Cousens 1960), to 1,000,000-1,500,000 (Mokyr 1980), the latter of which, based upon forward extrapolation of pre-famine growth trends is now considered an overestimate. Furthermore, it has proven difficult to ascertain the proportions of population decline

attributable to starvation, death by disease and emigration respectively. Controlling for emigration, O' Grada's data yields an estimate of population loss due to excess death of 981,000 - with particular vulnerabilities noted amongst the young and elderly - throughout the famine period (1986: 555). Kinealys' (2006: 369) poor-law union level analysis of variability in the up-take of soup rations throughout the famine years, further reveals a concentration of high distress in the western counties of Galway, Mayo, Clare, Kerry and Limerick. Tabulation and mapping of the agricultural census data of 1851, recently completed by the National Centre for Geocomputation (National Centre for Geocomputation 2010), further underscores the presence and continuities of such regional distinctions (see figures 7.2-7.5)[217].

As may be observed in the below figures, profound regional distinctions present according to 1851 crop distribution patterns. Production of wheat (figure 2.4) remains centred along an Anglo-Norman tract extending from South Kerry through Cork, Kilkenny and Wexford, with extensive flax cultivation (figure 2.3) centring on the protoindustrial spinning and weaving districts of Ulster. Although a number of profound correlations present, most notably a comparative concentration of potato cultivation and lower land valuation across the Western fringe - in turn corresponding to the distribution of clachans as noted in figure 7.1 – some reservations are warranted. Almquist (1977) and Gray (2005) have pointed out that such spatial distinctions are not representative of the true extent of proto-industrialisation throughout this period however, as significant proportions of rural households along the Atlantic seaboard engaged in spinning as a source of supplementary income (Gray notes over 50% of all occupied women in Donegal, Galway and Mayo were spinners, 2005: 52). Furthermore, patterns of high land fragmentation and early female nuptiality thought characteristic of this *small farm* zone, prevailed across much of Ireland throughout the early nineteenth century, resulting in 45% of all enumerated holdings across Ireland falling below five acres by 1841 (Connell 1950b: 284). An epistemological problem thus presents, whereby commonalities of process operating across regional boundaries are not readily represented by such spatial typologies.

[217] http://ncg.nuim.ie/content/projects/famine/Agriculture.htm

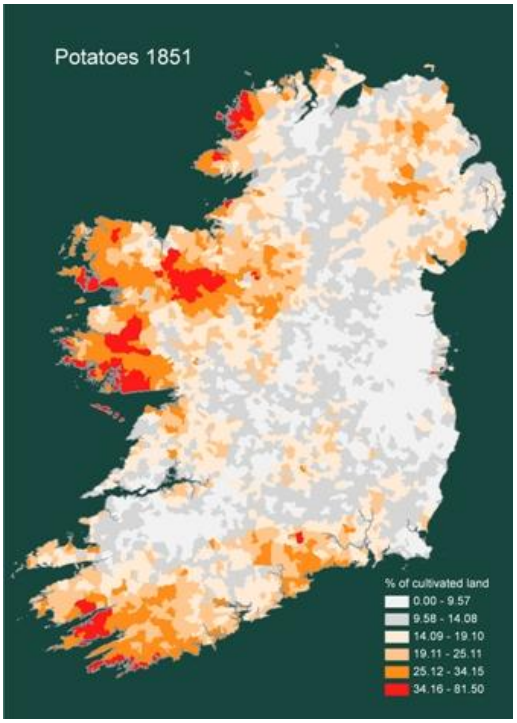


Figure 7.2

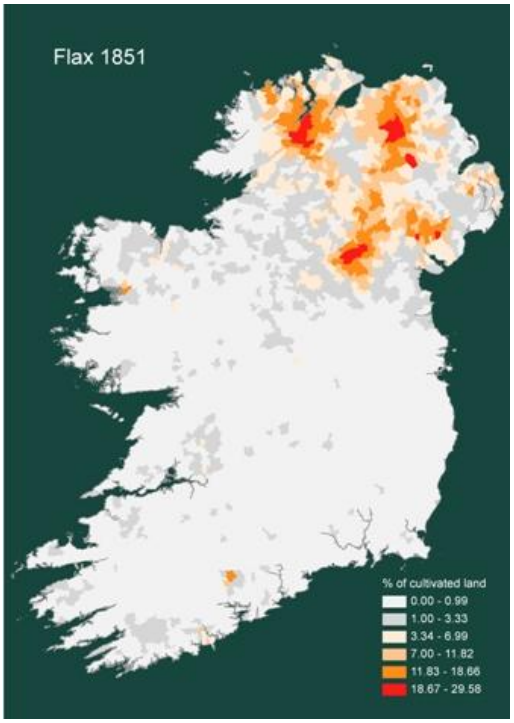


Figure 7.3

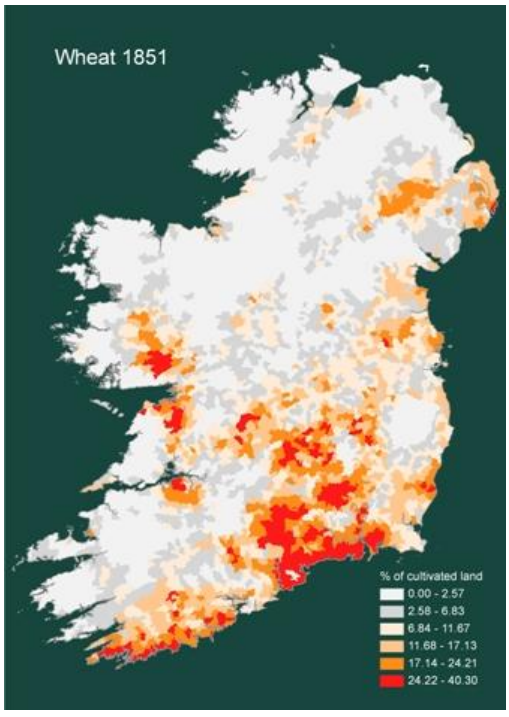


Figure 7.4

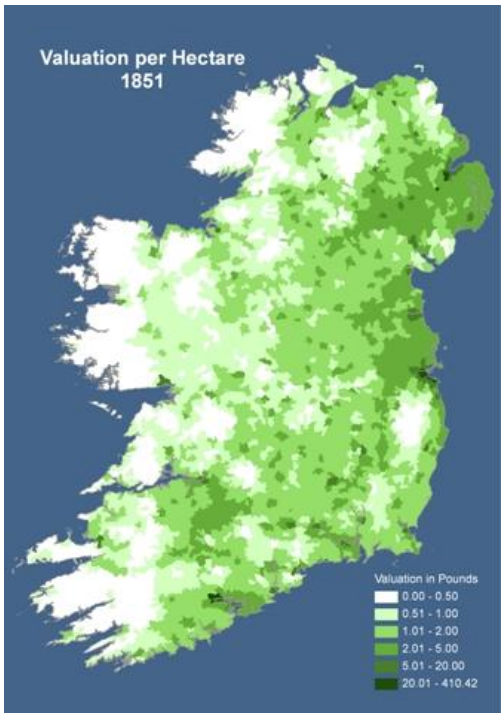


Figure 7.5

Despite such concerns, the exceptional and consistent characteristics of these Western areas warrant consideration, as the nucleated rundale settlements distributed across this area (figure 1) have courted much academic attention[218]. The extent of rundale throughout these western counties has already been established; indeed for County Mayo, McCabe (1991), estimated up to 831,000 acres – or 63% of the total area of County Mayo – was held in rundale in the 1840's. Furthermore, there is much qualitative evidence to support such a contention; Knight (1836), in his published travel memoirs, remarked on the prevalence of rundale throughout the Mayo Barony of Erris, and the documents of the congested districts board repeatedly cite the residual influences of fragmentation in these regions - in part engendered by the rundale system - as a barrier to land reform and redistribution efforts at the turn of the century (Breathnach 2005). Previous hypotheses positioning the rundale system as one of great antiquity have since given way to those interpreting such systems of communality as ones of adaptation to particular ecological niches, such as the marginal conditions of the West of Ireland, as discussed and tabulated in table 6.3 (see Aalen et al 2002; Whelan 1995, 1999). Indeed classical pronouncements on Ireland's unique demographic regime, such as those of K.H. Connell, have identified the critical role of wasteland reclamation, and the ability of the potato both to prosper in poor soils and yield a diet of calorific adequacy on small acreages, as key factors in the removal of barriers to early conjugal union, and consequently, higher fertility (1950b, 1962)[219].

Beyond such questions of ecology and settlement distribution, other prominent theorists within historical sociology have grappled with similar problematics, such as the explanatory capacities of macro-characteristics, and variables such as economic activity and class structure. Robert

[218] Although significant outliers of clachans may be observed in the South and North-East of *figure 1*, these may be considered distinct from those of the West. Burtchaell (1988) has suggested that those of the South, due to the influence of Anglo-Norman cultivation systems, represent devolved manorial systems previously operating under the medieval *three-field* rotation system. Consequently, they bear only structural similarities to those of the west, lacking their social institutions of collective governance, periodic reallocation, seasonal herding, and crucially, their poverty – buoyed as they were by the presence of speculative capital, and proximity to the prosperous market centre of Waterford. Centralisation of tillage in such areas, giving rise to their nucleated settlement patterns is thus attributable not to subsistence or reclamation partnership imperatives (as per those of the West), but the inherent centralisation of tillage engendered by the manorial three-field tillage system. Those of the North-East demonstrate differences in line with those of Kilkenny, due to their proximity to the linen centres of Ulster. Northern counties, due to the presence of 'Ulster custom', and the encouragement of husbandry practices distinct from those of Irish pastoralism enjoyed conditions conducive to fixed improvements such as drainage and enclosure. According to the 'Ulster custom', a tenant retained the right to uninterrupted sale of his lease, a security not present in the South (Gray 2005: 51). Consequently, fixed capital investments in the South were effectively discouraged, due to the inability of a tenant to realise the monetary value of his improvements through sale, and inevitable upward rental revisions incurred under systems of rackrent. Consequently, such territories are not readily comparable with those of the south (see Bell and Watson 2006 for a comprehensive study of clachans in the Glens of Antrim).

[219] As discussed in chapter 1, Ireland's population grew fourfold between the years 1687 (2,167,000) and 1841 (8,175,124) (Vaughan and Fitzpatrick 1978)

Brenner (1976) was amongst the first to thoroughly articulate the epistemological dangers inherent in such recourse to quantitative abstraction, particularly when properties such as economic activity and demography were elevated to the explanatory status of 'prime determinant'. Brenner's seminal paper thus took issue with the manner in which economic and social change had been analysed largely by economists, whom had tended to view social change as driven by objective economic forces such as demography, trade and markets, with mechanisms such as supply and demand assessed in terms of their capacity to induce social change through signification. Indeed, such an approach resonates with that of the commercialisation school, and certain practitioners of world systems theory examined in chapter 6, whom have emphasised the ability of variables such as the extent of commercialisation, and fluctuations in land-labour ratios to deterministically induce broader changes in socio-economic activity and structure.

Conversely, Brenner suggested that '...such attempts at economic model-building are necessarily doomed from the start precisely because…it is the structure of class relations, of class power, which will determine the manner and degree to which particular demographic and commercial changes will affect long-run trends in the distribution of income and economic growth and not vice versa' (1976: 31). Brenner's conclusion bears a crucial methodological and theoretical implication which resonates with that of complexity theory; if it remains a theoretical fallacy to accord explanatory primacy to the net effect of economic variables, alternative approaches must therefore consider, in a comparative sense, the ability of various structural configurations to give rise to differing socio-economic outcomes. Indeed, beyond the social and the economic, the ecological may now arguably be included under this rubric. In short, the assumption that particular outcomes are driven primarily by specific sets of prime movers - the effect of which remains constant across cases - must be subjected to greater scrutiny.

Although there is doubtless a broader narrative worthy of attention in accounting for the state of research at Brenner's time of writing (i.e. that of the rise, and subsequent dominance of reductive economic modelling), the prevalence of extremes of restrictive abstraction and empiricism has been a pervasive theme throughout preceding chapters. In this sense, it is unsurprising that Brenner chose to characterise the dominant mode of reasoning in quantitative historical studies as 'secular Malthusianism'. At his time of writing, Sraffa's critique of the labour theory of value was but fifteen years old, and rejection of the LTV had served merely to legitimise a quantitative theory of price, which gradually became institutionalised under the growth of the marginalist revolution. The concomitant logic of measurement inherent in this

general programme extended well to historical studies, where variables such as population, migration, investment and wages presented as sufficiently concrete to facilitate the kinds of investigation warranted by an emerging, and increasingly empiricist, research programme.

With regard to the abstraction and reification of market forces in historical analysis, Brenner cited Polanyi's treatment of institutionalisation and embeddedness, as concepts which capture the material foundation of market activity in human action; the market, for Polanyi, is thus viewed as embedded in society, but it also presents as an entity capable of undermining its social foundations, thereby creating space for the emergence of new organisational forms. The manifestations of these tensions and their consequences are far from uniform at national levels however, and in the case of Ireland, the colonial market was be viewed as sustained and structured by trans-national inequalities which wreak profound consequences for the local organisation and division of labour and, furthermore, settlement resilience and ecology. Such a conceptualisation arguably calls for a comparative approach which is capable of transcending the net effects of market and demography, by placing various cases in comparative context; a configurational approach is thus mandated.

What is required is an alternative typological approach which permits a closer examination of the presence of such distinctions and consistencies at a greater level of abstraction, albeit in a manner capable of transcending the epistemological confines of space imposed by the preceding forms of distribution mapping, and reliance on productive activity alone. In light of the specific methodology detailed at the conclusion of chapter 5, and in context of the elaboration of the relationship between 'system and case' at the beginning of chapter 6, an alternative approach to the critical interrogation of existing modes of typology is warranted which is capable of assimilating systemic complexity. Given the degree of abstraction the rundale system has been subjected to in context of the foregoing explication of its social form, discussion must now descend from the ideal-typical, toward an examination of the distribution of regimes of communality across the state-space of Ireland. Returning to the informants of complexity theory and resilience ecology, methods capable of addressing this question of multilevel systemic complexity may be applied, mindful of Brenner's caveat concerning the capacity of varying institutional and structural configurations to give rise to differential outcomes.

7.1.2. Orienting complexity and resilience to the task of typology

As established in chapter 1, advancements in sociological-systemic approaches subsequent to the major works of Parsons (1991 [1951]) have largely abated, yielding a problematic legacy of 'Durkheimian exceptionalism' in environmental sociology, whereby integration of the social and the natural has proven elusive both empirically and ontologically (Benton 1991, 1994, 1996; Castree and MacMillan 2001, Dunlap 1980, 1997; Gerber 1997, McNaughton and Urry 1998; Murdoch 2001; Murphy 1995; Franklin 2002; Gammon 2010; Swyngedouw 2010). Much of this post-Parsonian debate on the nature-society problematic has spuriously centred on the ontological separatism of *the social* as a distinct object of social-scientific investigation. Other prominent contributors have forwarded epistemic critiques of knowledge hierarchies through which the primacy of scientific knowledge in public discourse is challenged. Authors working within the rubric of Actor-Network Theory have thus developed alternative co-constructionist epistemologies of nature-society which carry implicit rejections both of structural regularities, and abstract consistencies of process (Dickens 1996; Latour 2004, 2005; Murdoch 2001; Swyngedouw 2004a; Yearley 2005).

More recently, others operating within mainstream sociology have sought alternative means of addressing such shortcomings in natural-social scientific dialogue and systemic theorising. Drawing upon the concepts of positive feedback and non-linearity associated with complexity theory, such authors have sought to rework systems analysis by emphasising the role of small changes in inducing path-dependent systemic change, thereby overcoming prior assumptions of negative feedback-conditioned equilibrium and normative socialisation, associated with more restrictive variants of Parsonian functionalism (Urry 2005a; Walby 2007)[220]. Furthermore, widespread acceptance within this paradigm of the assumptions of ontological depth associated with critical realism and complexity, have addressed the structuralist shortcomings of earlier variants of general systems theory (Byrne 1998). Systems, according to the informants of complexity, are thus viewed not as ordered hierarchies of nested sub-systems conditioned by higher-order processes, nor may they be understood atomistically through the study of their agents; instead, they are conceptualised as complex open systems, comprised of emergent social, cultural, economic and ecological properties and levels, in a state of mutual

[220] According to the *Gulbenkian Commission on the Restructuring of the Social Sciences*, to which Immanuel Wallerstein and Ilya Prigogine contributed, complexity as a unifying paradigm promised a '…breaking down of the division between 'natural' and 'social' science through seeing both characterized by 'complexity' (Urry 2005a: 3)

interconnection (Alhadeff-Jones 2008; Capra 2005; Cillers 2001; Harvey and Reed 2004, Miller & Miller 1992; Walby 2007).

Although such developments have proceeded apace within sociology, parallel works in ecology and human ecology - which have advanced the general systems programme to a productive analytical integration of the natural and the social - have passed largely unheeded by environmental sociologists. This stunted dialogue has produced a field of complexity-based research divided into two distinct orientations; those engaging with complexity metaphorically as a narrative of social order and change (Cillers 1998; Smith & Jenks 2006; Urry 2005; Walby 2007), and those who have co-opted the analytical concepts of complexity with a view to their practical application (Byrne 1998, 2005; Castellani and Hafferty 2009; Fisk & Kerhevre 2006; Harvey and Reed 2004; Sawyer 2001, 2005). It has already been suggested that in order to advance the complexity programme to successful application, it must more clearly be situated within current methodological debates – particularly those concerning the nature of cases – according to which the conventions of formal method render an interrogation of macro and microsystemic dynamics possible. The first step of this explication, according to table 5.1, is the progressive concretisation of the research field through an investigation of macrosystemic context. Based on this methodological template, the informants of the attractor and regime may be brought to bear on the data of this study in order to reduce this complexity into a typology of distinct regimes for further study. The heuristics of state-space and attractor form a central component of the conceptual apparatus of complexity, which together represent a systems' occupation of a particular region of state space. Accordingly, the inherently dynamic nature of such systems is rendered amenable to tentative empirical description, by adopting a configurational approach to their measurement. This particular mode of measurement is further mandated by those operating within the paradigm of resilience ecology.

To reiterate the core heuristic merits of chapter 3, *resilience* first emerged as a corrective to restrictive assumptions prevalent in ecological analysis associated with the concept of stability, in a series of debates demonstrating notable similarities with those concerning the theoretical deficiencies of functionalism in sociology (Holling 1973). Contrasted with *engineering* resilience as a measure of a systems' return time to 'base state' parameter values following disturbance, *ecological* resilience assesses the amount of disturbance a system may undergo before transition to an alternate state is induced (Gunderson 2003). The probability of a particular system crossing this threshold is determined by its *adaptive capacity*, as a heuristic assessing the systems capability to appropriately respond to feedback (Berkes et al 2003; Fabricius and Cundill 2011).

The utility of an ecological resilience approach, as opposed to a 'stability' or engineering resilience approach, rests in its use of the concepts of *regime* and *identity*, as opposed to equilibrium and structure. Drawing upon the techniques and terminology of complexity theory, a *regime* may be conceptualised as a '...locally stable or self-reinforcing set of conditions that cause a system to vary around a local attractor; the dominant set of drivers and feedbacks that lead to system behaviour; a 'basin of attraction' (Cumming 2011: 14). Localized concrete social-ecological systems may be conceptualised as specific arrangements of actors, components and their interactions, constituting a particular *identity* (ibid). Thus it may be stated, that a social-ecological system of particular *identity* occupies a specific *regime* insofar as fluctuations in the conditions or variables constituting its identity do not result in significant changes or critical losses. In the terminology of resilience and complexity, such a change as results in a loss of *system identity* constitutes a *regime shift*.

Resilience ecology is thus concerned with the assessment of such *regime shifts*, which may be observed as systems move within particular value-ranges of identity parameters, and with *system change* or collapse as measured by loss of identity. The assessment of system change, as a consequence of a loss of resilience, necessitates '...a shift in focus from numerical values of state variables to 'relationships', i.e. to the internal organization of ecosystems which gives rise to their properties' (Grimm and Calabrese 2011: 8). *Adaptive capacity* is the essential property mediating regime shift or identity loss, as differing configurations of social-ecological variables - representing multiple components of system identity such as demography, economy, labour strategies and modes of resource governance - interact to confer resilience in the form of institutional robustness to external shocks. Crucially, this resilience approach is inherently amenable both to qualitative *and* quantitative operationalisation, and further avoids restrictions previously imposed by the requirements of 'equilibrium state' input values (such as with engineering resilience), and the identification of homeostatic mechanisms (as with sociological functionalism).

Resilience is thus not a rigid 'metric' according to traditional quantitative definitions, but is instead a property which permits the assessment of '...the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks' (Walker 2004 cited in Grimm and Calabrese 2011: 8). It is an invaluable heuristic on a range of fronts, not least for countering extant shortcomings in structuralist systems theory as discussed above. Cumming suggests that a resilience-based approach may be implemented by operationalising *identity* as; '...a set of elements...that interact

with one another in a shared environment... Identity derives from the maintenance of key components and relationships, and the continuity of these through time' (2011: 10 - 13). This approach displays numerous similarities, with other theoretical and methodological approaches in sociology discussed and implemented across previous chapters, such as ideal-typical modelling (Ragin 1989; Harvey and Reed 2004)[221], and more abstract typological approaches to social-ecological systems, such as those of Marxian historical materialism, the latter of which explicates economic epochs of combined *forces* and *relations* of production into an abstract typology of successive modes of production, or dominant ways by which humans collectively engage in the appropriation of natural resources (Benton 1991, 1996; Foster 1999).

Although current research interests rest with a particular localised social-ecological system (the rundale system) prevalent across the Western fringe of pre-famine Ireland as illustrated above in figure 7.1, these systems are themselves merely nested within the broader geographical territory of Ireland. Consequently, before moving to examine the specific dynamics of rundale as a localised social-ecological system, an assessment of the macro-systemic complexities of 19th century Ireland must first be attempted, by exploring the potential presence of macro-level distinctions – or, in the terminology of resilience and complexity, the presence of particular social-ecological *regimes*, as attractors within which such rundale systems are located. Given that localised systems are themselves embedded within broader spatial units (such as townlands, counties and countries), and trans-boundary social systems (such as economic, legal, climatological, demographic and cultural systems), imposing such a degree of typological order appears a logical starting point. This approach is substantiated within the complexity literature, particularly by Byrne (1998, 2005), who has suggested the use of cluster analysis as a means of identifying such attractors, or cases located in n-dimensional space, with '...the dimensionality of that space equal to the number of variables used for the clustering procedure' (1998: 80).

Drawing upon these theoretical informants, a formal phase of methodology corresponding to stage four of the methodological template detailed in table 5.1 may thus be implemented, comprising;

[221] Ragin refers to such approaches as 'case-oriented' comparative (1989: 34), although the principles of this process of abstraction and generalisation are well established in classical theory - particularly Weberian and Marxian

1. Identification of a parsimonious set of *macro-systemic* variables within which particular regimes may be identified

2. Application of optimisation clustering techniques to develop a typology of such social-ecological regimes, or domains of attraction

3. Identification of regimes within which individual settlements may be susceptible to increased probabilities of ecological stress, or diminished resilience

4. Implementation of this macro-classification as a framework permitting the regional contextualisation of localised systems

5. Identification of identity components specific to the *localised* systems of interest, and a qualitative assessment of their adaptive capacity

7.1.3. Choice of clustering variables

The following discussion presents the results of an exploratory *k*-means cluster analysis, conducted with the intention of extracting a latent typology of *cases* from a set of county-level variables measuring physical, economic and demographic attributes. Although cluster analysis techniques are comparatively under-utilised in sociological research, other exploratory techniques such as factor analysis are relatively common, and the nature of cluster analysis may thus be outlined analogously[222]. Whereas factor analysis techniques are variously used for confirmatory validation (i.e. to validate the relatedness of groups of variables as scale components), or in an exploratory manner (i.e. to extract latent variables from sets of existing variables without predictive direction), cluster analysis is employed when the latent category of interest is that of *groups* rather than *variables*. Numerous commentators have drawn attention to the risks of succumbing to naive empiricism inherent in such exercises, and as with all such exploratory techniques, careful discrimination is required on the part of the analyst. Aldenderfer and Blashfield (1984) suggest that this empiricist tendency may be checked by grounding one's selection of variables within relevant theory; 'The basic problem is to find that set of variables which best represents the concept of similarity under which the study operates. Ideally the variables should be chosen within the context of an explicitly stated theory that is used to support the classification. The theory is the basis for the rational choice of variables to be used within the study' (1984: 20)

In the context of the preceding discussions, and on the basis of prior empirical research, particularly that of Eric Almquist (1977), who has subjected many of the following variables to

[222] For a recent example of applied cluster analysis in sociological research, see Edgell and Tranby (2010)

regression modelling with productive results, the following variables were selected (see table 7.1). These variables thus represent a parsimonious range of social, demographic and physical attributes of the n-dimensional (state) space of Ireland, in which potential attractors or regimes may be discerned[223]. The inclusion of demographic variables in the form of *land-labour ratio* and *females 26-35 married/widowed* is substantiated by existing literature on Ireland (as discussed above), and within broader works in human ecology. In a comprehensive review conducted by Axinn and Ghimire, the authors conclude that existing literature identifies *population* as a key determinant of resource consumption trends, controlling for levels of affluence and technology (2011: 215). Van Wey et al (2005) discuss the 'IPAT identity,' as a land use outcome model frequently utilised as a comparative device in development literature. In this model '...population in one form or another plays the role of the villain' (Ehrlich and Holdren 1971 cited in Van Wey et al 2005), taking the form ($I = P*A*T$) where I = impact on environment, P = population, A = affluence (consumption, per capital GDP, level of living) and T = technologies employed. The inclusion of a range of classificatory variables beyond these 'Malthusian' parameters alone is therefore justified as a counter to simple 'population determinism'; hence the inclusion of *land held in common or joint tenancy* as a crude index of the presence of particular social-institutional modes of local governance. The role of wasteland as a proximate determinant of rundale expansion is also well established, and many have drawn attention to the benefits inherent in collective leasing, particularly as they permit reclamation, and consequently, accommodations of new commune members (Connell 1950b; Currie 1986; McCourt 1955a, 1971; Slater and Flaherty 2009). Summary statistics, correlations, and a scatterplot matrix are provided below in tables 7.2 & 7.3, and figure 7.6.

[223] The principle of parsimony must be adhered to in order to minimise the risk of 'overfitting' resulting from inclusion of an excessive number of input variables, with a consequent reduction in explanatory power or excessive statistical noise (Agresti and Finlay 2009).

Table 7.1. Description of input variables

Variable	Unit	Source	Theoretical/empirical justification
Land-labour ratio	Statute acres per individual	*Devon Commission…* Part IV. 1845 [672] [673] xxii, appendix 83	Hypothesised by Chayanov as key determinant of household labour strategies. Elevated/diminished ratios associated with probability of uptake in subsidiary domestic industry / labour intensive crop cultivation (O' Neill 1984)
Poor law valuation	£(pounds) per individual	Almquist (1977)	Reliable index of poverty – lower valuations associated with lower potential land productivity
Females 26-35 marries/widowed	% all females	Vaughan and Fitzpatrick (1978)	Cited as key independent variable in land-use outcome explanation. Often-hypothesised component of pre-famine Irish demographic expansion (Connell 1950a), closely related to subdivision, and viability of potato
Holdings 1-5 acres	% of all holdings	Almquist (1977)	Rundale systems are characterised by fragmentation of holdings through subdivision
Waste (course pasture) below 800ft above sea level	% of all county wasteland	*Devon Commission…* Part IV. 1845 [672] [673] xxii, appendix 83	Wasteland / course pasture encroachment cited as characteristic of rapidly expanding rundale settlements. Wasteland availability conducive to resilience of communal systems through spatial expansion
Land held in common or joint tenancy	% of all county land	*Devon Commission…* Part IV. 1845 [672] [673] xxii, appendix 83	Key indicator of potential presence of rundale

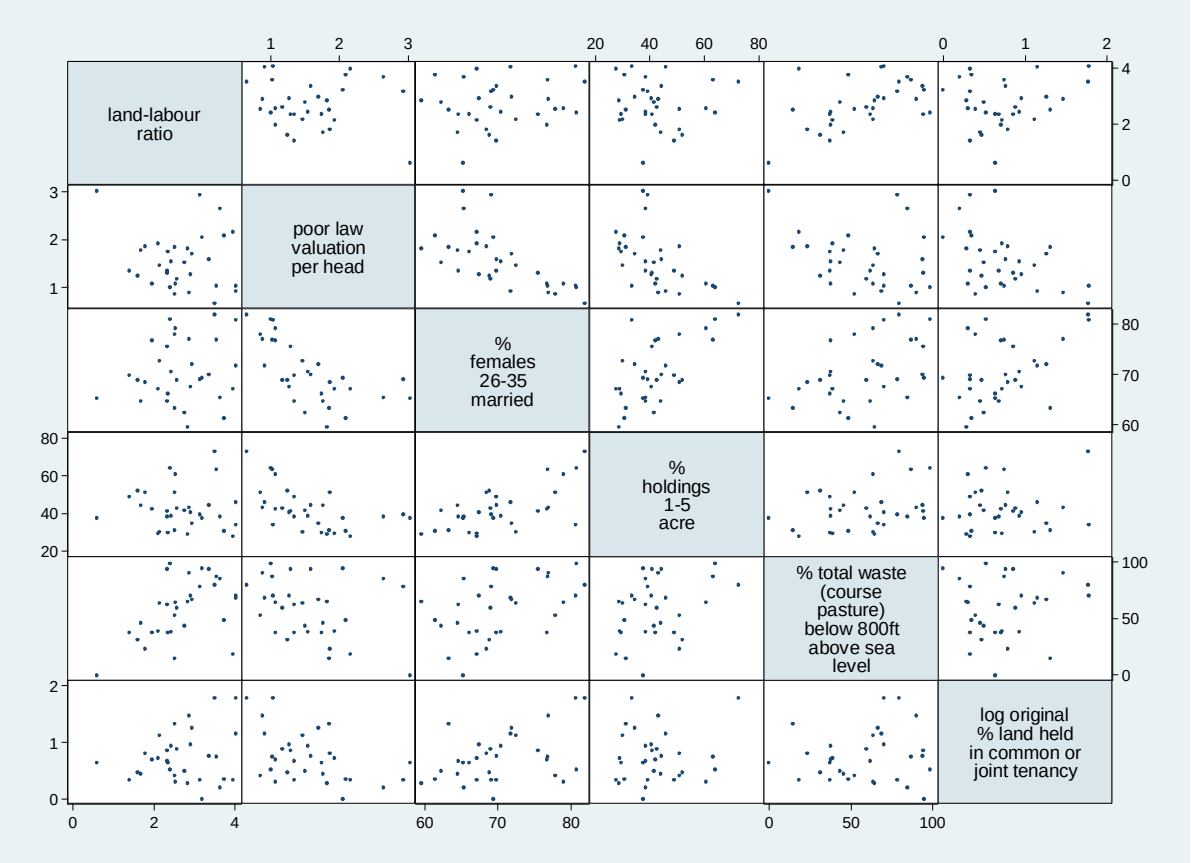
Table 7. 2. Input variable summary statistics

Variable	Unit	Mean	SD	Min	Max
Land-labour ratio	Statute acres per individual	2.68	0.81	0.61	4.04
Poor law valuation	£ (pounds) per individual	1.56	0.58	0.66	3.03
Females 26-35 married	% all females	70.35	6.03	59.49	81.85
Holdings 1-5 acres	% of all holdings	42.33	11.12	27.9	72.6
Waste (course pasture) below 800ft above sea level	% of all county wasteland	57.9	26.00	0	98.46
Land held in common or joint tenancy	% of all land	8.91	12.42	0	58.7

Table 7.3. Correlation matrix (* $p \leq 0.05$)

	Land-Labour	Poor law	Married	1-5 acre	Waste	Common
Land-labour	1.000					
Poor law	-0.1308	1.000				
Married	0.1466	-0.6568*	1.000			
1-5 acre	-0.0346	-0.5368*	0.6351*	1.000		
Waste	0.5134*	-0.3276	0.4500*	0.3276	1.000	
Common	0.1989	-0.4648*	0.4393*	0.0842	0.1038	1.000

Figure 7.6

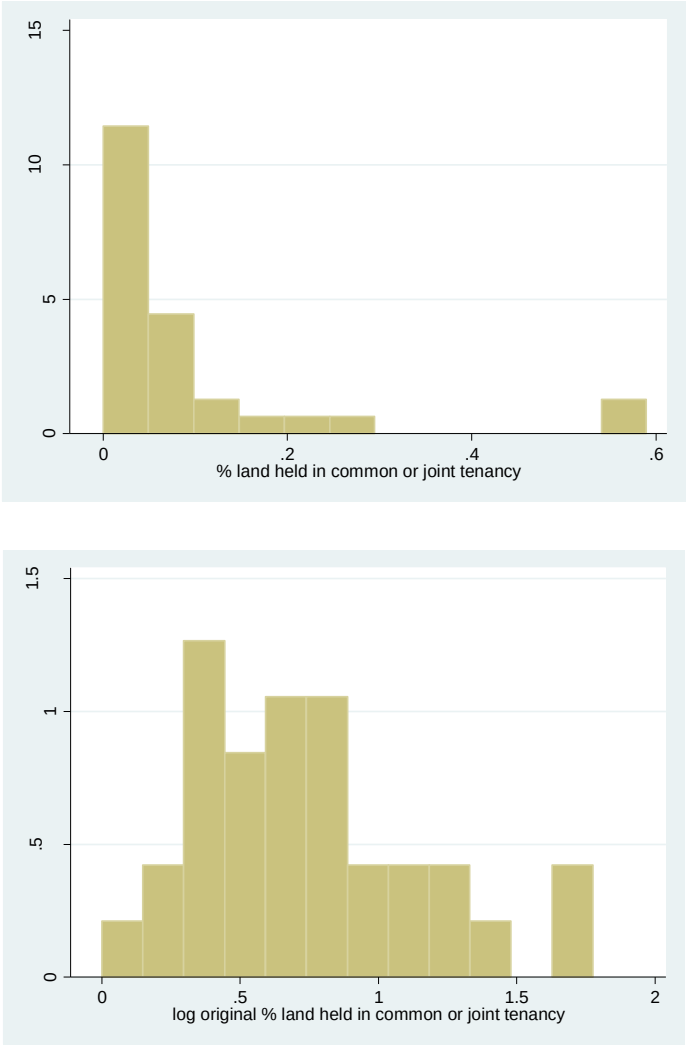


Input variable scatterplot matrix

As may be observed across the preceding tables and figures (and as discussed previously by Almquist 1977), the chosen input variables exhibit suitably broad ranges (table 7.2, min & max). Furthermore, a number of significant correlations present within table 7.3 and figure 7.6. Consistent with existing theory, the key demographic variable of 'females 26-35 married' demonstrates strong, significant correlations with others including 'holdings 1-5 acres' ($r = 0.6351$, $p \leq 0.05$), 'waste' ($r = 0.45$, $p \leq 0.05$) and 'common' ($r = 0.4393$, $p \leq 0.05$). Thus strong positive associations are observable between the broad demographic regime of high early female nuptiality, classical predictors of population growth (availability of wasteland), and a number of consequent effects of demographic expansions such as fragmentation of holdings, and the presence of common holding. Of note also are strong, negative associations between valuation ('poor law') and 'females 26-35 married' ($r = -0.6568$, $p \leq 0.05$), 'holdings 1-5 acres'' ($r = -0.5368$, $p \leq 0.05$) and 'common' ($r = -0.4648$, $p \leq 0.05$). Such associations point toward a diminished probability of early marriage, fragmentation and common holding within more affluent districts.

For the forthcoming cluster analysis, all variables were z-score standardised (to mean 0, standard deviation 1) prior to application of the clustering algorithm, consistent with Everitt et al's recommendations, given that optimization methods are inherently scale dependent (Everitt et al 2011: 115). A boxplot of the above z-score standardised variables is included as Appendix 1. A log transformation was also applied to the variable 'common' prior to clustering, in order to correct a profound positive skew. Consistent with Field's guidelines, a simple ln10 (log to base 10) transformation was applied, with the addition of a constant of 1 (due to the presence of '0' values in the original dataset). A comparison of histograms pre and post-transformation for this variable is provided below in figure 7.7. Preceding correlations are reported for the log-transformed version of 'common', whereas subsequent summary statistics are reported using the untransformed variable for ease of interpretation.

Figure 7.7



Comparison of distribution pre and post-transformation (variable 'common')

7.1.4. Clustering method and results

As stated above, the purpose of exploratory cluster analysis is to extract latent typologies of *cases*. For *k*-means optimization techniques as utilised below, *k* denotes the number of groups required by the clustering procedure, and is a user-defined input parameter (unlike hierarchical procedures which progressively match cases on the basis of similarity/distance measures). *k*-means clustering may thus be viewed as a kind of maximum likelihood technique, with trace (W) minimization as its optimization criteria (see Everitt et al 2011: 126)[224]. Although a number of formal procedures exist for the estimation of potential group numbers for optimisation clustering methods, such as the Calinski and Harabasz pseudo *F*–statistic (Rabe-Hesketh 2004: 276), and the Duda and Hart index (Everitt et al 2011: 127), Landau and Everitt (2004) suggest that many of these techniques are necessarily ad-hoc. Mardia et al suggest a more useful rule of thumb, in the form of [$k = \sqrt{(n/2)}$] which for this data yields [$\sqrt{(32/2)} = 4$] (1979: 365). This estimated value of *k* agrees with previous classifications of Ireland, which have tended to emphasise four distinct socio-economic zones (O'Grada 1994, Whelan 2000, National Centre for Geocomputation 2010).

Further benefits of employing a *k*-means method in the context of this research, are that such techniques '...seek to minimize the variability within clusters and maximise variability between clusters' (Landau and Everitt 2004: 312), thus yielding a set of groups optimally distinct from each other, yet retaining a significant degree of internal homogeneity. This process is thus theoretically consistent with the concept of *regimes*, as informed by complexity theory and resilience ecology, whereby each cluster group may be interpreted as a distinct *regime* or *attractor* (Byrne 1998). Complete output generated from the clustering procedure is provided in appendix 1, although this output is less intuitively interpreted owing to necessary standardisations employed prior to running the clustering algorithm. The reader may however, discern cluster centroids more intuitively through the following tables (7.4 and 7.5), which tabulate final cluster solution group members and input variable summary statistics according to derived cluster group membership.

[224] According to Everitt et al, 'The basic idea...is that associated with each partition of the *n* individuals into the required number of groups, *g*, is an index *c*(*n*, *g*), the value of which measures some aspect of the 'quality' of this particular partition' (2011: 111).

Table 7.4. Cluster solution group members

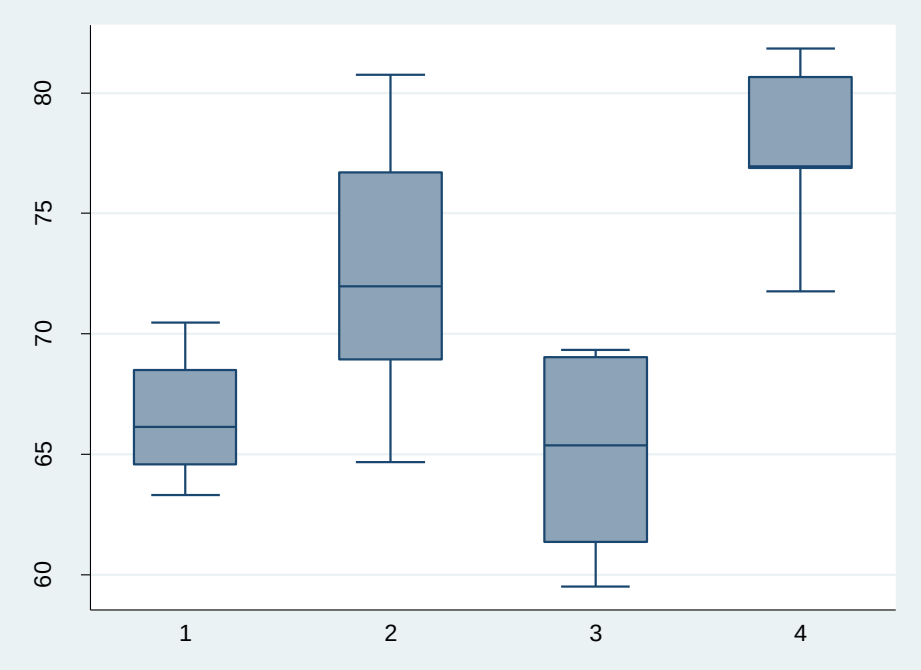
Group 1	Group 2	Group 3	Group 4
Antrim	Armagh	Carlow	Clare
Down	Cavan	Kildare	Donegal
Dublin	Cork	Meath	Galway
Kilkenny	Fermanagh	Queen's	Kerry
Louth	King's	Westmeath	Mayo
Tipperary	Leitrim	Wexford	
Waterford	Limerick	Wicklow	
	Londonderry		
	Longford		
	Monaghan		
	Roscommon		
	Sligo		
	Tyrone		

On the basis of these results, a number of manifest social-ecological regimes may be observed. Commensurate with a complexity account of systems as constituted by multiple ontological levels and trans-boundary properties, the above typology is not limited by restrictions of space, but rather designates an abstract set of typological characteristics indicating probable tendencies operating at lower levels of aggregation. Consequently, in light of the summary statistics presented in table 7.5, a distinct social-ecological regime may be observed, described by the territories of Group 4 (Clare, Donegal, Galway, Kerry and Mayo); the consistency of this group as a distinct social-ecological regime is defined by its high land-labour ratio (3.6), low 'poor law valuation' (£0.91), high proportions of 'females 26-35 married' (77.62%), high fragmentation of holdings 'holdings 1-5 acres' (51.72% of all holdings), high availability of wasteland (78.99%), and greater prevalence of common landholding (32.66%). This may in turn be compared to the regime described by Group 1, characterised by significantly higher valuation (£1.96), lower fragmentation of holdings 1-5 acres (37.31%), limited wasteland (28.13%), and comparative absence of common landholding (6.44%). The magnitude of these between-group differences may be observed by examining the following boxplots generated by cluster group membership for variables measuring the proportion of females 26-35 married, (figure 7.8) and land held in common or joint tenancy (figure 7.9).

Table 7.5. Input variable summary statistics by cluster group membership

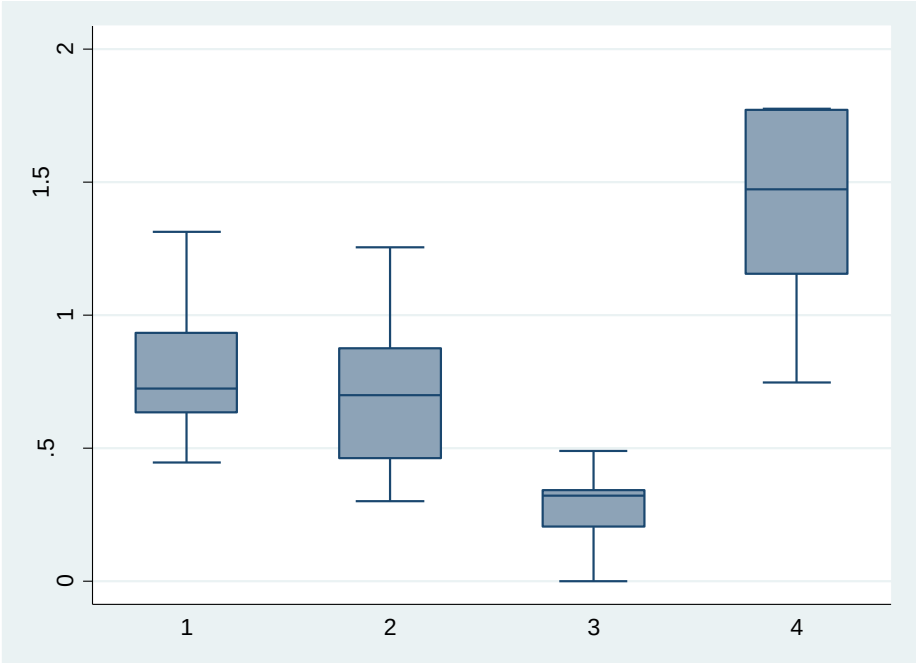
Variable	Unit	Group 1		Group 2		Group 3		Group 4	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Land-labour ratio	Acreage per head of population	**1.93**	0.67	**2.40**	0.54	**3.33**	0.47	**3.60**	0.47
Poor law valuation	£ (pounds) per head	**1.96**	0.49	**1.27**	0.54	**2.17**	0.48	**0.91**	0.15
Females 26-35 married	% all females	**66.47**	2.44	**72.61**	0.23	**64.84**	3.89	**77.62**	3.95
Holdings 1-5 acres	% all holdings	**37.31**	8.14	**45.43**	4.94	**34.90**	5.62	**51.72**	15.78
Waste (course pasture) below 800ft above sea level	% total county waste	**28.13**	16.34	**63.78**	9.69	**61.70**	26.74	**78.99**	9.67
Land held in common or joint tenancy	% all land	**6.44**	6.09	**5.39**	21.81	**1**	0.64	**32.66**	24.99

Figure 7.8



Boxplot (% females 26-35 married or widowed) by cluster group membership

Figure 7.9



Boxplot (log % land held in common or joint tenancy) by cluster group membership

7.1.5. Theoretical and methodological implications

Although this exercise bears numerous theoretical implications, they must be advanced with a measure of caution, as the preceding exercise has relied upon data drawn from ecological units (i.e. counties). As units in which 'individuals' such as settlements or specific actors are contained, individual data points here denote the attributes of broad containment units, and should not be interpreted as proxy measures of association at lower levels of aggregation; this is potentially problematic for a number of reasons, and discussions assessing the validity of individual-level inferences derived from ecological correlations are extensive (Goodman 1959; Schwarz 1994; Freedman 1999; Robinson 2009). Although the computation of correlation coefficients is relatively commonplace in quantitative sociology, comparatively less attention is given to the validity of correlations computed on ecological units (i.e. counties, as are utilised above). Such practice is not without long historical precedent; sociology owes a significant debt to the ecological correlations of Durkheim, whose pronouncements on the explanatory power of the social were constructed from aggregate data on suicide rates and religious affiliation in Prussia. The use of such units is extensive and unproblematic within sociology, and cross-national comparative work typically proceeds by employing data measured at particular levels of aggregation (such as cross-national comparative human ecology, or studies in ecological modernisation - Bradshaw et al 2010). Consequently, despite the limited downward-predictive validity of such approaches, particularly in the context of complex open systems such as societies, the explanatory power of such emergent attributes as social-ecological regimes is no less diminished *a priori* by the mere utilisation of aggregate units by the analyst, with whom blame must also reside when the explanatory limitations of ecological units are breached, and projected downward onto individuals.

It is therefore critical not to over-generalise such associations, (i.e. to assume that the characteristics of individual settlements within such containment units will necessarily display similar association). Given a comparative lack of data at lower levels of aggregation, such limitations are unfortunately unavoidable. This exercise does however confront certain existing pronouncements on the social-ecological complexity of pre-famine Ireland, particularly those of Fraser (2003, 2006) whose implementation of a resilience approach in the context of pre-famine Ireland has drawn attention to the critical outcome of perturbation exposure engendered by high systemic connectivity, both in terms of settlement, and biomass concentration. A tri-axial model of this relationship is provided by Fraser (2006), illustrating the relationship between connectivity, biomass, diversity and resilience (see figure 3.8).

Connectivity - as measured by settlement density - when coupled with high concentrations of biomass and low species diversity, functions to lower resilience, and to increase exposure to perturbation (see Peterson et al 1998). As systems ascend the respective axes toward critical risk exposure levels, the magnitude of disturbance required to induce collapse becomes increasingly smaller. Pre-famine Ireland is therefore cited as a prime example of this critically diminished resilience (as a function of gradual ascension of the above axes), resulting of limited adaptive capacity at local levels. This diminished adaptive capacity encompasses reductions in biodiversity and increases in connectivity and settlement density incurred through population growth and surplus production (rent), pre-famine subdivision, and both spatial and monetary restrictions on external subsidy imports (Fraser 2003, 2006, 2007, Kinealy 2006). Initially, such ecocentric conclusions were borne out by K.H. Connell's identification of the potato as a dominant independent variable accounting for expanding pre-famine fertility and population density. The classical narrative of biodiversity reduction through monoculture subsistence - somewhat authenticated, albeit with significant regional variation (Bourke, 1959, Downey 1996) - in turn led Connell (1950a) to hypothesise the potato as a key agent facilitating wasteland colonisation, subdivision through subsistence on smaller acreages, with a consequent removal of barriers to early reproductive union as discussed above.

Clearly there is much possible heterogeneity across various trajectories of systemic development and collapse, and caution must be exercised in mapping any such model (i.e. figure 3.8) onto particular case studies. It is thus a critical oversight of studies such as Fraser's that do not further consider the internal diversity of Irish social-ecological regimes, distinguished by the preceding analysis according to demography, tenure and geography. There is clearly much merit in complicating such generalised frameworks, which in turn serves to direct discussion away from sweeping statements such as '...the agro-ecosystem in Ireland progressed from a relatively complex system of mixed livestock, grain and potato production to a system that was wholly based on the potato' (Fraser 2003: 4). Works examined previously such as Currie (1986), Slater (1988), O'Grada (1994), O' Hearn (2001), Slater and McDonough (2005) have revealed profound internal variability in factors such as rental regimes, modes of tenure, regional economies and landholding distributions; points which demand a closer examination of how resilience may be distributed across regions and settlement types, in turn augmented by specific local practices.

In context of existing pronouncements on metabolic rift, this exercise further reveals something of the necessity of historical contextualisation in order to adequately reorient its abstractions

toward empirical work. The generalised narrative of resource movement established by existing works, despite its conceptual sophistication, is arguably too limiting in context of the regimes established above which have revealed the immanent possibility for profound variation in forms of social-ecological metabolism at lower levels of aggregation. Indeed, the preceding typology has figured the phenomenon of communality as central to a regime of compromised resilience, the specifics of which must in turn be explicated and theorised by a closer examination of the mechanism of metabolic rift, such as it may have conspired to compromise components such as fertility, and the capacity for maintaining systemic identity, as is attempted in the following section. Consequently, this typology fast outlives its limited functionality; by serving merely as an orienting device, it confirms something of the exceptionalism of the peripheral locations in which rundale abounds, quantifies such regional macro-characteristics, and offers a basis for subsequent inquiry. From the preceding results, what is observed is merely a *potential* differential distribution of social-ecological resilience across the state-space of Ireland, by noting areas subject to greater probabilities of ecological stress. This reveals little of the dynamics of *localised* social-ecological systems (i.e. individual settlements) however. Consequently, focus must now descend a level of aggregation in order to provide more robust inferences concerning the manner in which they confronted their encroaching ecological limitations, by augmenting adaptive capacity through the mechanism of collective governance. Before transitioning to the micro-level however, the rundale must first be engaged with quantitatively, by exploiting a number of further statistical sources which enables exploration of the dynamics of communality at a lower level of aggregation, that of the poor law union (N=130). The following section thus examines more closely, through the use of descriptive statistics and multiple regressions, the relationship between communality, agricultural production, productivity and distress.

7.2. Social-ecological resilience, communality and the metabolic rift

Discussion thus far has emphasised that social-ecological resilience may be conceptualised according to a number of competing levels of particularity. Within surveyed literature, these definitions variously assume the form of an epistemological basis for collapsing the natural-social divide, a specific measure of ecosystem integrity, or a conceptual framework for analytically integrating natural and social-systemic components under a common vocabulary. According to Cumming, this broad diversity may more pointedly be confined to two distinct groupings;

> "The first...is a three-pronged definition which suggests that resilience consists of (1) the amount of disturbance that a system can absorb while still remaining within the same state or domain of attraction; (2) the degree to which the system is capable of self-organization (versus lack of organization or organization forced by external factors); and (3) the degree to which the system can build and increase its capacity for learning and adaptation. The second definition...if we think of a complex system as an individual, it only remains the same for as long as it has a consistent identity. Identity derives from the maintenance of key components and relationships, and the continuity of these through time" (Cumming 2011: 13).

Cummings identity-based definition of resilience has already been operationalised in chapter 5 under the ideal-typical map of essential identity components constitutive of rundale, and their corresponding identity-loss thresholds. However, such an identity-based conceptualisation of resilience, as outlined at the conclusion of the preceding chapter, calls for empirical corroboration with a case-intensive qualitative approach. Consequently, the forthcoming quantitative analysis must be grounded in a related definition of resilience, albeit one which more readily lends itself to analytical implementation. A substantial start has already been made on this task by opting for a regime-based conceptualisation, coupled with a complexity-informed epistemology, which has enabled a 'first pass' assessment of the distribution of resilience across the state-space of Ireland. This exercise remains, however, largely descriptive – despite its utility, as argued above, as a baseline for addressing existing restrictive typologies, and theoretical models of structural homogeneity.

Having thus confirmed the immanent possibility of variation in resilience at a high level of aggregation, attention may now turn toward more pointed operationalisations of the concept, by seeking out suitable indicators of ecosystem integrity; here, the conceptual groundings of metabolic rift aid this task substantially, by suggesting a number of mechanisms through which levels of differential resilience may be generated and distributed. The rundale system is crucially implicated in this differential resilience; as established above, it forms a key locus around which the preceding regimes have been defined, a profound association has been observed between a number of structural indicators, and higher proportions of communality within specific regions. In short, the following analysis exploits the substantive components of historical materialism and metabolic rift as narratives of social-ecological change, complexity theory tempers application of method and interpretation of results, and resilience, yet again, provides direction on measurement.

7.2.1 Datasets and units of measurement

Two principal datasets are utilised throughout the forthcoming analysis; the first, a set containing variables measured at county level, has already been introduced and exploited in the preceding section. Readers may therefore refer to table 7.2 for descriptive statistics and information on the content of these variables. An additional dataset consisting of variables measured at poor law union level is introduced in the following section, and full descriptions of its variables may be obtained from table 7.9. Supporting discussion and footnotes justifying and elaborating the specific content of these variables will be supplied as appropriate. Given that the forthcoming discussion alternates between both sets according to specific requirements (although the majority of forthcoming analyses utilise the poor law union set), readers may identify the relevant sets in question in regression tables, tabulations and graphic output by referring to the recorded sample size. Where county level variables are used, the noted sample size is 32 (N=32); where poor law union level variables are used, the noted sample size is 130 (N=130). This information will be clearly displayed in table headers, or statistical output as appropriate.

Multiple statistical series were drawn upon in order to construct the following dataset, and there is marked inconsistency across sources regarding units of measurement. Although all weights and quantities of produce in the documentary sources consulted are recorded in imperial units, alternate series interchangeably employ units such as the hundredweight (cwt), imperial long ton (ton), quarter (qtr), and the barrel. Furthermore, barrels are typically expressed in terms of contrasting multipliers; weights of wheat and potatoes, for example, are often reported in 'barrels (20 stone)', whereas barley is reported in 'barrels (16 stone)' – in which case the base stone weight may be obtained simply by multiplying the reported weight by either 20 or 16. Aggregate weights of flax and hay are also reported in stone, and as a point of further complication, aggregate weights are often expressed in differing units from year to year. Where comparisons and illustrations are made at a high level of aggregation (that of the county, n=32), imperial units are left unchanged. Since the goal of the forthcoming tabulations is to illustrate relative trends in short and long term fertility and output, there is little need to employ conversions, and for ease of future use by other readers - who may wish to refer to original documentation for future work - these units are left unchanged. Arithmetically, any such conversion would merely alter the numeric base, leaving relative differences constant. The reader may therefore discern trends from the forthcoming graphs irrespective of measurement unit.

With regard to comparisons of different crop yields, the question of standardisation is rendered problematic by issues of differing output weights; turnips, for example, display an output weight per unit area up to 3 times that of potatoes, and up to 15 times that of corn. It is difficult, however, to assess the human or societal implications of this difference in yield. Such standardisation would need to consider each crop in terms of calorific adequacy or nutritional profile, and the relative proportions of each crop allocated for sale, animal feed, or human consumption respectively. Notwithstanding the complexities of such calculations (data for which are not available), such an attempt would unnecessarily compromise the validity and parsimony of any modelling procedure. Instead, a more modest strategy was here employed for comparisons at lower levels of aggregation (that of the poor law union, N=130), where all weights of crop were converted to kilograms. This transformation was applied in order to aid interpretation of yield outputs, and to enable comparisons of rates across different crop types.

Any such exercise in comparative modelling entails certain judgements concerning data selection. In the Irish case, data permitting assessments of production and productivity are not available in any systematic series until the beginning of the annual agricultural censes in 1847. This particular series thus permits an assessment of the state of Irish agriculture at the cusp of the initial seasons of drastic collapse precipitated by the arrival of blight in 1845. The unit of aggregation employed in the 1847 agricultural series is that of the poor law union (n=130), which allows for a more nuanced examination and assessment of internal variations in social structure and agricultural activity than that of the county. These initial poor law unions, established as formal administrative units in 1838 for the coordination of relief and collection of rates, were revised by the boundary commission in 1850, resulting in significant alterations in the location and extent of many original boundaries[225]. Consequently, comparisons with the 1847 series are limited to those of 1848 and 1849, although this particular timespan offers ideal scope for examining the dynamics of resilience across such a critical and challenging period.

This limitation of comparisons to the original (1838) poor law unions is further mandated by this exercises use of figures contained within the Devon Commission, collected between 1843 and 1845. These critical figures, the only aggregate series which provides systematic estimates of the extent of land held in common or joint tenancy, were presented according to 1838 poor law unions, these data being largely supplied by local union clerks. Given that this variable, and

[225] *Report of the Irish Poor Law Commissioners, on the Measures Taken for Carrying Into Effect the Recommendations of the Boundary Commissioners.* 1850 [1162] xxvi

others contained in the appendices of the Devon Commission such as poor law valuation per head, and the distribution of pre-famine landholding were chosen as essential predictor and selection variables, their inclusion was paramount to assessments of the relationship between common holding and resilience. Although various alternative strategies were considered, such as amalgamating all 1838 and 1850 poor law unions into counties, and distributing earlier Devon Commission statistics to the 1850 unions according to the proportional area occupied by the 1838 unions, such an approach proved too ambiguous to be justified. The forthcoming discussion should, however, bear out the utility of the data selection procedure. Where conversions are employed, all stages and conversion factors are clearly illustrated.

7.2.2. Principal outcome measures

Regarding chosen outcome measures, a number of related resilience indicators are here employed, albeit ones necessarily constrained by limitations to available data. These measures may, however, be considered as essential indicators of key components central to the concepts of resilience, whose variation and distribution may be more broadly interpreted within the theoretical framework of metabolic rift. Commensurate with his multifaceted depiction of resilience, Cumming identifies two concepts associated with the empirical study of social-ecological systems which serve to orient toward measurement; those of *asymmetry*, and *vulnerability*. *Asymmetry* deals with '...systematic variation in system components that can provide the impetus for a particular process to occur, and/or alter system dynamics in important ways' (2011: 14). This term thus empahsises a dimension of study recognisable in the frequentist traditions of quantitative sociology and human ecology, which assesses the additive contribution of various parameters to resilience outcomes, net of included controls.

Adger defines *vulnerability* as the '...the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt' and; '...[the] degree to which a system is susceptible to and is unable to cope with adverse effects...In all formulations, the key parameters of vulnerability are the stress to which a system is exposed, its sensitivity and its adaptive capacity' (2006: 268-269). Notable within this broad family of concepts centered on vulnerability is the entitlements framework expounded by Sen, which emphasised the explanation of distress and famine through institutional-economic accounts centered on access to resources. Consequently, both terms suggest an imminent amenability within the tradition of resilience-based human ecology, to the

quantitative[226] modeling of resilience as a function of various stressors and structural characteristics.

The potential pitfalls inherent in linear modeling must be borne in mind, as discussed in chapter 1. Much of this criticism has centered on the pretensions of its practitioners to capture causality (Byrne 2002; Hartmut 1996), a concept which has already been much criticised throughout preceding chapters – particularly in discussions of critical realism – which although optimistic regarding the prospects of measurement, remains healthily sceptical toward claims concerning causation. Furthermore, the criticisms of Brenner considered above speak as much to lack of contextualisation, and lack of theoretical precision concerning the elaboration of mechanisms of differentiation, as they do to techniques of modeling themselves. Byrne (2002) affirms much of this in his tentative endorsement of linear modeling as one of a family of useful techniques which, when used in concert with other methods and epistemological groundings, can edge insight closer to a fuller understanding of system dynamics. Consequently, the worst excesses of quantitative optimism have been tempered in this thesis by opting to examine the case study system through a plethora of methods, without according explanatory propriety to any one in particular. In addition, great care has been taken throughout to elaborate the specific constitution of the system in question, and the mechanisms of differential resilience through invoking the concepts of metabolic rift, mode of production, and resilience respectively. Therefore, a position has been established from which to interpret more intuitively the forthcoming results, mindful of the potential for cross-case variation, and the influence of configurations of case properties on the specific outcomes under analysis. In either event, a degree of intuition now exists concerning the configurations of factors which are hypothesised to give rise to negative effects on the above-selected outcome resilience measures, configurations which in particular emphasise the role of communality. Table 6.5 introduces the principal outcome measures employed in the forthcoming analyses, and offers elaboration on their relevance in the context of working concepts of resilience and existing work on the metabolic rift.

[226] Chapter 8 deals specifically with qualitative comparative analysis.

Table 7.6. Principal outcome measures[227]

Variable	Variable names	Unit	Resilience implications	Metabolic rift & mode of production
1. Extent of land under root crop & corn	corn_chg, potato_chg, turnip_chg, flax_chg, uncult_chg, meadow_chg, corn_chg2, potato_chg2, turnip_chg2, flax_chg2, uncult_chg2, meadow_chg2	% of all crop land; change in % of land under crop, 1847-1849	Assessment of response strategies; indicates response of social-ecological system in the form of production adjustment; character of output and production serves as key identity component	Emphasises centrality of pluriactivity (production of cash and subsistence crop) to mode of production of feudalism based on extra-economic coercion
2. Crop yield	ycorn47, ypotato47, yturnip47, ycorn49, ypotato49, yturnip49, ycorn_chg2, ypotato_chg2, yturnip_chg2	Metric weight per unit area; change in yield, 1847-1849	Captures consistency of productivity levels between successive seasons; crisis-induced 'back loop' phase of the adaptive cycle predicts critical release of tightly bounded biotic stocks with significant loss of natural capital (famine)	Key component in existing theoretical models of metabolic rift which hypothesises progressive decline as consequences of industrialisation, urbanisation, and growth of global trade
3. Uptake of relief rations	rationheadz, rationmaxz	z-standardised maximum number of rations issued in single reporting period	Indicator of severe distress, necessitating uptake of outdoor relief; penultimate measure of ecological collapse and immanent physiological risk	Collapse of subsistence means; inability of means of production to satisfy realisation of both use value (subsistence) and exchange values (rental income)

[227] See appendix 2 for variable summaries and data source citations

The first outcome measure, 'extent of land under root and corn' permits an assessment of the nature of agrarian response to distress throughout the famine period. Since depictions of Irish agrarian society as capitalistic throughout this time have already been redressed, through a discussion of existing works on the nature of the rent relation, the specific composition of agricultural output within specific regions may thus be interpreted not only in terms of its ecological function, but also its social, as an essential source of exchange value (i.e. corn production). Therefore, although combined root and corn production in both high and low-density communality regions should be expected, the specific nature of the response to famine throughout this period is less well documented or understood. Inclusion of this variable thus permits examining whether increased intensity of root crop production or maintenance of rates of combined root-corn production for the facilitation of exchange-value generation continued unchecked. The broader relevance of this variable is borne out by the fact that the Irish tenantry were far from immune to the vicissitudes of macroeconomic policy. Following the repeal of the Corn Laws in 1846, further impetus was offered to consolidation with the removal of Ireland's monopoly of free importation to Britain (Marx, 1990 [1867]: 870). Furthermore, the centrality of cash crop production has been established across all social forms owing to the necessities of rental obligations, to the extent that up to 27% of all agricultural produce was exported in the immediate pre-famine years (Turner 1996: 18).

A note of caution is warranted on interpreting changes in the extent of crops from period to period. Although some attempt at standardisation using an alternative estimate of population is attempted below, this is less adequate in the case of acreage. Therefore, it is difficult to discern whether declines in the extent of a particular crop over time are capturing a reconfiguration of agrarian output, or merely a decline in population according to which rates of acreage, by virtue of death, emigration or dispossession, will also decline. Undoubtedly, the decimation of the cottier class throughout this period may be cited as a key determinant in root crop acreage reductions as detailed previously, although their combined influence, when included with estimates of the decline of all holdings under 5 acres between 1841 and 1851, amounts to just over 18% of all lands under crop. Given that the window of operation of this study is decidedly smaller (1847-1850), the magnitude of this likely error is drastically reduced. In any event, the composition of agricultural production was more complex than a simple one-way dependence of smallholders upon potatoes; in 1847, turnips entered rotation in large volumes as an emergency subsistence measure, where after it remained under high cultivation as animal fodder (Turner 1996: 20-21). It is therefore reasonable to hypothesise that a resultant alteration in pricing structure and market incentives should exert an observable influence on the character of production over time, and indeed on the distribution of landholding as mediated through the

imperatives of landlordism, although the former dimension may arguably be difficult to discern from chaotic changes in production due more to immediate distress than market signification.

The second outcome measure, 'crop yield', is a simple measure of output per unit area. Utilising data from general union tables contained in the 1847 and 1849 agricultural censes[228], measures were computed for three crop variants; (1) corn and beans, (2) potatoes and (3) turnips. Weights for all crop variants were in turn converted to kilograms, yielding an outcome measure of *kilograms per acre*. An alternative measure of yield was also generated using population data. Calculation of this particular measure was somewhat problematic, owing to substantial changes in population from 1841 and 1851, throughout which population declined an average of 20% within individual counties (the overall rate of decline was 19.83%, with Dublin City and County experiencing the only growth rate of 8.69%)[229]. Consequently, an alternative measure of population was employed, by calculating the rate of adjustment between counties, and applying this adjustment to all unions within each county. 70% of the total adjustment was applied in order to obtain a population estimate for 1847, and 90% of the total adjustment was applied for an 1849 estimate. This essential adjustment must be interpreted with severe caution; although no superior basis exists for estimating growth rates[230], adjustments must be made owing to the magnitude of population loss between 1841 and 1851. Consequently, relying on 1841 data alone would have yielded overly pessimistic 'output per head' estimates. It was not possible to use 1851 census data to interpolate union estimates, given that poor law union boundaries were substantially revised between both reporting periods.

Given that yield and fertility themselves are outcomes of social processes, and modes of cultivation as discussed in chapter 5 under 'differential fertility', this variable is crucial to grasping the capacity of regions to cope with ecological collapse, and to maintain systemic integrity[231]. Although this systemic integrity is itself multi-faceted, consisting of myriad

[228] *Returns of Agricultural Produce in Ireland, in the Year 1847.* 1847-48 [923] lvii; *Returns of Agricultural Produce in Ireland, in the Year 1849.* 1850 [1245] li

[229] *The Census of Ireland for the Year 1851. Part VI, General Report.* 1856 [2087] xxxi

[230] Although this exercise was attempted, albeit with questionable success, by others using extrapolation of long-term growth trends as discussed in the preceding section. See also Cousins (1960) and Mokyr (1980) for exercises in mortality estimation.

[231] This crucial state of differentiation was noted and accounted for by the enumerators of the agricultural censes; '...the yield differs so materially as well in different parts of the country as from the different state of preparation of the land, that it was thought better, in the present imperfect state of our knowledge, to attempt an estimate of the yield from each crop in every district, rather than to trust to an arbitrary

strategies, agricultural techniques, and social relations, the outcome of yield offers a simple, albeit highly reductive means with which to capture resilience trends at a lower level of aggregation, a level which in turn allows for more nuanced considerations of local social structure. The mediation of yield rates at settlement level is far from uniform however; although the classic narrative of metabolic rift is suggestive of a mechanism of declining returns owing to the removal of agricultural produce off-site through commodity sale, the labour-intensity of agricultural techniques adopted under rundale such as ridge cultivation, lent themselves to remarkably high unit-area yields, particularly in the case of root crops (Crotty 1966; O' Grada 1988). Although it is questionable whether this potential mediating mechanism may be detected in the aggregate, it is worth bearing in mind as a potential hedge against overall reductions in yield, given its inherent ecological flexibility and efficiency - more of which below.

Aggregate dynamics are undoubtedly more complex however, and when considered in the context of the adaptive cycle heuristic, the Irish famine may be conceptualised as a critical watershed in the 'backloop' release-reorganisation phase, throughout which tendencies of resource accumulation and reductions in biodiversity begin to exert disastrous consequences on local resilience, as a result of the visitation of blight. The Irish rundale system is crucially implicated in this process, as the preceding section has argued; higher proportions of communal holding constitute a critical component of a macro-regime of compromised resilience. This important predictor (extent of communal holding) may thus be introduced to the analysis in order to examine more closely how variation in social structure behaves in relation to yield. In the context of discussions in chapter 5, this analysis thus proposes to add a further layer of insight into the specific ecological dynamics of rundale, by illustrating the effect of communality on productivity rates.

The third outcome measure, 'uptake of relief rations', features in an appendix to Kinealy (2006), who uses it in order to map areas suffering from high levels of distress. Following initial ruminations concerning the establishment of a system of rate-based poor relief in pre-famine Ireland, the famine-era crisis relief activities of the 'select committee on poor laws' were recorded in a series of reports presented to parliament in 1847. An important set of statistical tables in these reports tabulates the extent of mitigating activities undertaken by the relief commissioners in July of this year. Under the provisions of poor relief, a system of relief works projects was established in order to distribute aid in return for labour. The limitations to

average, as a multiple for the extent of each in the whole kingdom' (*Returns of Agricultural Produce in Ireland, in the Year 1847*. 1847-48 [923] lvii, p. iii).

this system were however, quickly recognised by the commissioners, who remarked on worrying increases '...at the rate of about 20,000 persons per week' in those seeking relief"[232]. Furthermore, such works produced an exacerbating consequence, that of reducing available agricultural labour;

> "The matter has now become of so grave and critical a nature, that if the number of persons employed on the Relief Works is not reduced in time to remove all obstacles to the usual amount of labour being employed in preparing the land for the next harvest, evils must ensue which, while they would be painfully felt throughout the whole kingdom, would in Ireland produce calamities greater even than those which have been hitherto experienced"[233]

Owing to necessary increases in the importation of foodstuffs throughout this time, a consequent reduction in domestic food prices enabled the commissioners to subsidise outdoor relief in the form of rations (either gratuitously, or at reduced cost according to individual means), albeit with characteristically liberal caveats concerning market interference, and the necessity of countering tendencies toward idleness. These issued rations consisted of 1&1/4lb of bread (or 1lb biscuit or meal), or 1 quart of soup thickened with a portion of meal along with ¼ ration of bread[234]. The first table of records concerning the issue of rations appears in the second report of the relief commissioners, and distinguishes between rations issued gratuitously to the registered destitute, and those sold to individuals of limited means at reduced cost[235]. Statistics employed in the forthcoming analysis are limited to those concerning the issue of gratuitous rations, which in a majority of unions significantly outnumber those sold at subsidised rates. The data are drawn from six successive reports of May 8th, June 5th, July 3rd, July 31st, August 28th and September 11th 1847[236]. The largest number of rations issued on a single date across all reporting periods was selected for inclusion. This current measure differs from that of Kinealey (who also employed z-score standardisation), in that this measure is first calculated as the rate of rations issued per head of population. This figure is in turn z-score standardised, offering a moderate degree of correction to that employed by Kinealey.

[232] *First Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7.* 1847 [799] xvii, p3

[233] Ibid, p4

[234] Ibid, p 14

[235] *Second Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7.* 1847 [819] xvii, p24

[236] *Second Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7.* 1847 [819] xvii, pp24-26; *Third Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7.* 1847 [836] xvii, pp30-31; *Fourth Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7.* 1847 [859] xvii, pp6-7; *Fifth, Sixth and Seventh Reports of the Relief Commissioners, constituted under the Act 10th Vic., cap. 7.* 1847-48 [876] xxix, pp7-8; 8-9; 8-9

An important predictor, 'number of holdings' (see appendix 2) was calculated using data on the distribution of farm sizes contained in the agricultural censes of 1848 and 1849[237]. Assessment of change is necessarily restricted to this period, due to aforementioned alterations to union boundaries conducted in 1850. Unfortunately, data on farm size distribution were not collected with the agricultural census of 1847; consequently, comparisons must be limited to the 1848 and 1849 waves, although this particular period offers ideal scope for examining the rapid pace of rural restructuring underway throughout this time. The dynamics of structural change and consolidation are critical outcome measures, due to their combined social and ecological effects – indeed, Marx devoted specific attention to this important dynamic in his illustration of the general laws of capitalist accumulation in volume one of Capital. Others have drawn attention to related dynamics, such as the drastic decline in surplus agricultural labour in the immediate post-famine period (Fitzpatrick 1980), and the decimation of the cottier class (Whelan 1995), both of which are closely implicated in the imperatives of the relative rental regime which sought to eradicate fragmentation and consolidate smallholdings. It has already been observed in chapter 6, how the enclosure and annexation of common lands impacted in particular upon the rundale system, dependent as it was upon the free availability of common land in order to graze its stock. Deprived of this crucial resource, seasonal movements of livestock critical to such systems of combined tillage and grazing were in turn disrupted, undermining not only the capacity of the tenantry to appropriate fertiliser through outfield grazing, but also the very basis of communality itself.

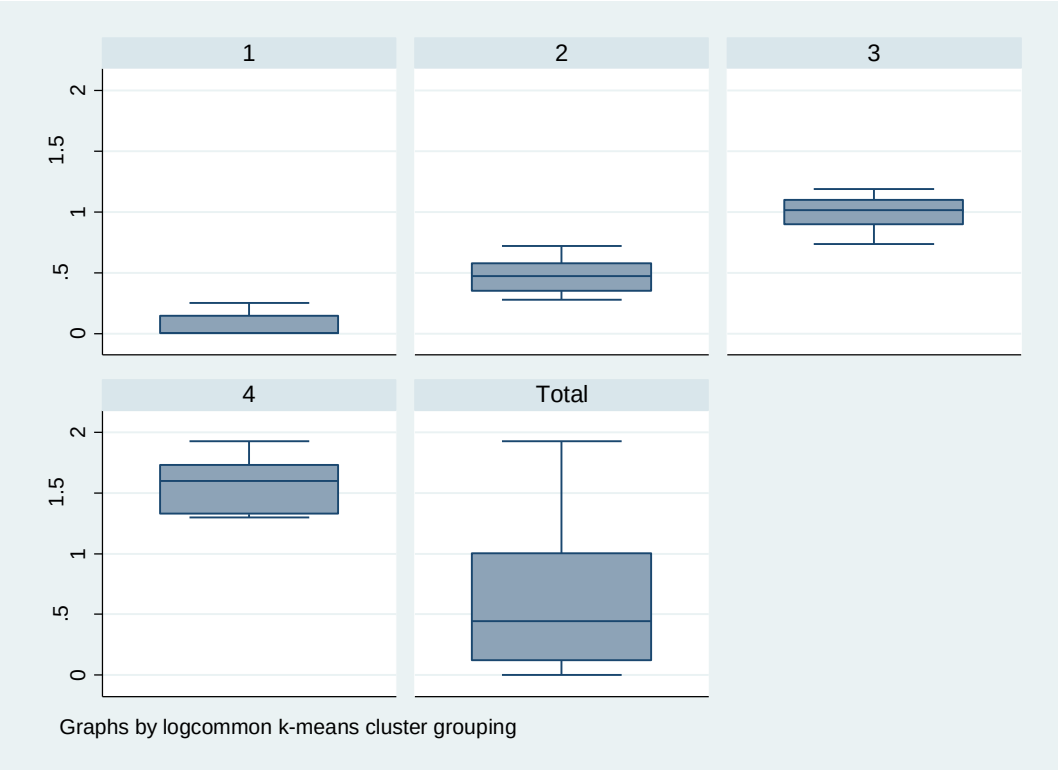
Furthermore, discussion has also been offered concerning the emergence of economic imperatives throughout this period which gave rise to the relative rental regime, a mode of surplus appropriation which favoured intensive modes of agriculture and settlement, based on economies of scale. Materials cited in chapter 6 have attested to periods of widespread evictions, conducted in order to facilitate consolidation, and minutes of evidence from the Devon Commission are rife with denouncements of rundale as both a barrier to productivity, and a hedge against modernisation. There is little doubt that this more sinister dimension of landlordism is implicated centrally in examinations of famine-era resilience; according to existing pronouncements on metabolic rift, the aforementioned imperatives of landlordism functioned to undermine fertility by mandating the generation of exchange value on the part of the tenantry, thus implicating the Irish producer in the burgeoning capitalist world system. As established previously, the 'mode of production' is considerably more complex, and this

[237] *Returns of Agricultural Produce in Ireland, in the Year 1848.* 1849 [1116] xlix, pp14-17; *Returns of Agricultural Produce in Ireland, in the Year 1848. Part II. – Stock.* 1849 [392] xlix, pp16-1

particular outcome thus offers ideal scope for studying interactions amongst various levels of this complex panarchy. Therefore, although the concept of metabolic rift enables conceptualising such macro-determinants of differential fertility, a position now exists from which to explore its effects empirically under a social form characterised by feudal, primitive-communal, and capitalistic elements. With this in mind, this variable assumes the character of a measure of a number of components of social-ecological resilience, such as depopulation, and structural change in the form of land redistribution.

The following discussion and presentation of results relies on tabulating descriptive output by categories of common holding. To this end, a 4-category dummy grouping variable was generated using the same basic k-means algorithm as in section 7.1; the results of this categorisation thus allow the displaying of summary output according to levels of common holding. The clustering procedure yielded adequate differentiation between groups as may be observed in the boxplots below; group summary statistics are also provided beneath for ease of interpretation.

Figure 7.10



Boxplots of logged common holding (‘common’) by cluster group membership (N=130)

Table 7.7. Cluster group mean common (logged and original)

Cluster Group	Common Level	Number of unions	Mean logcommon	Mean common
1	Low	48	.068	.196
2	Low-Mid	39	.476	2.133
3	Mid	25	.981	9.124
4	High	18	1.562	39.993

Regarding the above variables, foregoing critiques of deterministic modeling and structuralist systems analysis are thus inherent in these choices of measure – current interest rests not in deriving linear determinants of social change, but in interpreting results as configurations of values which give rise to rates of structural change of varying magnitude. Although foregoing theoretical informants here give rise to a number of hypotheses concerning likely predictors of variation in outcome beyond common holding alone, such excessively deductive tendencies toward model specific must be countered by taking a quasi-inductive approach to model specification. This iterative approach to model specification was adopted at all stages of estimation across all outcomes. Although there are reasonable grounds for specifying certain hypotheses, the diversity of chosen predictors, and the abstract, loosely defined nature of the mechanism of metabolic rift, such as it operates at local levels, is less well articulated and consequently, less amenable to deductive hypothesising. In place of deductive specification a 'general to particular' approach was adopted, which initially involved regressing all theoretically relevant variables on the predictor in question. Model refinement thus proceeded in an iterative manner, removing variables according both to statistical and theoretical criteria. Statistically, where low t-statistics were observed, such variables were dropped, although these were reintroduced experimentally at all subsequent stages of specification in order to check for suppression effects. On this basis, models were refined until additional adjustments in specification yielded no substantial gains in explanatory capacity. Certain control variables considered critical to the overall model, were, in many cases, included regardless of convergence to significance. It must here be emphasised that every care was taken to balance statistical against theoretical criteria, and that these were not merely exercises in 'star hunting'.

All models, including time series models, were estimated using ordinary least squares (OLS) regression and where appropriate, standardised coefficients are reported along with original regression coefficients. Standard criteria were used for assessing statistical significance and a typical threshold of 0.05 (5%) was deemed appropriate for establishing statistical significance (t-statistics are reported beneath regression coefficients in parentheses throughout). It must also

borne in mind that the typical interpretation of such figures may be misleading in the context of this study data. Since this is population data, it does not make sense to think of significance in its usual capacity as a measure of the probability of sample error. Regression diagnostics are provided in appendix 3, and where appropriate, references to relevant appendices are provided within text. Typical diagnostics are provided, including assessments of residuals, checks for colinearity, information criteria (AIC), and influential cases. Increment R^2 values are reported along with diagnostics included in appendices. Using stata's 'pcorr2' command, it is possible to obtain an estimate of the unique contribution of each variable to the overall explanatory capacity of the model. The pcorr2 command estimates a model without the variable in question, and then a model including the omitted variable. The increase in R^2, as a result of including this variable is usefully provided, thus offering a further assessment of the relative importance of various predictors aside from predictor significance alone.

7.2.3. The metabolic rift under rundale: a quantitative examination

The question of differential fertility - as a consequence not of natural endowment, but of variations in modes of cultivation and social form - has preoccupied much existing work on the explanatory utility of the concept of metabolic rift. Much of this work has been either loosely grounded, or discussed historically in the context of the emergence of capitalism; indeed, the presence of a putative or burgeoning capitalism, as discussed in chapter 5, is often asserted as a key catalyst for the exacerbation of regional ecological inequalities. Regarding the specific manner in which the metabolic rift manifested under rundale, the essential dynamics of production at commune level may be summarised, such as they conspired to diminish adaptive capacity and confer differential resilience, as follows. This clarification thus details the mechanism of differential resilience – subject to greater qualitative corroboration in chapter 8 – which for now, provides a point for further empirical elaboration with the forthcoming models. As discussions of the social form of rundale in chapter 6 have suggested, the reproduction of individuals as commune members depended upon a plethora of institutions which served to 'inhibit' individualization. Central amongst these was the inherent tendency of rundale communes to subdivide the means of production in order to accommodate new members under a burgeoning pre-famine demographic regime. In corroboration, the preceding exercise has shown how group 4, which recorded the highest levels of common holding across cluster groups, was also characterised by high rates of fragmentation, high nuptiality and higher levels of available wasteland, all of which suggest mounting pressure on the already limited means of production.

As the arable lands of the commune became increasingly parcellised into smaller tillage strips under the pre-famine absolute rental regime of subdivision (McDonough and Slater 2005; Slater 1988), a paradoxical state obtained whereby the commune's lands, which were in many cases subject to continuous cropping without fallow, were forced to yield both subsistence and cash crops under conditions of increasing ecological stress. Much to the lamentation of contemporary commentators, communal holding also functioned to dis-incentivize capital intensive improvement works such as drainage schemes and systems of rotation; indeed the very principles of share allocation, and the necessity of winter stubble grazing mandated an absence of permanent boundaries, in order to permit combined tillage and pasturage otherwise difficult to accomplish on an individual level[238]. Therefore, although the institutions of communality functioned in the abstract both to facilitate combined tillage & pasture and to efficiently exploit scarce sources of fertilizer; conditions in Ireland conferred a specific form of metabolic rift upon the rundale system which critically diminished its resilience, and increasingly compromised its ability to maintain fertility. According to Marx, these specific forms of fragmentation, engendered under such communal modes of production, served to disperse labour power in a sub-optimal manner (Shanin 1983: 122). In this sense, historical context is crucial, and limitations to the contemporary, generalized narrative of metabolic rift are further underscored.

The rundale system was thus compromised from without as well as from within, and evidence has been offered in chapter 6 attesting to restrictions imposed on the ability of rundale to expand outwards, in comments on the enclosures of upland commonage on the Nixon estate in response to rising wool prices. As market conditions shifted in favor of production regimes

[238] The cause of limited capital investment in improvement works was not merely, as some have suggested a consequence of insecurity of tenure - although a brief comparison with the pace of reform in Northern counties under the provisions of 'Ulster Custom' serves as a crucial case in point (Dowling 1999). Mokyr has cited evidence from the Devon commission suggesting that lack of investment was equally prevalent among holders of substantial leases; '...Nor did it appear that "the tenants who have the longest leases have brought the lands they hold to a more productive state than others not possessing such security" (1983: 81). Instead, common holding in many cases functioned to inhibit the application of capital to long-term improvement works, as Knight's comments on Erris in 1836 suggest; 'It is evident from this system, that although a man may expend a good deal of labour in digging and manuring his ridge, it is only chance whether he will enjoy the labour so expended the third year; and hence that he is careless of future benefits, and that, of course, the land will be but imperfectly cultivated' (1836: 46-47). Similarly, a witness before the Devon Commission, commenting on rundale in his reporting district, claimed; '…his tenement consists of a number of scattered patches, each too small to be separately fenced and exposed to constant depredations of his neighbours cattle, thus affording a fruitful source of quarrels and utterly preventing the possibility of the introduction of any improved system of husbandry' (Dowling 1999: 211). This reluctance therefore ensues from the principles of share and risk equalization which produce a counter tendency under the dualism of communality and individualism; development of the 'productive forces' thus tends to remain at such a level as to maximize individual returns, in the context of a communal system which minimizes collective risk. In this case, an individual's 'rational strategy' is not to expend his efforts on improvements on his own plot, lest he lose its benefits upon rotation of shares.

dependent upon large-scale grazing, imperatives of enclosure and consolidation sought to deprive the commune of its grazing grounds, and to realign the imperatives of landlordism away from a rental regime of maximum population density, toward one of consolidation. Within the commune itself, Marx has suggested in chapter 4, that the fragmentation of the means of production inherent under such conditions accelerated private accumulation under favourable conditions, thereby shifting balance toward the individual side of the communes characteristic individual-communal dualism.

Within the Irish rundale, commune members thus began to engage in activities such as spinning (Almquist 1977; Gray 2005), and illicit distillation (Bonner 1969; Connell 1968; Knight 1836) as important sources of subsidiary income[239]. Therefore, although engagement in peripheral commodity production imbued the rundale system with an inherent flexibility and resilience to market competition; as the constraints of population growth, landlordism and enclosure came to bear upon the rundale, the result was an undermining of the very institution of communality by accelerating dependence on such peripheral, individualized activities, and mandating the further parcellisation of the already strained means of production. Furthermore, the consequences of these constraints on the means of subsistence of the tenantry was disastrous; on Clare Island, these dual pressures of commercialization and subsistence lead to an elimination of oats from the tenants diet, whereby the population came to depend increasingly upon the potato for its subsistence, and the oat crop was '…increasingly consigned to the market' (Whelan 1999: 81 cited in Slater and Flaherty 2010: 24). Given that the sale of agricultural commodities was integral to the reproduction of the commune through realization of rent, the 'classic' mechanism of metabolic rift also came into play, whereby movements of produce off-site deprived the commune permanently of these repatriated nutrients, which were consumed in locations far from their site of production; '…the great export of live stock and of various other kinds of agricultural products raised in this country, tends, and has tended for many generations, to cause a depletion of fertility which can only be made good by importing feeding stuffs and fertilizers, and bestowing constant attention on the land' (Hooper 1922: 215).

The dynamics of this multilevel panarchy thus conspired to interrupt the flow of nutrients back into local ecosystems which, despite the attempts of the commune to counter declining returns

[239] In the parish of Moville, Co. Donegal, Samuel Lewis observed; 'Here the system of rundale is still kept up, and the land, being divided into very small holdings, is much neglected, nearly all the population being employed in the weaving of linen cloth and fishing, combined with agricultural pursuits: the produce of the land is chiefly corn and flax, wheat having only been grown since 1830, but it is found to answer very well' (1837: 399). Similar dynamics persisted on the Aran Islands, where the enumerators' books of the 1821 census reveal high reporting of dual occupations.

with the selective application of fertilizer through the use of 'lazy-beds'[240], and the maintenance of an infield-outfield rotation system increasingly undermined by shifts toward individualization, were; "…inadequate to overcome the loss of nutrients from the tilled soil and thereby unable to repair the damage done to the nutrient recycling process by the metabolic rift. More nutrients apparently leaked from the ecological system than were replaced by the rundale members and this was manifested in the continuing decline in the fertility of the soil" (Slater and Flaherty 2010: 29). As a crucial component in Fraser's tri-axial panarchy model, this state of declining fertility, coupled with loss of species diversity, increased connectivity and biomass density – along with the concrete constraints specific to modes of communality in Ireland such as individualization, commodification, enclosure and rackrenting – together define the specific character of the 'metabolic rift' such as it operated in the context of the Irish rundale system.

Consequently, such an understanding of the internal dynamics of the commune, and the specific manner in which the nutrient cycle of its production process was critically disrupted is essential - not merely an understanding of its placement within the broader context of the capitalist world system as suggested in chapter 5. A closer, qualitative examination of these dimensions is offered in chapter 8; for now, the forthcoming section may be contextualised by concluding that the mechanism of diminished fertility and compromised resilience is not intelligible through a

[240] The lazybed, ubiquitous within the rundale system (McCourt 1955a; Whelan 1999), was a method of ridge cultivation inherently adaptable to local geological, climatological and topographical nuance. Its ecological efficiency and flexibility is borne out by the following comments of Estyn Evans; "Not only does this method make full use of the humus and decaying grass but it prevents the sets from becoming waterlogged and rotting, for the whole bed is raised above the water-table. And the unbroken sod checks the downwash of plant nutrients. The trenches or furrows between the ridges provide open drains, and the lazy-beds are always carefully aligned with the slope of the land. Moreover, when the trenches are dug a second time for earthing the potatoes, they often go deep enough to penetrate the hard layer of iron pan which tends to form under heavily leached soils by the washing down of iron salts. This the old fashioned plow could not do. Breaking the impermeable pan not only improves the drainage but provides minerals which are returned to the topsoil when the potatoes are earthed" (1979: 143). The lazy-bed thus performed a range of ecological functions, the efficiency of which was maximised under systems of intensive spade husbandry. The structure of the ridge itself, including its width and depth, could be adapted to location variations, which was particularly important given both the marginality of many rundale lands, and the inherently haphazard layout of tillage strips which often resided in multiple locations of varying quality. Such was the variation in local cultivation practices, that in 1830, a Tyrone mill was producing almost 200 different types of spade (Bell and Watson 1986: 43). The lazy bed was especially suited to 'breaking in' marginal lands, where after it purportedly offered yields superior to those on lands sowed in drills. According to Bell and Watson, "The sensitive adjustments practiced within these techniques in response to aspect, soil type, crops grown, their place in the crop rotation, and the methods of harvesting, show that, although developed by the poorest farmers, ridge-building was part of a remarkably sophisticated cultivation system" (2008: 61). O' Grada attributes much of Ireland's success in terms of comparative yield to the use of soil-cleansing root crops such as the potato, spade husbandry, and the application of manure. His assessment thus mandates an alternative interpretation of the rationality of indigenous practices of this time; 'Our numbers support the reinterpretation of some peasant behavioural responses…Examples include the lazy-bed and the spade…Marked regional variation in cultivation techniques and tillage implements is another example of methods which at first seem to reflect conservatism…may simply show a determination to get the most out of what capital there was to hand' (O' Grada 1988: 56).

simple, capitalistically-driven account of produce movement alone; rather it is exacerbated through the aforementioned contradictions which are only fully comprehensible through abstraction, as the methodological template advanced at the conclusion of chapter 5 has argued. This chosen approach has thus vindicated the pronouncements of Benton (1991; 1994) who has suggested the necessity of examining resource dynamics in their historical specificity, and of Benton (1998) and Byrne (2005; 2009b), whom have emphasised the necessity of abstraction, in order to isolate *internal* generative-causal properties and mechanisms giving rise to specific systemic outcomes. This cumulative insight thus paves the way to move toward the final quantitative component of this investigation, wherein the aggregate dynamics of communality and agricultural production are explored, as the aforementioned constraints came to bear in their full force from 1845-1850.

7.2.3.1. Production, productivity and fertility pre and post-famine

In the years immediately following the end of the Napoleonic wars, Irish agriculture entered a period of unprecedented change, in which the vicissitudes of market and landlordism conspired to wreak widespread change upon production and productivity. As previously noted, the gradual upward trend in grain prices throughout the eighteenth century - exacerbated greatly by shortages in export markets during the Napoleonic wars - served to incentivize the consolidation of a tillage-based economy. Consequently, as per Connell's classic model of pre-famine demographic behaviour, with the removal of barriers to early family formation, an increasing proportion of the rural population came to subsist on the prolific potato, buoyed by their capacity to carve out a living on limited tillage plots. As the nineteenth century wore on however, converse trends of rising livestock prices meant that in order for landlord and agent to maintain their incomes at comparable levels, the profitability afforded by conversion to grassland became increasingly attractive[241]. Large-scale grazing thus began to supplant tillage in terms of profitability, owing both to favourable export market conditions, its comparatively lower production input costs, and limited capital outlay requirements. Where tillage survived, as it did in certain districts with remarkable tenacity, it tended toward areas accustomed to outward expansion through cooperative, labour-intensive reclamation onto comparatively

[241] This extent of consolidation in the interim (i.e. post-Napoleonic – famine) period is as yet subject to debate, as Cormac O' Grada has pointed out discrepancies between evidence submitted to the Poor Inquiry and the Devon Commission concerning the extent of conversion to pasturage and consolidation throughout this time. According to the Poor Inquiry (1835), only 67% of the 1502 participating witnesses testified that consolidation was widespread, while the evidence of the Devon Commission points toward extensive consolidation (O' Grada 1994: 117). In light of his analysis of fluctuating relative prices and wages throughout this period, a more valid conclusion would emphasise the tendency of tillage and pasture to wax and wane according to local contexts. The work of Hooper (1922) is emphatic however, in its demonstration of a consistent fall in tillage acreage in the post-famine period.

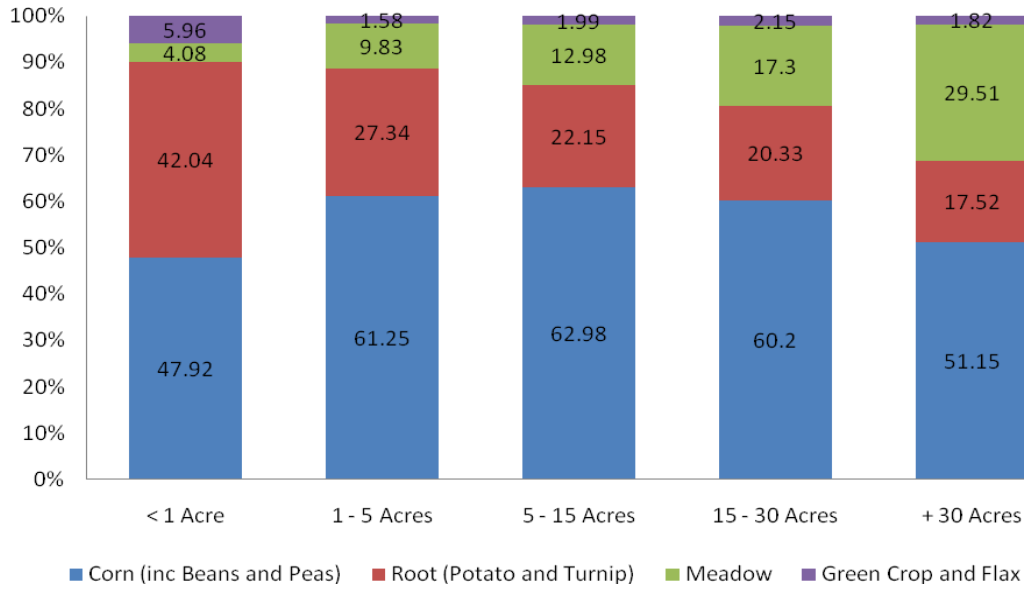
unproductive mountain and bog, as was endemic under rundale. The net effect of these economic 'push' factors was both to limit the internal reproductive capacities of such marginal tillage systems, and to limit their capacities for outward expansion under the imperatives of consolidation. So pervasive were these imperatives, that the number of holdings under 5 acres fell 70%, from 442,000 in 1841, to 126,000 in 1851, facilitated both by legislative reform, and opportunities afforded by famine (Crotty 1966: 49, 351)[242].

Figure 7.11 (below) offers an overview of the state of this distribution of productive activity across settlements of varying acreages. A general impression of the composition of Irish agricultural production in 1848 may be obtained from this figure, which displays proportions of agricultural produce (in terms of acreage), tabulated within categories of landholding size, thereby providing a comparative overview of the character of agricultural production across smallholdings, middle-sized farms, and larger units, within which a number of striking patterns present. Significantly, the highest proportions of root crop cultivation (42.92%) are evident within the '<1 acre' category, weighted almost evenly with proportions of 42.04% corn, a category which predominantly consists of wheat, barley and oats, or the staple cash crops of the labouring poor[243]. The existence of this division lends further weight against arguments presented previously concerning the presence of predominantly 'subsistence' zones confined to areas of extensive smallholding; therefore, although this figure represents an aggregation of diversity, it is quite unlikely that many succeeded in existing beyond the rent relation, which by its very nature required the constant generation of exchange value. A simple regression using county-level data from section 7.1 introduces the dimension of joint tenancy into this perspective on productive activity and smallholding, by assessing the additive effects of both variables on poverty rates (table 7.8).

[242] In terms of legislation, Crotty (1966) refers to the enactment of the Gregory clause in Irish poor law, which exempted occupiers of holdings falling under one-quarter acre from availing of relief, forcing many from their former conacre settlements onto the labour market. The plight of this labouring class was singled out for particular attention in the Devon commission; '...it will be seen...that in many districts their only food is the potato, their only beverage water, that their cabins are seldom a protection against the weather, that a bed or blanket is a rare luxury, and that nearly in all, their pig and manure heap constitute their only property' (*Devon Commission…Part I.* 1845 [605] [606] xix, p 35). The dependence of this labouring class on the potato, along with those identified as subsisting on marginal, cooperative tillage plots by Crotty, are both, doubtless, in part responsible for sustaining pre-famine tillage levels.

[243] It is likely that many rundale settlements fell into both the '< 1 Acre' and '1-5 Acre' categories; through directions established under Griffiths' valuation in 1853, enumerators were instructed to record details of each individual holding on a joint lease where possible; *Copies of the instructions issued by the late Sir Richard Griffith in the year 1853…* 1882 [144]

Figure 7.11[244]



Distribution of agricultural produce by holding size, 1848

Table 7.8. OLS Regression of Logged Joint Tenancy and % Holdings 1-5 Acres on Poverty (Poor Law Valuation Per Head); N=32

Variable	Unstandardised Coefficient	Standardised Coefficient	Part Correlation	Mean	Standard Deviation
	B	β			
Log % land held in common (x_1)	-0.555** (-3.10)	-0.420	-0.419	0.736	0.441
% Holdings 1-5 Acre (x_2)	-0.507** (-3.74)	-0.507	-0.505	42.33	11.13
Intercept (y)	9.465***			1.56	.583
R^2 = 0.471					
R^2 = 0.434					
F (29, 2) 12.906***					

t-statistics in parentheses
*p<0.05, **p<0.01, ***p<0.001

[244] *Returns of Agricultural Produce in Ireland, in the Year 1848.* 1849 [1116] xlix

Despite their high level of aggregation, the above variables nonetheless offer a robust prediction of poverty rates within counties. Although of little explanatory value alone, the above model nonetheless posits a preliminary statistical link between common holding and poverty, controlling for levels of smallholding, insofar as greater extents of common holding exert a negative effect on valuation (-.420 standard deviation units of the outcome). In essence, the above model empirically corroborates a theoretical connection between communality, and a crude outcome of comparative affluence which functions for now as a tentative proxy of potential ecological distress. Furthermore, utilising data from the union level dataset (N=130), a correlation coefficient of (-0.364, $p < 0.001$) was noted between poor law valuation per head, and the percentage of total area under potato within unions, 1847, suggesting that areas scoring comparatively high on potato acreage tended to occupy settlements of lesser valuation. On the basis of the above figures and tables, it is clear that the aforementioned tendencies of consolidation conferred quite a heterogeneous character on Irish agricultural productivity, according to which the activity of grazing came to assume greater viability on larger holdings (as per figure 7.11, with regard to the predominance of meadow in the >30 category), and in which the production of root crops under a regime of combined tillage prevailed in far greater proportions within holdings of the 1-5 range, a situation which the above regression suggests, bears strong associations both with communality, and poverty.

But what of questions of productivity and yield? Although Crotty's account suggests that an increasing confinement of tillage to marginal lands should lead to ever declining returns in the form of diminished long-run yields, Turner (1996: 29) claims that the labour-intensive character of Irish tillage, based as it was in the pre-famine years upon manual spade husbandry, and the selective application of manure, sustained a level of yield on par with those of wider Europe at the time. Comparisons between Arthur Young's estimates of grain yields in the 1770's with levels of the 1840's further demonstrate an increase of 20% over this period (O' Grada 1994: 120). According to Turner, the post-famine years, during which the imperatives of consolidation and mechanisation took hold, saw a decline in yield owing to a shift toward extensive, rather than intensive techniques, which tended to dissipate fertility. This was particularly the case under rundale, where the ubiquity of the lazy bed, under favourable conditions, ensured maximum efficiency in tillage yield. Based on Turner's contention therefore, the predominance of labour-intensive ridge cultivation in certain regions, such as those of high-density communality, should in turn serve to augment yield[245]. The eradication

[245] Clearly other factors enter this equation in times of distress – in which case the close proximity of tillage plots and their low levels of species diversity both functioned to facilitate the spread of blight. The question of yield alone is therefore no indication of the quality of output.

and consolidation of rundale in the post-famine years doubtless contributed to this net decline of yield in certain high-density regions. Notwithstanding Crotty's contention that in certain instances, tacit selection by farmers for prolific variants tempered this decline, a condition of overall fertility decline in the interim, and post-famine years appears well substantiated, as the following time-series regressions presented in table 7.9 suggest (see table 7.10 for descriptive statistics).

Table 7.9. OLS Time Series Regression, Total Country Crop Yields 1847-1861 (N=14)[246]

Variable	Coefficient	Standardised Coefficient β	t	R^2
Wheat	-6.351*	-0.518	-2.18	0.2118
Oats	-8.250**	-0.723	-3.78	0.4864
Barley	-9.528**	-0.656	-3.13	0.3866
Potato	-243.981**	-0.700	-3.54	0.4514
Turnip	-363.936*	-0.557	-2.42	0.2567
Flax	-13.880**	-0.782	-4.53	0.5819
Hay	-11.251	-0.404	-1.59	0.0990

*p<0.05, **p<0.01, ***p<0.001

[246] Regression of yield levels (1847-1861) against linear trend dummy. Sources: *Returns of Agricultural Produce in Ireland, in the Year 1847.* 1847-48 [923] lvii; *Returns of Agricultural Produce in Ireland, in the Year 1848.* 1849 [1116] xlix; *Returns of Agricultural Produce in Ireland, in the Year 1849*. 1850 [1245] li; *Tables Showing the Estimated Average Produce of The Crops for the Year 1861; and the Emigration from Irish Ports, From 1st January to 31st September, 1861*. 1862 [2996].

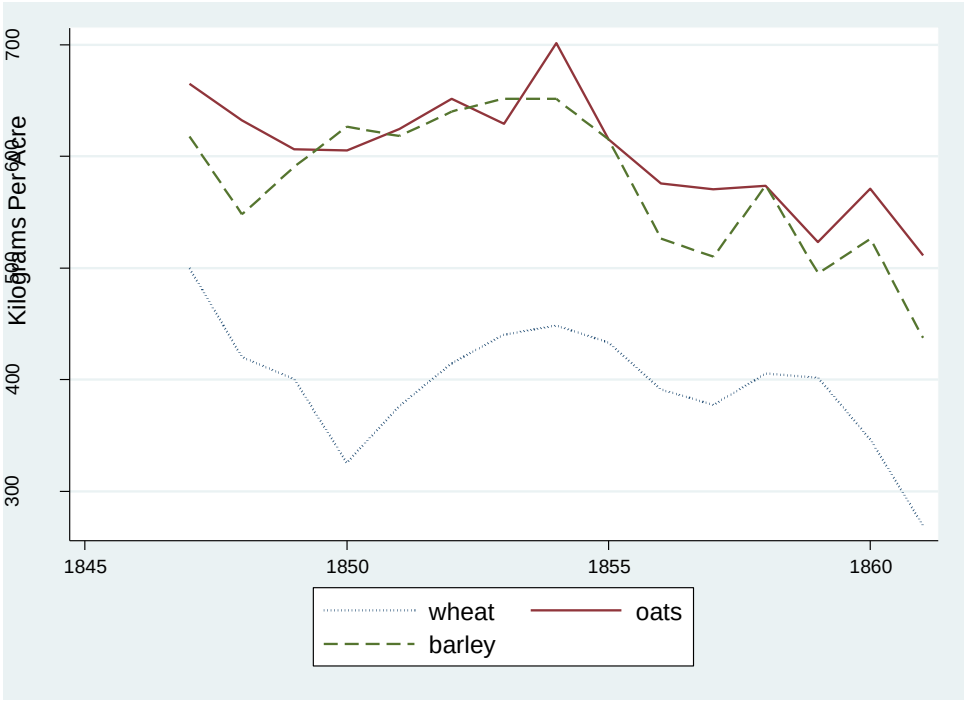
Table 7. 10. Time-series variable summary statistics

Variable	Unit	Mean	SD	Min	Max
Wheat	Kilogram per acre	396.713	54.858	269.6	499.7
Oats	Kilogram per acre	603.720	51.010	511.1	701.2
Barley	Kilogram per acre	575.260	64.949	437.5	651.5
Potato	Kilogram per acre	4596.787	1557.793	1665.8	7324.4
Turnip	Kilogram per acre	13889.830	2924.330	8382.1	16816.3
Flax	Kilogram per acre	236.939	79.359	150.496	470.458
Hay	Kilogram per acre	1956.099	124.495	1634.975	2124.799

The above models record a negative coefficient for all crop variant yields (measured in kilograms per acre), spanning the period 1847-1861 when regressed against a linear trend. Of particular note above are profound declines evident in oats and potatoes. Although these aggregate models undoubtedly gloss over internal variations in distribution, the above figures nonetheless lend credence to the preceding claims concerning long-run fertility decline, although it is difficult to tease out the specific mechanism at work – i.e. whether declines may be attributable to the erosion of labour-intensive cultivation methods – in the absence of further corroboration, and at this cursory level alone. The following set of figures further illustrates the volatility of these long-run trends[247].

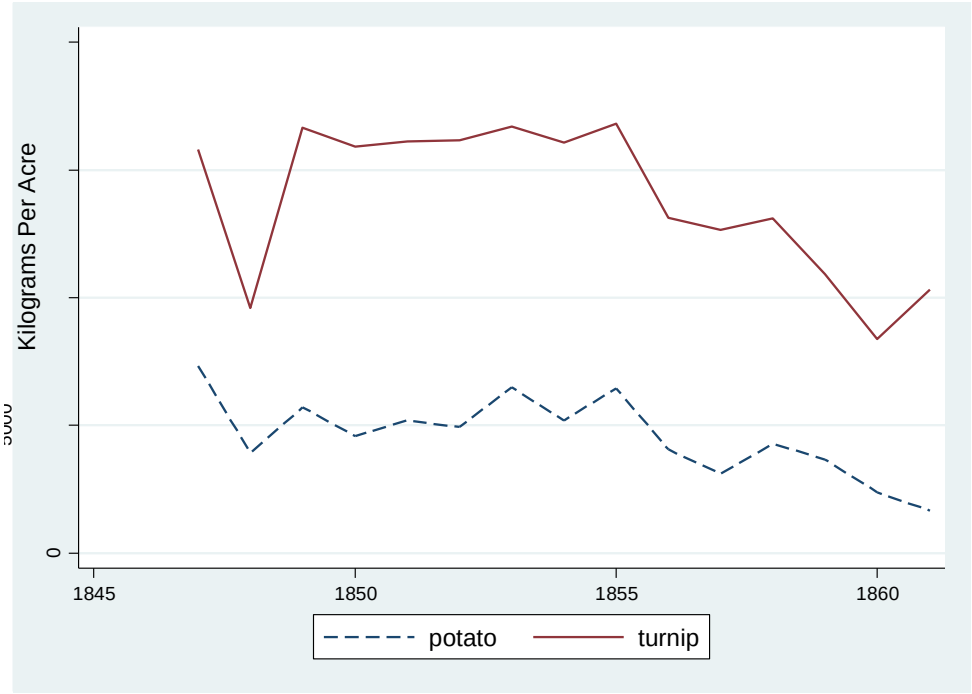
[247] Substantial fluctuations in certain cases are due to weather effects – these fluctuations were controlled for by Hooper (1922) who resorted to quinquennial averages in his 1847-1920 series. Current interest is specifically with interim famine trends however, which are decidedly negative across all crop variants (see footnotes for source details).

Figure 7.12



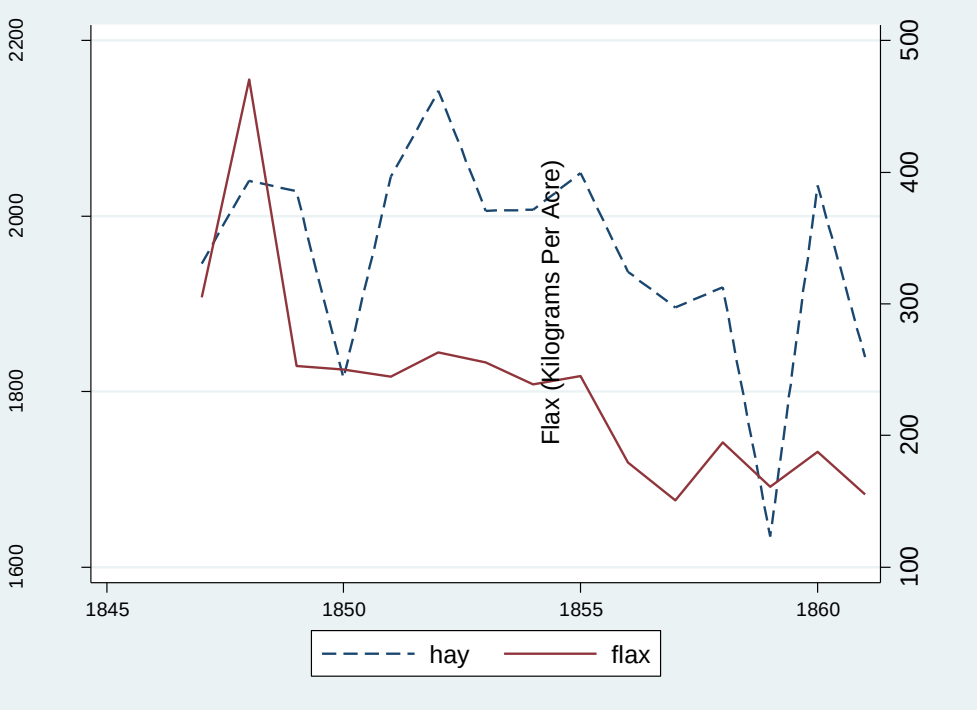
Wheat, oats and barley yield, 1845-1861

Figure 7.13



Potato and turnip yield, 1847-1861

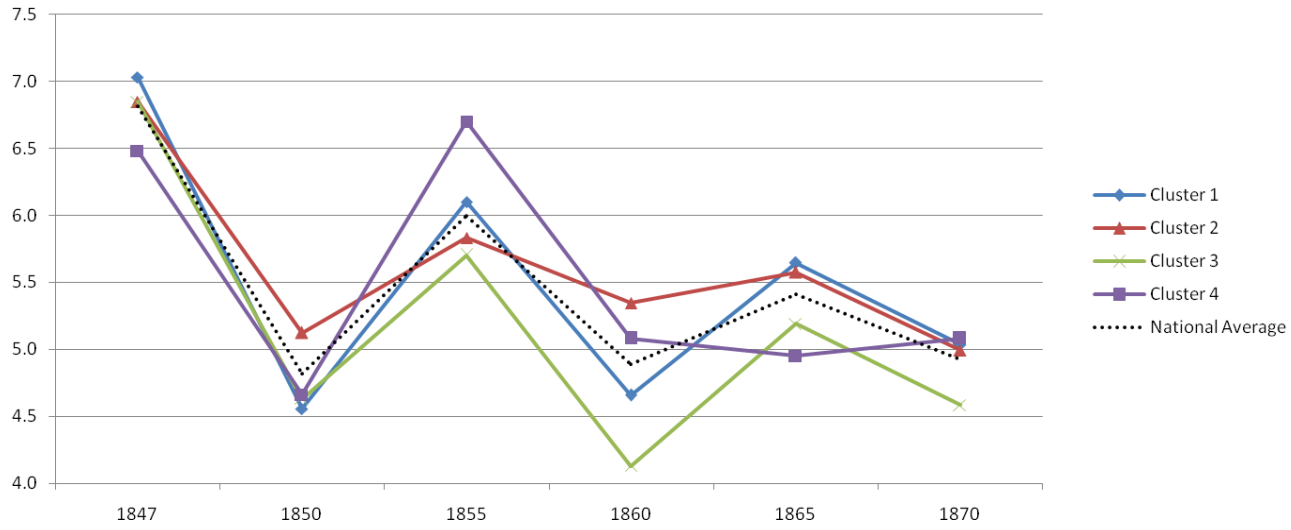
Figure 7.14



Hay and flax yield, 1845-1861

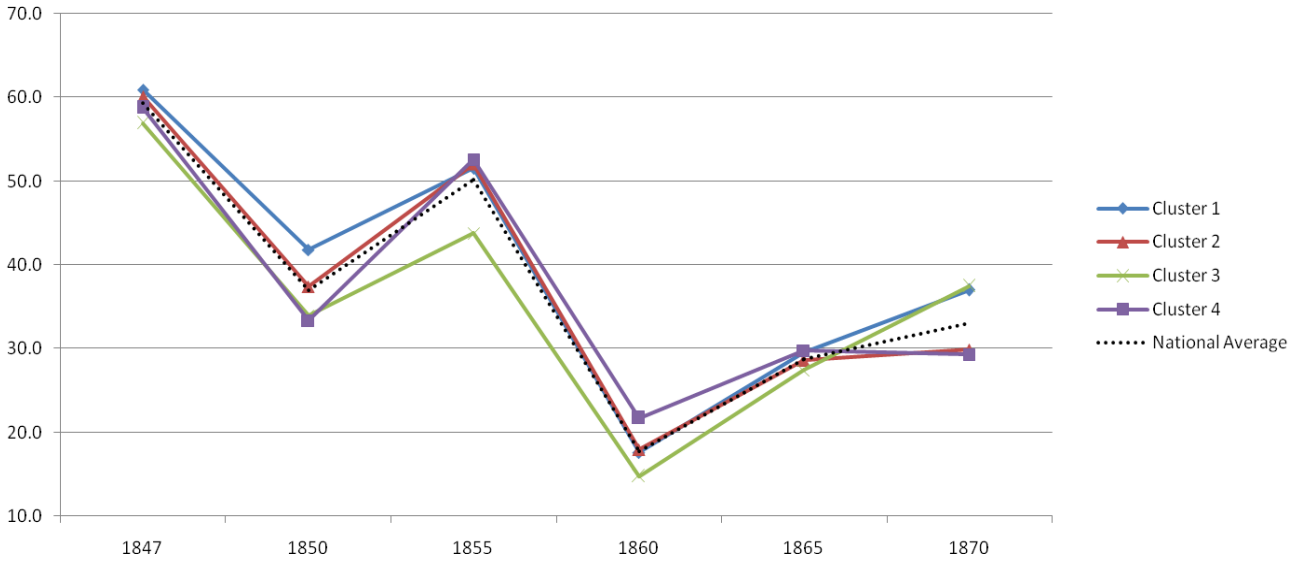
The above diagrams thus highlight both the summary fluctuation of yield rates – particularly throughout the famine years of 1847-1850, and an overall negative trend across all variants in the post-famine decade. In particular, drastic declines are noted between 1847 and 1850, particularly for root crops, as per figure 7.11. Given that the above trend diagrams inevitably gloss over internal complexities, it is worth examining a decomposition of these aggregate statistics utilising the typology derived in section 7.1. Based on this decomposition by cluster group membership, in which the statistics utilised in table 7.10 and figures 7.12 to 7.14 are again invoked, the following results were obtained, and are presented below in figures 7.15 - 7.16. For comparison, national average rates of production are included; although in cases it will be observed that prolific clusters exert undue influence on overall trends, in which case, caution is advised when interpreting.

Figure 7.15



Long-run wheat yield trends (barrels – 20 stone per acre), 1847-1870

Figure 7.16



Long-run potato yield trends (barrels – 20 stone per acre), 1847-1870

In essence, these trends substantiate something of contentions thus far concerning the susceptibility of cluster group 4 to diminished resilience, as well as claims presented previously attesting to the yield-boosting effects of labour intensive tillage. In times of crisis, it is clear that for both corn (in this case, wheat) and root crops, group 4 suffered worst in terms of compromised yield. The drastic returns to yield rates above national average, however, is

suggestive of the effects of continued labour-intensive tillage in the post famine years which served to boost yield levels within group 4 in particular. On this point, Crotty (1966: 54-55) suggests that increases of agricultural land from 12.2 million acres to 12.9 million between 1851 and 1871 are indicative of the continuation of reclamation and labour-intensive tillage techniques long into the post-famine period, providing a strong indication of the survival of such practices closely aligned with communal settlement. The nature of distribution of yield levels in the interim famine years for potatoes, points particularly toward a state of differential resilience, for the moment relying strictly on yield as indicator. According to figure 7.16 all cluster groups begin from a relatively common baseline yield level in 1847; what follows thereafter is striking, specifically the profound divergence, whereby groups 4 and 3 deteriorate below national level (it must again be noted that this measure takes account of changes in acreage, and is therefore not attributable to population attrition or decline alone). Furthermore, post-famine recovery rates are equally disparate across cluster groups. In short, the above exercise, which invokes a cursory level of differentiation by social condition, substantiates much of Marx's contentions concerning the necessity of historical and social contextualisation when considering resource dynamics and differential fertility, as well as confirming the presence of the summary dynamics of metabolic rift, if not a specific mechanism of its differential distribution. A closer examination is now attempted, through a series of statistical models, of the interaction of these and other outcomes with a range of theoretically relevant predictors in order to further interrogate these summary trends.

7.2.3.2 Production, yield, distress: resilience and reconfiguration

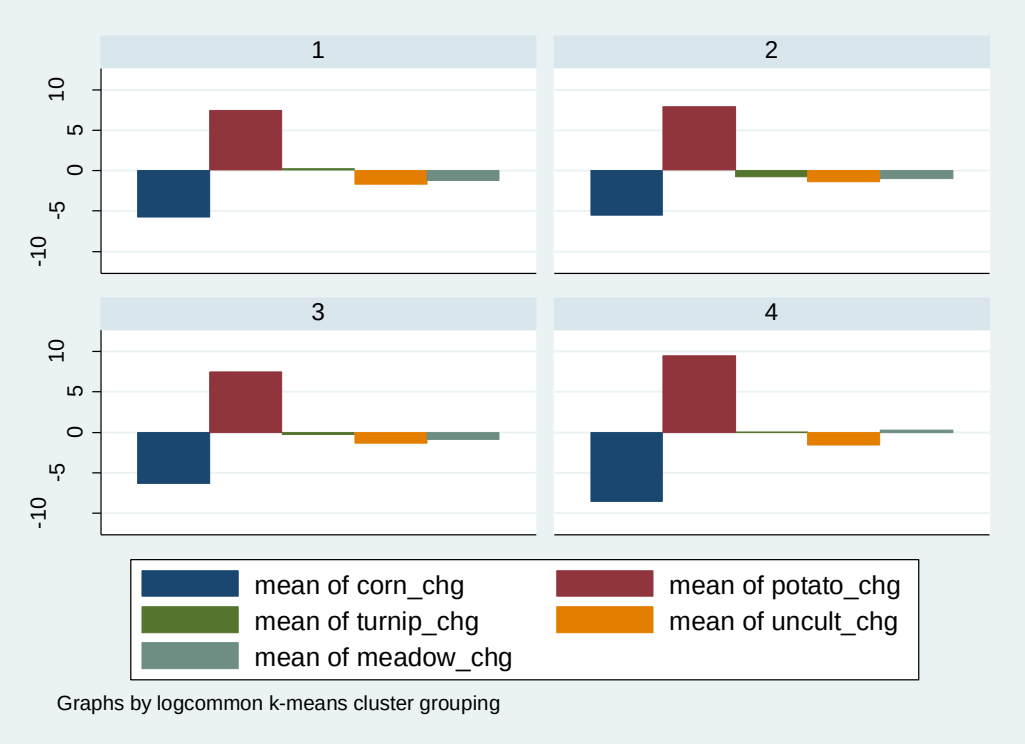
The distribution of agricultural produce tabulated in figure 7.11 is very much suggestive of the presence of mixed modes of agricultural activity across both Ireland as a whole, and within categories of holding size. According to an account of the 1830's, the Irish agricultural landscape of this time was one of '...an interwoven patchwork of potatoes, wheat, barley, and so little intervention of meadow and pasture that one is surprised how the inhabitants contrive to maintain their cows, horses and sheep' (O' Grada 1988: 51). Within this patchwork, the potato functioned very much as a subsistence crop, constituting the staple food of over one-third of the population, whilst up to a quarter of all additional tillage output was consigned to export (Bourke 1959; O' Grada 1988: 51). The extent of recorded potato acreage in 1847 is somewhat lower than its rates in previous seasons however; according to Bourke, Ireland experienced a drastic reduction in potato acreage in 1847 owing to a shortage of seed due to the widespread failures in 1846. From its previous high of 2,000,000 acres, potato acreage fell

dramatically, only recovering to previous levels by 1859 (Bourke 1959: 3). As a result, the statistics of 1847 reflect a substitution in the crop rotation of turnips as a means of subsistence;

> "In regard...to the culture of turnips, it must be remembered that in the remote and populous districts, where regular rotation of crops had scarcely been introduced, they have been sown from necessity rather than from foresight, and by no means to the same extent to which potatoes would have been planted. They were sown, in fact, in despair, as the food of man, not of cattle"[248]

In order to gain a representative view of the respective importance of various crops according to their function as subsistence, or potential commodity, the role of turnips as a crucial food source must be borne in mind when interpreting the following figures. Although a state of productive diversity appears well substantiated by the preceding descriptive statistics, the specific nature of change in agricultural activity throughout the initial famine years is suggestive of a degree of diversity in terms of response dynamics, which are presented below. Figure 7.17 thus tabulates changes in the relative proportions of various crops cultivated within unions; when decomposed according to levels of common holding, the following results are obtained.

Figure 7.17



Mean rates of acreage change (% points change), 1847-1849

[248] *Returns of Agricultural Produce in Ireland, in the Year 1847.* 1847-48 [923] lvii, p. 5

Table 7.11. Mean rates of acreage change (% points change), 1847-1849

Cluster group	Common level	corn_chg	potato_chg	turnip_chg	uncult_chg	meadow_chg
1	Low	-5.808	7.500	.224	-1.724	-1.289
2	Low-Mid	-5.517	7.919	-.715	-1.428	-.999
3	Mid	-6.423	7.513	-.246	-1.375	-.983
4	High	-8.588	9.462	-.066	-1.54	.245
National Mean	-	-6.224	7.900	-.188	-1.542	-.930
National mean acreage (% all union land)		**corn**	**potato**	**turnip**	**uncult**	**meadow**
1847		62.6	5.985	6.854	28.585	21.962
1849		56.066	13.853	6.686	69.9	21.057

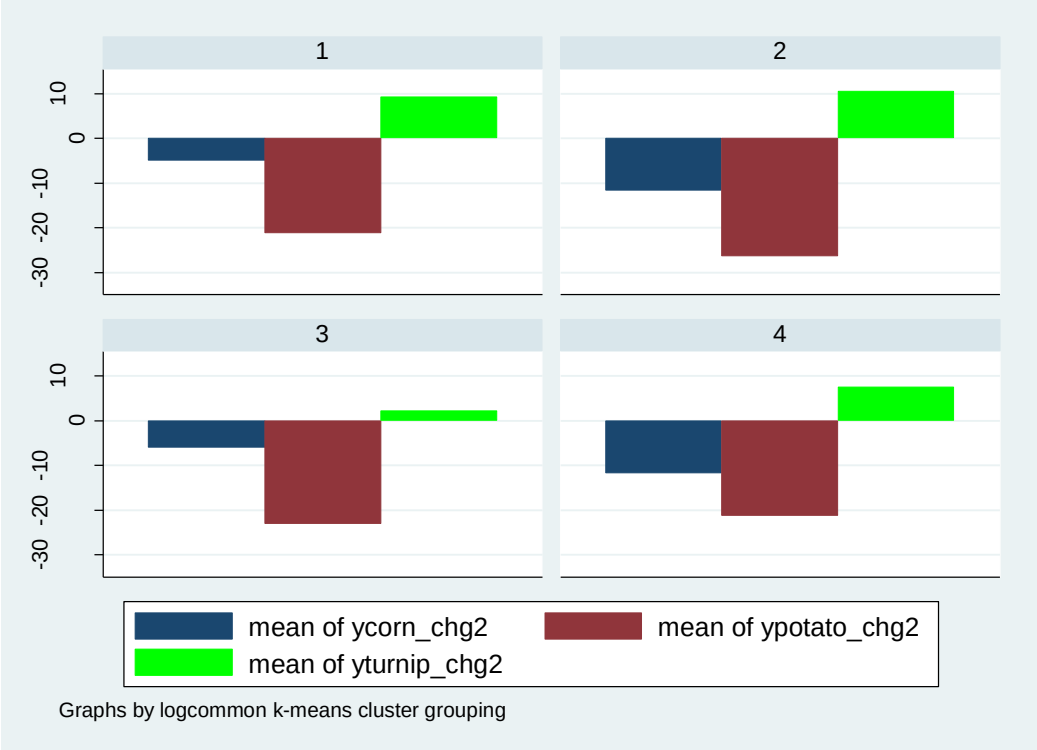
There appears to be little variation in the direction of change between common holding groups, which accords with comments of the agricultural census concerning overall relative rates of adjustment between growing seasons – it must be remembered that the above does not record adjustments in output volume, but rather the proportions of land allocated to various crops within unions. A number of deviations within group 4 (high communality) bear closer examination however. In the case of both corn and potato, rates of adjustment were above national average at -8.588 and 9.462 respectively. Furthermore, the percentage of land under root crop within cluster 4 was the highest of all four groups, with potatoes at 7.201% of all union acreage in 1847 (national average 5.985%), rising to 16.661% in 1849 (national average 13.853%). The results are thus indicative of a contradictory trend; as previous decompositions of long-run fertility have shows, losses in fertility were most pronounced amongst the group of least resilience, on the basis of the typology derived in section 7.1. When considered in context of the above results, what is observed is a tendency for more pronounced returns to potato cultivation amongst group 4, whereas proportions of lands under corn remain relatively constant across common holding groups. Furthermore, although corn production was indeed declining consistently at national levels as a result of aggregate shifts away from tillage, rates of decline within areas of high communality were somewhat higher (-8.588%), albeit marginally so.

These descriptive results are provisionally suggestive of a generalised response, consisting of broad adherence to root cultivation, with a continued reliance on corn production at constant

rates across all groups. Consequently, the dominant trend appears to be maintenance of pluriactivity, in which the combined production of both subsistence and commodity crops continued to exert its influence throughout the famine years. There is one further aberration within group 4 which bears consideration, namely that of a marginal increase in the proportion of lands under meadow – the only group to record such an increase in context of national declines. Although little may be inferred from this deviation alone, it is perhaps indicative of the effects of consolidation which saw increasing reversions to pasture - as observed in chapter 6, estate clearances were enacted with particular veracity within areas of high communality which offered little resistance in their diminished states. Given the small size of this effect however, this remains a highly tentative interpretation.

With regard to yield, Hooper (1922) was quick to recognise its multifaceted nature, determined as it was by factors such as fertility, quantity and variety of fertiliser, implements and intensity of cultivation, weather, social conditions and seen variety (Hooper 1922: 211). Controlling for the inherent volatility of yield rates by smoothing his series to five-year intervals, Hooper concludes however, that a substantial degree of variation in yield was attributable to agricultural conditions, as much as to climatological and geological controls. The following output (figure 7.18 and table 7.12) offers summary yield trends by common holding groups, as above.

Figure 7.18



Mean % change in yield (kg per acre), 1847-1849

Table 7.12. Mean % change in yield (kg per acre), 1847-1849

Cluster group	Common level	ycorn_chg2	ypotato_chg2	yturnip_chg2
1	Low	-5.049	-21.289	9.229
2	Low-Mid	-11.528	-26.417	10.491
3	Mid	-5.99	-23.146	2.11
4	High	-11.702	-21.324	7.427
National mean	-	-8.095	-23.189	7.989
National mean yield (kg per acre)		**ycorn**	**ypotato**	**yturnip**
1847		775.369	7406.131	15739
1849		701.231	5516.100	16359.39

Commensurate with previous examinations of long-run yield, significant declines were observed across all crop variants. What is somewhat at odds with these previous county-level decompositions however, is the stability observable within cluster group 4 in yields of potatoes. Two points are worth bearing in mind when interpreting these results; that decompositions of yield in previous figures are derived from a county-level typology which encompasses a range of factors beyond communality alone, and that the above series focuses on a much narrower interval, thereby increasing the scope for aberrations due to seasonal vicissitudes (Crotty 1966; Hooper 1922). Comparisons of turnip yield across groups are doubtless unreliable, owing to incidental increases in yield given the significant, and historically unprecedented expansion of turnip acreage throughout this time. Nonetheless, summary trends appear to point toward a tendency for corn yields to decline more sharply amongst the high communality grouping. One possible interpretation of this tendency, specific to the phenomenon of communality, resides within the particular adjustments in infield-outfield structure and tillage experienced within communes throughout this time, as population expansion gave rise to increasing parcellisation and the colonisation of outfield lands. In Donegal, this parcellisation had advanced to such a degree as to seriously threaten the viability of tillage; 'By 1851, subdivision had almost reached its physical limits and the arable area per holding had become very small. The average arable per holding had fallen to 2.3 acres, while the average per person was .43 acres' (Douglas 1963: 11).

As previously discussed, the rundale system did not posit a surplus population beyond the commune's boundaries, but rather attempted to incorporate it within, through increased

subdivision. The net effect of this expansion throughout the early nineteenth century was that rundale communes began to annex their own outfields and wastelands, in order to cope with increased tillage demands, the result of which was a critical interference with the balance of outfield livestock grazing necessary to maintain fertility through seasonal infield stubble grazing, and an encroachment of tillage onto lands of lesser quality. Consequent declines in the capacity of the outfield to accommodate new livestock – given that grazing entitlements were reckoned on the basis of the 'collop' – meant ever diminishing declines in fertiliser, and consequently, of yield. These effects were particularly pronounced where the practice of share rotation remained entrenched[249];

> "…reclamation of land for cropping led to curtailment of grazing, and a reduction in the number of livestock meant less manure for the infield when animals grazed the stubble. Livestock numbers could be maintained if alternative winter fodder was available and root crops were an obvious solution, used in combination with a green fallow, which in turn would help maintain the fertility of the infield. If this was adopted, however, livestock would have to be denied access to the infield in winter. There were two possibilities: to provide enclosed pasture for the livestock or to enclose the infield strips. The former was often achieved by enclosing the individually owned plots on the outfield, or on the edge of the common grazing; but the latter required common agreement since it denied rights of common grazing. This was impossible to achieve where changedale was practised, and it became increasingly difficult as subdivision progressed. (Buchanan 1973: 595–596 cited in Slater and Flaherty 2010: 30)

The ideal-typical adaptive cycle model of rundale presented in chapter 3 (figure 3.6), maps particularly well onto these summary dynamics of population increase, marginal reclamation and peripheral encroachment. According to the adaptive cycle heuristic, between phases r - K (the foreloop), a period of intense resource exploitation and accumulation is experienced, whereby the system binds biotic stocks, landscape characteristics, and social structures within its boundaries, leading to progressive demands on the system to maintain structure and connectivity (in the case of rundale, the infield-outfield spatial structure, social-connective structures of communality, and connectivity established through the cycling of fertiliser from outfield to infield via. livestock, as well as absolute increases in biomass and reductions in species diversity). This close binding of biomass, and increase in biological and social-structural connectivity, leads to a critical loss of resilience through overconnection, whereby the system becomes an '...accident waiting to happen' (Holling 2001: 394). As a result of this ever-

[249] In the townland of Kilcroagh Co. Antrim, complicated arrangements were noted, whereby one man was permitted two collops each year for three years, but only one sum in the fourth year, whilst a neighbour was permitted one collop each year for three successive years. In parts of Co. Mayo, it was customary to value the entire farms in terms of collops, and to divide tillage according to the number of portions (McCourt 1947: 61-62). In this way, a delicate regulation of fertilization requirements was maintained through tacit knowledge of local ecological conditions. Encroachment of tillage into the outfield disrupted this crucial balance.

diminishing resilience, the magnitude of perturbation required to induce the release-reorganisation phase of the adaptive cycle (Ω – α, or backloop), becomes increasingly smaller;

> "...the longer the conservation phase longer the conservation phase persists the smaller the shock needed to end it. A disturbance that exceeds the system's resilience breaks apart its web of reinforcing interactions. The system comes undone. Resources that were tightly bound are now released as connections break and regulatory controls weaken. The loss of structure continues as linkages are broken, and natural, social, and economic capital leaks out the system" (Walker and Salt 2006: 77)

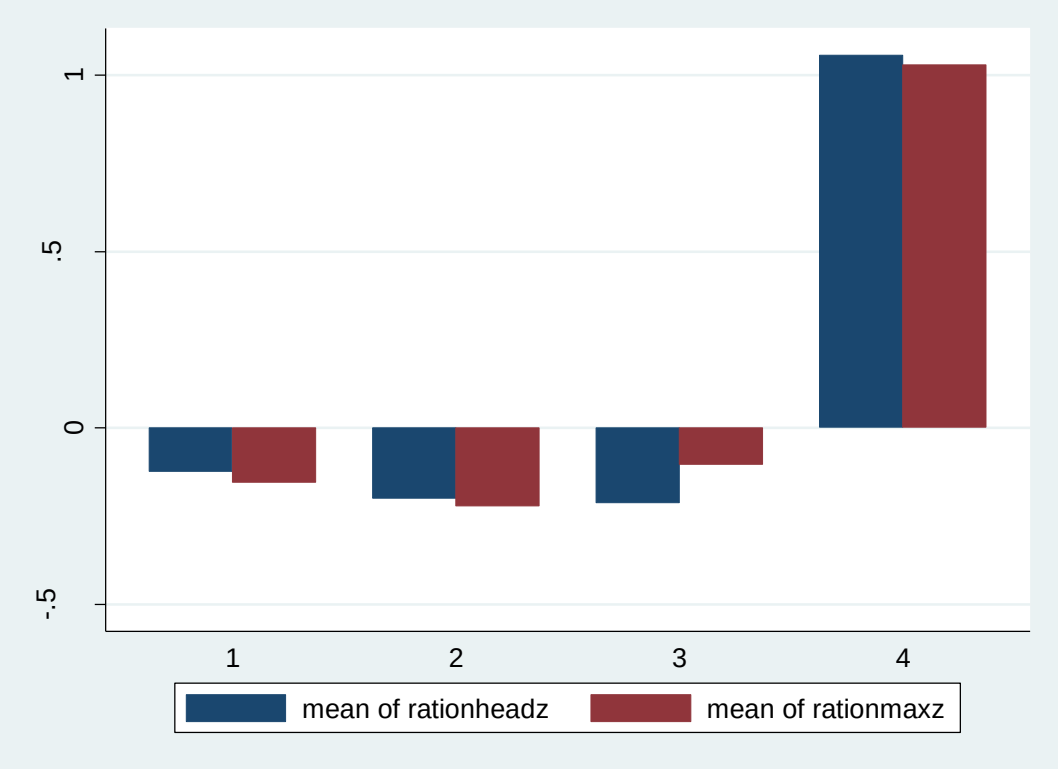
This 'leaking of natural and social capital' was here turn conditioned by the specific form of metabolic rift endured by the rundale system; consequent losses of natural capital, as indicated by declining corn yield, and of social capital, as indicated by the inability of the institutions of communality to adequately cope with the requirements of expanded tillage, therefore contributed to the particular stresses experienced by areas of high communality, as measures concerning the uptake of relief rations will soon confirm. Given that potato cultivation relied on the more energetically efficient lazy-bed, it is likely that the differential consistency in yield observable between corn and root within group 3 is attributable to the continued use of such intensive techniques for potato growth; although comparable rates of potato yield stability between high and low commonage groups render this conclusion somewhat problematic.

In terms of the historical-structural development of settlements themselves, the adaptive cycle of rundale depicted in figure 3.6 further maps Buchanan's comments concerning the marginal encroachment of tillage onto resilience heuristics. As the rundale transitioned through phase K-Ω (the conservation-release phase), settlement tended to drift concentrically from infield to outfield, where habitations began to spring up on former booley sites (figure 3.6, part 3, Ω-phase), according to Aalen, Whelan and Stout (1997). The 'peripheralisation' of tillage was thus conditioned by the institutions of communality, which by necessity struck a sub—optimal balance between livestock and tillage, offering a source of compromised resilience at this crucial stage in the adaptive cycle, during which the systems' exposure to perturbation increased exponentially under the constraints engendered by its particular form of metabolic rift. In this sense, the case-specifics of the system here render the dynamics of change and collapse somewhat more intelligible.

An alternative measure of systemic 'collapse' is required however, in order to substantiate these claims. Given the inherently volatile nature of yield and acreage, it is difficult to ascertain whether these fluctuations and between-group variations translated into concrete difficulties, or indeed, systemic collapse for the tenantry. On this point, measures of the uptake of relief rations

provide some striking clarity (figure 7.19 and table 7.13); these variables are z-standardised, therefore national mean is 0, with a standard deviation of 1. Respective differences may be interpreted as the number of standard deviation units above or below national mean ration uptake experienced by each common holding group.

Figure 7.19



Uptake of gratuitous relief rations, standard deviation units from mean, 1847

Table 7.13 Uptake of gratuitous relief rations, standard deviation units from mean, 1847

Cluster group	Common level	rationheadz	rationmaxz
1	Low	-.124	-.153
2	Low-Mid	-.199	-.220
3	Mid	-.213	-.104
4	High	1.056	1.029
National Mean	-	0	0

The differential distribution of distress was recognised from the earliest reports of November 1845, which noted that although proportions of crop in places remained safe, in many districts

such as Skerries, '...not more than one potato in twenty was found lying in a state which would admit of preservation', the entire crop was lost[250]. Following a more widespread reappearance of blight in 1846, the limited resources of union workhouses quickly came under strain, to the extent that the workhouses of Ballina, Cork, Granard and Waterford were full by November, and over half of the 130 workhouses full by Christmas (Kinealy 2006: 107). Under the provisions of the poor act of 1838, with workhouses filled to capacity, union guardians had thus discharged their duties; responsibility for additional relief fell to the newly constituted local relief committees. The necessity of temporary outdoor relief was thus becoming increasingly urgent, as the following correspondence from Capitan Pole of Banagher to Charles Trevelyan demonstrates;

> "During the past week the issues from my depot have been 110,000lbs, circulated over the counties King's and Tipperary, and some new Committees of Relief have also sprung into existence. The language of these bodies is now of a more importunate kind, testifying to increased distress, and no doubt can remain that were it not for these supplies...the privations of the population in the three counties for which I am concerned, King's, Galway, and Tipperary, would be dreadful – such, in fact, as would have rendered all property in the shape of food a common prey, or a guarded object of jealousy...It is difficult to procure from committees generally so ample an account of the causes of application as the above; but they all correspond in one sentiment, viz., that distress is urgent, unusual, and increasing" (Pole to Trevelyan, June 1846)[251]

Conditions in the union of Westport, where up to 83% of lands were held in rundale, were no better;

> "...I am sorry to say, that the suffering and starvation is very urgent in some of the localities on the coast. I had received instructions from Sir R. Routh not to send any more supplies to Clifden in Connemara, as he feared my depot would be exhausted, and not able to meet the demands from the Relief Committees in the inland districts...Mr Cuscaden, the commander of the "Eliza," revenue cutter, has just been calling, and he tells me that on his last trip to the Killeries, he saw a boat, which pulled alongside, and the men entreated for some food for one of their comrades, who was stretched out half dead, and was unable to eat the bread which he gave him; he gave me to understand that this was a case of starvation, and described the emaciated countenance and prominent eye-balls of the other men who were in the boat. This is very sad to head. He tells me also that Sir James had ordered some of the meal to be distributed gratis, from what he saw of the destitution on the spot" (Perceval to Trevelyan, June 22, 1846)[252]

[250] *Copy of the report of Dr. Playfair and of Mr. Lindley on the present state of the Irish potato crop, and on the prospect of approaching scarcity. – (Dated 15th November 1845).* 1846 [28] xxxvii. A presentation to parliament the following February noted that of 2058 electoral division, more than 1400 had reported similar failures, recommending that stores of provisions be established in order to alleviate distress (*Extract of a Report of the Commissioners of Inquiry into matters connected with the Failure of the Potato Crop.* 1846 [33] xxxvii).

[251] *Correspondence explanatory of the measures adopted by Her Majesty's government for the relief of distress arising from the failure of the potato crop in Ireland.* 1846 [735] xxxvii, p 184.

[252] Ibid, p 171.

According to figure 7.19, and table 7.13, areas of high communality were profoundly affected by the ecological catastrophe wrought by the arrival of blight, to the extent that the 18 unions of group 4 record a mean deviation of 1.056 units above average ration uptake levels compared to other unions; for all other groups, deviation is negative. Under the provisions of the temporary relief act (Act 10th Vic., *cap* 7), individuals under distress could, subject to disclosure of their means, obtain relief in the form of subsidised or gratuitous rations; in many cases, this was preferable to submission to workhouses, which by this time were rife with fever, dysentery, influenza, and limited cases of smallpox (Kinealey 2006: 122). Outdoor relief, in the form of gratuitous rations thus augmented the existing poor relief system, a system which, based on the preceding figures, experienced substantial demand in areas of high-density common holding[253].

These striking results thus confirm both the general conclusions of section 7.1, and the preceding discussion; that despite a country-wide experience of significant distress, the presence of communality appears to explain something of the differential distribution of resilience across unions at this time, with a tentative explanatory mechanism established by explication of the contextual constraints, and specific form of metabolic rift manifested under rundale. Furthermore, the regime-based typology derived in section 7.1 has suggested that a configuration of factors, including high common holding, high fragmentation, high nuptiality, and low valuation, interacted to confer unique characteristics of ecological marginality on these particular areas. This combination of characteristics thus constituted the 'attractor basin' in which the rundale system resided which, following the disastrous effects of famine, began to transition rapidly toward a new domain of attraction conditioned by ecological collapse, consolidation, eviction and enclosure. The social-ecological dynamics of this movement, in the abstract, are in turn captured by the heuristic of the adaptive cycle.

7.2.4. The dynamics of rift, resilience and communality

The preceding results merely offer a summary account of the relationship between communality, agricultural productivity and distress however; in order to gain a fuller appreciation of the interactions between these related components, the following models are

[253] In evidence to the Select Committee on Poor Laws, February 27th 1849, Alfred Power estimated that over 70,000 persons in Co. Clare alone were in receipt of outdoor relief. It is interesting to note that 455,009 acres of the total 827,994 of Clare were under arable - common group 3 contains the Co. Clare unions of Scariff, Ennistimon and Kilrush, which recorded rates of common holding of 70.51%, 52.62%, and 18.94% respectively (*First Report from the Select Committee on Poor Laws (Ireland).* 1849 [58], p 12).

offered, which include a variety of additional structural controls. Results are reported in two sets of tables, one containing unstandardised, and the other, standardised coefficients. With regard to certain variables of differing units and transformations, it is preferable to refer to standardised coefficients; the unstandardised regression coefficients are included both to allow for comparisons with existing works, and to offer an intuitive interpretation of absolute effect size. Given that the following cases are not derived from randomly sampled data, and that the assumption of non-correlation of predictors with error terms is likely to be violated under such conditions, robust standard error adjustments were specified using stata's 'robust' appendage to the standard regression command. In the presence of heteroscedastic error terms, biases in standard errors could lead to inaccurate parameter inferences, therefore this measure was essential. Diagnostics of heteroscedasticity, influential cases and residual normality for each model are included in appendix 3.

Table 7.14. Production and Productivity, 1847-1849 (OLS regression coefficients)

	(1) corn_chg	(2) potato49	(3) ycorn49	(4) ycorn_chg2
popdensity	-5.135* (-2.03)	2.652 (1.40)	-122.055 (-1.38)	-7.962** (-2.92)
plvacre	1.496 (1.96)	-1.148 (-1.97)	53.515* (1.98)	-
onefive	-.071 (-1.53)	-	-	-
uncult47	-.112** (-3.06)	.038 (1.28)	-	.458* (2.47)
corn_chg	-	-.446*** (-5.93)	-	-
potato47	-.274 (-1.93)	.836*** (6.34)	-	-
potato49	-	-	-	-
ypotato49	-	-	-	.003** (3.25)
ypotato_chg2	-	.021* (1.82)	-	-
logcommon	1.380 (.87)	.082 (.12)	-	.574 (0.15)
underonefive_chg2	-	.123** (2.71)	-	-
overthirty_chg2	-	-	-2.399** (-2.69)	-.450** (-3.30)
rationheadz	-	-	-	-5.415* (-2.35)
cluster4	-	-	-	-7.058 (-1.27)
potato_chgxcommon1	-.491** (-3.27)	-	-	-
potato_chgxcommon2	-.650*** (-5.45)	-	-	-
potato_chgxcommon3	-.786*** (-5.98)	-	-	-
potato_chgxcommon4	-.766 (-4.69)	-	-	-
potato47xcommon1	-	-	.275 (.09)	-
potato47xcommon2	-	-	-9.571* (-2.25)	-
potato47xcommon3	-	-	-7.476* (-2.56)	-
potato47xcommon4	-	-	-12.073*** (-3.69)	-

Table 7.14. Production and Productivity, 1847-1849 (OLS regression coefficients)

	(1) corn_chg	(2) potato49	(3) ycorn49	(4) ycorn_chg2
Constant	10.239*** (3.85)	3408 (1.60)	756.857*** (23.03)	-52.055** (-3.25)
F	(10, 118) 14.33***	(8, 121) 38.13***	(47 122) 8.26***	(7, 122) 6.41***
R^2	.5270	.7492	.2154	.1880
AIC	717.511	667.896	1603.294	1123.751
Mean VIF	5.33	4.99	4.89	1.48
N	129	130	130	130

*p<0.05, **p<0.01, ***p<0.001

t-statistics in parentheses

Table 7.15 Production and Productivity, 1847-1849 (OLS standardised coefficients)

	(1) corn_chg	(2) potato49	(3) ycorn49	(4) ycorn_chg2
popdensity	-.442*	.202	-.446	-.187**
plvacre	.410	-.278	.623*	-
onefive	-.126	-	-	-
uncult47	-.262**	.080	-	.295*
corn_chg	-	-.394***	-	-
potato47	-.174	.525	-	-
potato49	-	-	-	-
ypotato49	-	-	-	.254**
ypotato_chg2	-	.091	-	-
logcommon	-	-.007	-	.016
underonefive_chg2	-	.131**	-	-
overthirty_chg2	-	-	-.142**	-.172**
rationheadz	-	-	-	-.284*
cluster4	-	-	-	-.152
potato_chgxcommon1	-.418**	-	-	-
potato_chgxcommon2	-.512***	-	-	-
potato_chgxcommon3	-.499***	-	-	-
potato_chgxcommon4	-.553***	-	-	-
potato47xcommon1	-	-	.009	-
potato47xcommon2	-	-	-.209*	-
potato47xcommon3	-	-	-.182*	-
potato47xcommon4	-	-	-.284***	-

Table 7.15 Production and Productivity, 1847-1849 (OLS standardised coefficients)

	(1) corn_chg	(2) potato49	(3) ycorn49	(4) ycorn_chg2
Constant	-	-	-	-
F	(10, 118) 14.33***	(8, 121) 38.13***	(47 122) 8.26***	(7, 122) 6.41***
R^2	.5270	.7492	.2154	.1880
AIC	717.511	667.896	1603.294	1123.751
Mean VIF	5.33	4.99	4.89	1.48
N	129	130	130	130

*p<0.05, **p<0.01, ***p<0.001

Table 7.16. Distress, 1847-1849 (OLS regression coefficients)

	(5) rationheadz	(6) rationheadz
popdensity	1.508* (2.51)	.624 (1.11)
plvace	-.510** (-2.83)	-.214 (-1.23)
uncult47	.031*** (5.39)	.037*** (5.47)
uncult_chg	-	-
potato49	-	-
corn47	-	.009 (1.11)
ycorn_chg2	-.009 (-1.63)	-.009 (-1.51)
crop_chg	-.069** (-2.44)	-
flax47	-.148*** (-3.59)	-
logcommonxflax47	-	-.113 (-1.95)
overthirty_chg2	.006 (.73)	-
common1	reference	reference
common2	-.109 (-.70)	-.025 (-.15)
common3	-.153 (-.95)	-.016 (-.09)
common4	.694* (2.49)	.907 (3.11)
Constant	-2.369*** (-5.31)	-3.444*** (-4.27)
F	(10, 119) 11.49***	(9, 120) 10.31
R^2	.5115	.4380
AIC	296.793	313.012
Mean VIF	4.31	4.79
N	130	130

*p<0.05, **p<0.01, ***p<0.001
t-statistics in parentheses

Table 7.17. Distress, 1847-1849 (OLS standardised coefficients)

	(5) rationheadz	(6) rationheadz
popdensity	.678*	.346
plvace	-.730**	-.310
uncult47	.383***	.477
uncult_chg	-	-
potato49	-	-
corn47	-	.161
ycorn_chg2	-.180	-.168
crop_chg	-.157*	-.219**
flax47	-.300***	-
overthirty_chg2	.040	.312
common1	reference	reference
common2	-.050	-.037
common3	-.061	-.029
common4	.241*	.279
Constant	-	-
F	(11, 118) 11.18***	(11, 118) 9.32
R^2	.5336	.4857
AIC	292.760	292.760
Mean VIF	4.34	4.34
N	130	130

*p<0.05, **p<0.01, ***p<0.001

For consistency, each model is discussed in turn, with necessary cross-referencing as appropriate, since dynamics noted in various models often reveal interesting relationships of theoretical relevance to alternative outcomes. With regard to production and productivity models (tables 7.14 and 7.15), it must be noted that 'logcommon' functions weakly alone as a predictor of change in corn acreage, potato acreage, and change in corn yield (models 1, 2 and 4), although inclusion of the county-derived clustering variable from section 7.1 performs according to expectations[254]. A number of interaction terms were thus generated, by interacting the common holding group cluster variable utilised above with other predictors, which in turn yielded insightful and robust results. Inclusion of these terms acts as a further hedge against existing criticisms of linear modeling from complexity practitioners, insofar as they permit a closer comparative assessment of case characteristics and dynamics. Where suspicions of a specific relationship between high communality and distress outcomes – specifically models 5, 6 and 7 – were suspected, a categorical dummy was employed with common group 1 as reference. This set of dummies permits the isolated effect of high common holding to present in the model, in the event that this effect may have been suppressed by the sample-wide 'logcommon'. Inclusion of this variable throughout initial specifications of models 1-4 yielded no significant results, and was therefore excluded in favour of interaction terms in certain cases. Hierarchical random coefficient models were specified in outcomes where a difference in slope across common holding groups was suspected, although no model yielded a random effects parameter suggestive of extensive variation. Fixed effects models were not considered appropriate for models of common holding, given the relative homogeneity of intercepts and levels across common holding groups after logging 'common'.

Model 1 (y = corn_chg)

The results of model 1 (table 7.14) conform largely to theoretical expectations concerning changes in the extent of corn acreage. Consistent with accounts of agrarian activity considered thus far, greater population density (popdensity) tended to depress recorded corn acreage, whilst greater poor law valuation (plvacre) gave rise to increases, within the confines of a strictly statistical interpretation. Furthermore, the presence of fragmentation (onefive) served to depress corn acreage, as did the extent of uncultivated lands (uncult47). When considered independent of their units (table 7.15), the structural controls of population density, poor law valuation, and the presence of uncultivated land exhibited moderate effects on changes in corn acreage, which along with other included predictors explained approximately 52% of its

[254] For reasons of potential aggregation error, this variable (cluster4) was tentatively employed in model 4, although its inclusion performs robustly in subsequent models of consolidation.

variation (although results of the Ramsey test are suggestive of likely omitted variable bias – this is unsurprising given current reliance on such inherently limited historical data sources). In context of foregoing discussions of the metabolic rift under rundale, it is interesting to note that the greater presence of uncultivated land and higher population density tended to diminish corn contraction in this model, suggesting that a capacity for expansion perhaps somewhat tempered reductions in cash-crop production.

These relationships are particularly relevant in light of foregoing elaborations of the centrality of the rent relation, and the conditioning effect of cash-crop production on local ecology, given that the requirements of rent realisation were not waylaid during the famine. If anything, realisation of rent became even more critical, as the results of model 6 suggest that the presence of exacerbated distress was closely related to the pace of consolidation. Materials cited in chapter 6 have also attested to the rapidity of clearances enacted in certain districts – especially within marginal areas of high communality – throughout this time, rendering the continued realisation of surplus essential. Of particular interest, therefore, are coefficients on the interaction terms generated from common holding and change in potato acreage 1847-1849 ('potato_chgxcommon'). As this model suggests, growth in potato cultivation, and the greater presence of uncultivated land, were negatively associated with changes in corn acreage. Although it is impossible to argue local causation in the presence of aggregation, these results nonetheless suggest that reliance on the potato continued catastrophically at the expense of corn production, which diminished particularly in the presence of high population density, and lower poor law valuation. This distribution of the relationship between common holding, potato production and corn contraction is revealed by the coefficients on 'potato_chgxcommon1' to 'potato_chgxcommon4', which suggest the effect of increasing potato production on the contraction of corn production was more pronounced in areas of higher common holding. The coefficient on low common holding 'potato_chgxcommon1' (-.491) is thus substantially lower than those of 'potato_chgxcommon3' (-.786), and 'potato_chg4' (-.766). It thus appears that in attempting to cope with the growing effects of famine and compromised resilience (an outcome which will be substantiated by subsequent models) the net effect of these parameters was to diminish acreages given over to corn production, a crop which functioned largely as a crucial source of rent.

This critical adjustment was doubtless compounded by the 'cruel trick of nature' in 1847. Following a near total failure of potato crop in 1846, unusually high yields in 1847 spurred a subsequent increase in potato acreage, which was quickly followed by another disastrous collapse in 1848, exacerbating excess mortality (O' Grada 1994: 177). Co. Mayo thus

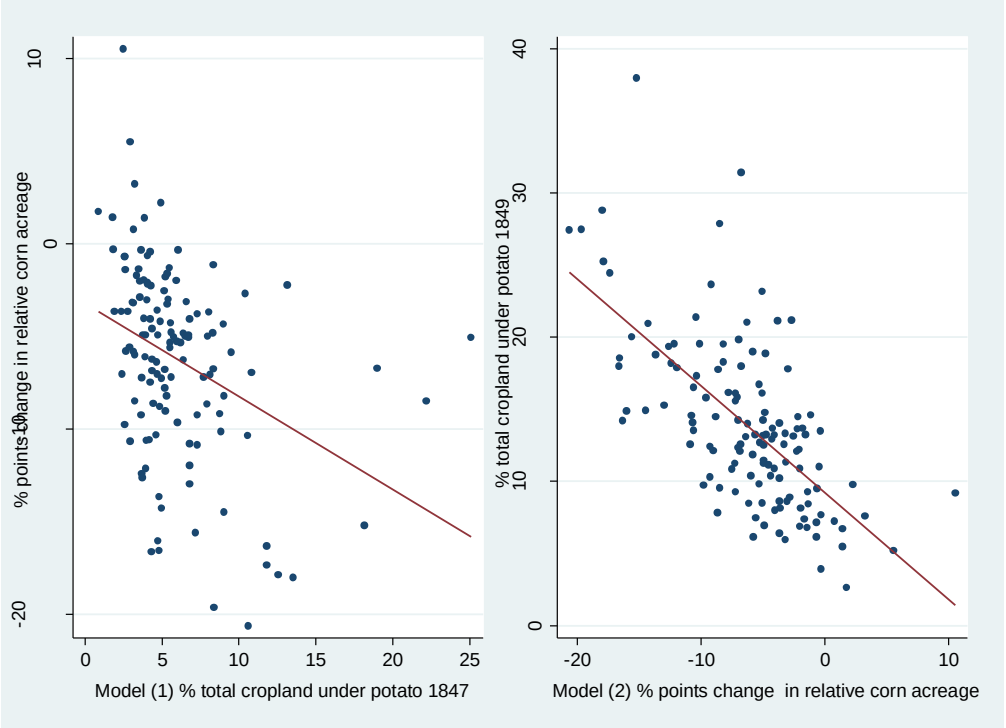
experienced a drastic leap in mortality between 1847 and 1849, from a point of 2,176 in 1842, to 9,774 in 1849 (Almquist 1977: 237-238). As a result, the combined pressures of population stress, land-poverty, fragmentation and potato dependency interacted to diminish a crucial source of commodity cash crops, at a time when continued occupancy depended very much upon maintaining rental obligations, as much as physiological integrity. These effects were, in turn, particularly in evidence amongst rundale-dense regions, where potato cultivation began to supplant that of corn, as is evident in model 2.

Model 2 (y = potato49)

Model 2 further corroborates tendencies noted in model 1, whereby greater population density served to increase the extent of recorded potato acreage. Given that this outcome is specific to 1849, it permits modeling of the effect of antecedent conditions; in this case, greater potato acreage was negatively associated with lower land valuation, and increases in corn acreage. In essence, this result maps well onto that of model 1, which indicated a similar dynamic; both models thus suggest that as corn production contracted, extents of land under potato remained high, controlling for holding size (see figure 7.20 below). It must be borne in mind that the dominant countrywide tendency at this time was for corn production to contract, as the total mean adjustment rate was -6.22 percentage points, whereas in contrast, potato acreage increased by 7.9. The net effect, as further illustrated by figure 7.20, was thus to supplant cash crop for root which, as model 1 suggests, appears to have continued with particular tenacity under rundale. According to table 7.11, net contraction of corn acreage was also greatest amongst rundale-dense regions, at -8.588%, compared to a rate of -5.808% in areas of low common holding. Model 2 further introduces the dimension of consolidation and fragmentation 'underonefive_chg2' into this equation by factoring the effect of changes in the extent of holdings less than 5 acres between 1848 and 1849 which, despite its short interval, records a discernible positive association. The specific mechanism of association is considerably more tentative in this instance, and especially fraught in the presence of aggregate data; it is thus tempting to conclude that fragmentation, which continued apace throughout this time, to the extent that holdings in the <1-5 category grew by a national average of .83 percentage points between 1848 and 1849 (range 22.18), served to exacerbate potato dependency, although this model is arguably emphasising a more cursory country-wide effect of signification, such as that suggested by O' Grada above. It is safer to interpret this parameter, in the context of this particular model however, as a control variable which serves to 'average out' the potential effects of fragmentation within specific unions, rather than attempting to post-hoc impose a mechanism of causation.

In terms of resilience, a profound indicator of the capacity for self-directed reorganisation is evident in the parameters on 'potato47' and 'ypotato_chg2'. An essential characteristic of living systems is their capacity for autopoiesis, as a non-essentialist property which conceptualises a systems potential for adaptive learning through structural and organisational elaboration, as established in chapter 1. Resilience ecologists have also emphasised the potential for augmented resilience throughout the (Ω - α) back loop of the adaptive cycle, provided that this phase of release is met with self-directed reorganisation. Their conceptualisation of systems as panarchical further empahsises the presence of both 'fast and slow' variables, which in turn condition response capabilities at various organisational levels, with the potential for cross-scale interactions to impact substantially on resilience outcomes. The parameters on 'potato47' (.836) and 'ypotato_chg2' (.021) thus suggest a systemic response lag, demonstrating a profound cross-scale interaction whereby 'fast' adjustments of productivity engendered under conditions of blight confronted institutional arrangements slow to respond to such signification; in this case, antecedent extents of potato and yield offer a worryingly robust indication of future high potato acreages. Structural parameters across both models such as 'popdensity', 'plvacre' and 'underonefive_chg2' tentatively capture the negative influence of these crucial contextual constraints.

Figure 7.20



Scatterplot of % cropland under potato 1847 by % points change in corn acreage (model 1), & % points change in corn acreage by % cropland under potato 1849 (model 2)

Model 3 (y = ycorn49)

Given the volatility of potato yield and extent throughout this period, it is safer to regard corn yield as a better indication of fertility. Given that standardisations involved in computing yield estimates necessarily rely on aggregate weights, it is reasonable to assume that likely reductions in recorded weight would have excessively biased potato yield figures. Model 3 suggests a strong association between lower rates of land poverty and higher yield, although the added-variable plots in appendix 3 suggest the presence of outliers (despite this influence, overall model residuals appear homoscedastic, although normality plots are suggestive of slight bias at extreme values). The effect of common holding, when interacted with the extent of potato crop in 1847 is striking. A clear, ascending pattern is indicated across interaction terms ('potato47xcommon1' – 'potato47xcommon4', table 7.14), which demonstrates an increasingly stronger effect according to higher levels of communality. Therefore, not only did common holding conspire to depress acreages of corn, it also functioned to exacerbate declining fertility to the extent that members of common group 4, whom were also involved in the greatest extents of potato cultivation, also experienced the greatest reduction in yield as a consequence. In essence, the negative effect of greater extents of potato cultivation on yield was compounded progressively by greater extents of common holding. Arguably, this could be linked to a country-wide decline of 6 percentage points in total acreage under corn; however the standardisation of yield, by default, factors changes in the extent of acreage. Furthermore, the robustness of these estimates and their theoretical consistency serve as an encouraging indicator that this effect is more than incidental. Despite existing work attesting to the yield-boosting effects of ridge cultivation as a white-crop primer for corn (Bell and Watson 1986, 2008), it thus appears that this association – particular to the period of 1847-1849 – was largely absent. Undoubtedly, substantiation of this particular inference must resort to more grounded corroboration; consequently, it remains here as largely suggestive.

It thus appears that despite the labour-intensity of cultivation techniques employed under rundale, they were insufficient to forestall declining yield. Indeed, corn yields were lowest within common group 4 in both 1847 (735 kg per acre, compared to 782.3 for group1), and 1849 (627 kg per acre, compared to 735 for group 1). Considering models 1 and 2 noted a tendency within high-communality areas to contract commodity crop cultivation in favour of root, it appears the rundale system was subject to a 'double stress', which rendered it incapable of balancing both its subsistence and commodity requirements, and of sustaining its own fertility levels. This was doubtless exacerbated, as both models suggest, by population density

which mandated continued parcellisation, and therefore, ever-diminishing returns. Indeed, coefficients on fragmentation in model 2 (underonefive_chg2) and consolidation in model 3 (overthirty_chg2) both attest to the continued presence of subdivision, and the negative consequences of consolidation on aggregate yield. It is therefore tempting to infer that in the context of expanding tillage and population density under rundale, which necessitated encroachment onto peripheral outfield locations of lesser quality, the net effect of this systemic dynamic is captured and substantiated by the interaction terms of models 1 and 3. Consequently, relations established thus far largely substantiate the modified narrative of metabolic rift presented in this work, which calls for specific case-contextualisation in order to interpret manifest systemic dynamics; in this sense, the vicissitudes of necessary pluriactivity, in context of the specific form of metabolic rift endured under rundale, appear to have exerted a particularly negative influence on the adaptive capacities and fertility of such areas.

Model 4 (y = ycorn_chg2)

The effect of population density on changes in corn yield between 1847 and 1849 appears tempered somewhat by the parameterisation of model 4, recording the smallest of all standardised coefficients across previous models. Despite some evident distribution of yield consistency rates across common holding groups in table 7.12, the linear model yielded a comparatively small coefficient for 'logcommon' (.574), which exhibits a t-statistic too small for valid inference concerning its direction of association. Neither did any combination of interaction terms, or common holding dummies yield a significant coefficient or pattern suggestive of a relationship between communality or yield consistency, which is perhaps attributable more to lower variance in this particular outcome (given that the variance is that of changes in a two-year period, rather than an examination of country-wide variance in yield and production, as per model 3)[255]. In the absence of additional predictors with which to account for this variation, it is safer to conclude that the mechanism of differential yield stability resides at lower levels of aggregation, beyond the scope of the linear model alone; in this sense, model 3 appears to have better exploited the variance of the 1849 yield estimates, and offered a more representative overview of the dynamics of communality.

Prefiguring model 5 which examines more pointedly the distribution of profound distress, lower rates of seasonal yield consistency are associated with greater uptake of relief rations

[255] The estimators of the agricultural census noted as much in their comments concerning the widespread distribution of yield levels across Ireland in 1847. By comparison, previous exercises have shown that aggregate seasonal trends are somewhat slower to present (*Returns of Agricultural Produce in Ireland, in the Year 1847.* 1847-48 [923] lvii, p. iv).

('rationheadz'), suggesting that where crisis conditions tool hold, the diminishment of cash crop yield affected subsistence capacities also. The effect of each additional standard deviation increase in ration uptake, which figure 7.7 has shown affected rundale regions in a profoundly negative manner, was thus a reduction in yield consistency of 5.415 percentage points. These results map closely onto those of models 1 and 2 which suggest that the general strategy – especially profound amongst rundale dense unions – was to increase potato acreage at the expense of corn, the result of which, according to model 3, was a drastic reduction in yield. Model 4 suggests further that those areas of cluster group 4 ('cluster4') were especially affected by declining yields, to the extent that this group of counties experienced a decline of -7.058 percentage points in corn yield between 1847 and 1849 relative to their neighbours of other groups.

Finally, this model suggests that consolidation played a significant role in compromising yield consistency, to the extent that 'overthirty_chg2' accounts for the largest standardised effect of all variables in this model, whilst greater proportions of available uncultivated ground ('uncult47') exert a significant positive effect. The dual implications of these effects suggest that in the presence of spatial constraints, maintenance of seasonal consistency was depressed, a phenomenon commented upon in the previous section regarding the enclosure of grazing grounds, and the encroachment of tillage onto marginal, peripheral land tracts under population growth. The question of common grazing rights features prominently in political history, where it formed a key point of contention for the Whiteboy disturbances of 1760, which paid specific attention to the levelling of ditches erected by graziers, beyond which smallholders previously enjoyed grazing entitlements (Clark 1982: 17). Conversely, outward expansion under favourable conditions, particularly under the labour-intensive methods of reclamation utilised by rundale groups such as 'paring and burning' (particularly as practiced in counties Mayo and Donegal); continuity of yield was enhanced by efficiently maximising the extraction of bound up nutrients, augmented with local sources of fertiliser such as lime, kelp and marl (Bell and Watson 2008: 72; Collins 2008; Lucas 1970)[256].

[256] In evidence to the Devon commission concerning the union of Glenties, Co. Donegal, John O' Donnell observed that the practice of tillage had improved with the application of animal manure, seaweed and lime, as well as the burning of land (*Devon Commission. Evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part II*. 1845 [616] xx, p. 147). Commenting on systems of manuring in Castlerea, Joseph Sandford stated; 'Among the lower classes horse manure; and they use a compost of clay, what we call mud, and a little lime mixed with it, and by burning land. They burn a good deal in some parts of the country' (Ibid, p. 360).

Models 5 and 6 (y = rationheadz)

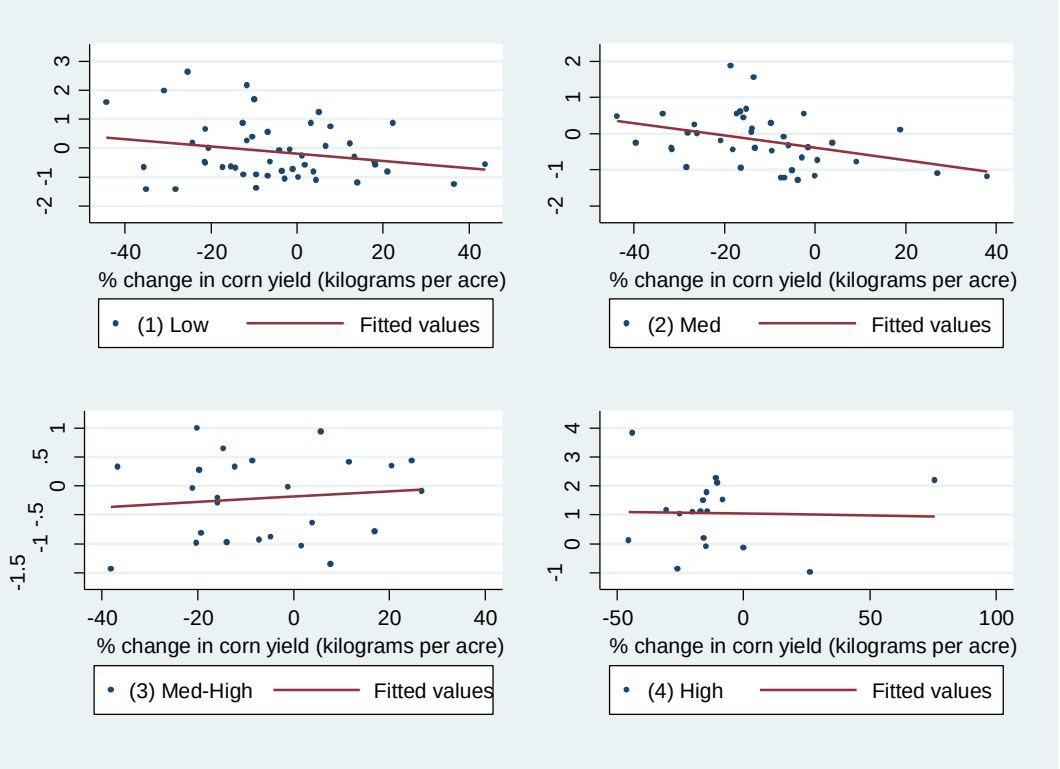
The coefficients of model 5 provide the most striking picture of resilience under communality however, and it appears that the dynamics of models 1-4 are corroborated in this penultimate measure of systemic collapse, which exhibits specific negative effects amongst the high-communality cohort ('common4'). In this model population density again figures as a key predictor of distress, yielding the largest effect, independent of units, across all model variables (table 7.17). Higher rates of land poverty also figure prominently as a component of compromised resilience, with each additional unit of valuation per acre yielding a reduction of .510 standard deviation units above mean ration uptake ('plvacre'), according to model 5. The presence of uncultivated ground ('uncult47') appears to offer a degree of resilience against ration uptake however, as does the comparatively small – albeit negative - coefficient on seasonal yield consistency ('ycorn_chg2'). Of particular interest is the role of flax cultivation, which appears to yield a reduction of .148 deviations in ration uptake for each additional percentage of total cropland per union within model 5.

The role of peripheral commodity production has been cited previously as a key, albeit paradoxical element, in both the undermining of communal institutions through private accumulation, and the conferring of resilience to market vicissitudes by affording a degree of flexibility in productive activity and income. The importance of subsidiary domestic industry as a means of absorbing excess labour has been well substantiated by existing scholarship (Almquist 1977; Gray 2005). Although interaction of flax rates with communality dummies yielded no significant effect in model 5, an alternative specification (model 6), in which a continuous interaction term was generated between 'logcommon' and 'flax47', yielded a negative coefficient of -.113 on the product term. This coefficient was marginally insignificant however, yet its magnitude is suggestive of a key mechanism of resilience in terms of the capacity for greater extents of common holding, in which flax production was also high, to lead to a reduction in ration uptake. Given that the outcome measure accounts for the capacity of the means of production to yield both use value (subsistence) and exchange value (agricultural commodities), this implied relationship suggests that in particular cases where conditions were favourable, subsidiary industry augmented conventional cash crops such as corn, in order to confer an additional degree of systemic resilience in the face both of ecological distress, and the requirements of the rental regime. The presence of this effect simultaneously problemtises and augments existing accounts of rundale, by corroborating the capacity of subsidiary industry to act as a hedge against distress, and by warranting greater attention to the manner in which

peripheral commodity production interacted with the institutions of communality to alter the balance of the individual-communal dualism; such elaboration is thus reserved for the concluding chapter.

Finally, models 5 and 6 confirm something of hypotheses thus far concerning both the distribution of resilience, and the presence of distinct mechanisms of metabolic rift according to varying social forms, and social-ecological regimes. Consequently, in both models, common holding dummies (‘common1’ – ‘common4’) display a consistent pattern, whereby ‘common4’ is the only category to record a significant increase in ration uptake, net of other control parameters. This account was suggested provisionally above in tabular analyses of ration uptake, and is here substantiated in terms of its magnitude. The presence of greater degrees of common holding conferred an increase of .694 standard deviations above mean ration uptake level (common4) according to model 5. The distribution of this effect is further substantiated by figure 7.21 (below) which displays a decomposition of bivariate regressions of ‘ycorn_chg2’ on ‘rationheadz’ according to common holding groups. These models assess the role of seasonal yield consistency as a hedge against distress, and reveal a further interaction in terms of productivity and communality. Based on this figure, higher rates of yield consistency (examined above in models 3 and 4), within groups 1 and 2, serve to depress ration uptake. Conversely, groups 3 and 4 of higher common holding display marginally positive and level slopes, suggestive of a more tempered relationship. In short, it appears that seasonal yield consistency alone was inadequate to forestall distress; indeed the preceding models have suggested as much, by examining the complex interactions between production, productivity and communality. Models 5 and 6 affirm as much, by suggesting that resilience to distress was tempered both by the presence of flexible income sources, and the capacity for additional reclamation. In both models, the negative effect of communality is thus well substantiated, and it may be concluded that the contentions of section 7.1, which asserted a provisional distribution of resilience according to social-ecological regimes are well substantiated.

Figure 7.21



Decomposition of slope by common holding cluster (x = ycorn_chg2; y = rationheadz)

On the basis of these results, it is abundantly clear that the rundale system was subject to a unique form of ecological stress, tempered by various characteristics of its productive activity, such as its balance between subsistence and commodity crop production, its ability to maintain seasonal yield consistency, the potential to engage in subsidiary industry, and its capacity to expand and colonise. Consequently, existing theoretical pronouncements on the rundale system are in need of drastic revision; no longer is the position of rundale as a functional adaptation alone tenable; instead, it must be subjected to a greater degree of scrutiny in terms of these various factors, in order to discern the manner in which this variety of parameters conspired to confer differential states of compromised resilience. It has here been suggested, on the basis of table 7.6, that 'resilience' is defined by the capacity of a system not only to persist within a domain of attraction characterised by a configuration of identity components, but in its capacity to respond to, and absorb perturbation, and therefore reproduce itself as a dissipative metabolic entity. The foregoing results suggest that, despite existing scholarship attesting to the capacity of regimes of communality to respond to such perturbation, in the case of the rundale, such arrangements were ultimately inadequate. This inadequacy must however, be interpreted in terms of the position of rundale within the panarchy of complex, multilevel relations established in chapter 6, in which the vicissitudes of ecology, landlordism, enclosure, and

market, all conspire to the production of differential local outcomes. This crucial state of compromised resilience, tentatively outlined here through statistical modeling, has in turn been interpreted in the context of the informants of metabolic rift which suggest a mechanism of constraint unique to the social form of rundale in Ireland.

Having established this crucial macro-systemic context, in which explication of a number of key relationships and associations between system parameters has begun; attention now turns to the final stage of the methodological template which empahsises a grounded examination of the trajectories of systemic reproduction. Discussion thus far has engendered a paradoxical position; why, despite the litany of research attesting to the inherent 'functionality' of modes of communality, did the rundale system appear to experience such profound ecological distress? Arguably, the foregoing analysis, and indeed the manner in which existing works on metabolic rift have been pitched, appears to have left little room for the incorporation of agency and intentionality. Chapter 8 thus examines further the internal complexities of regimes of communality, and the mediation of adaptive capacity by addressing the range of techniques mobilised within the rundale in order to cope with its diminishing fertility under the metabolic rift; this forthcoming discussion is in turn augmented with reference to the essential macro-systemic context established within this chapter. In this sense, the following chapter continues in dialogue with these results, by offering further empirical and conceptual enrichment.

8

Resilience from below: regimes of communality and the mediation of adaptive capacity

Continuing within the methodological rubric of complexity, a point has now been reached where stage five of the methodological template detailed in figure 5.1 may be addressed. Accordingly, this final stage calls for a more intensive examination of systemic composition, and reproduction. Having established in the previous chapter that the rundale system was subject to a form of compounded, compromised resilience through its unique contextual constraints, and particular experience of metabolic rift, the following discussion seeks to examine the institutions, techniques and strategies by which commune members addressed the dissipative tendencies of their social-ecological systems. These varied mechanisms included the mobilisation of particular institutional and cultural configurations, the employment of a range of intensive modes of cultivation, and the maintenance of sufficient nutrient stocks under the aegis of communal governance. Given that existing critiques of classical systems theory have emphasised it's undermining of the centrality of agency under structural constraint, subsequent discussions and empirical elaborations must empahsise the active mediation of resilience, as is captured by the concept of adaptive capacity, elaborated throughout chapter 3.

Consequently, the following discussion addresses a number of outstanding research questions central to asserting the validity of the framework developed within this thesis, including an examination of the concrete forms of configurational diversity *within* the category of communality, and an assessment of the augmentation of adaptive capacity through purposive intervention. In doing so, this exercise offers a number of further summary conclusions concerning the possibility of normative assessment, by co-opting the ideal-typical identity model derived at the conclusion of chapter 6 as its epistemological cue, in order to subject it to further empirical enrichment. This endeavour begins with a qualitative comparative analysis (QCA), focusing specifically on unions exhibiting higher proportions of communality and distress, in order to assess the internal, configurational diversity of regimes of communality, as opposed to the broad macro-typologies attempted thus far. In doing so, an opportunity is presented to return to existing conceptual models of Irish social structure, and global models of social change, in order to reassert the necessity of a complexity-based methodology which is capable of assimilating diversity. This exercise also adds a further layer of empirical rigour to the necessity of a 'mode of production' approach, insofar as such an approach is capable of

conceptualising the coexistence of multiple modes in varying states of devolution, as was hypothesised within the seminal works of McCourt (1947, 1950). Following this explication, an interrogation and assessment of the commune's productive strategies is offered, followed by a brief examination of the institutions of communal governance, and an epidemiology of the clachán. This chapter concludes by suggesting that the decline of rundale was mediated varyingly, and dialectically, through growing contradictions within the system as it struggled to resolve the inherent tensions of the individual-communal dualism, and through constraint from without in the form of enclosure, redistribution, and the influence of the world system.

8.1. The internal complexities of communality: a qualitative comparative analysis

Returning to a number of core methodological points established in chapter 6; it was suggested by Byrne (2002), that the concepts of system and case were essentially synonymous, insofar as the ontological construct of 'system' merely captures an emergent, inherently dynamic configuration of relations and attributes characteristic of the entities referred to as 'cases'. This is a familiar epistemological grounding, given that previous discussions dedicated much time to establishing the centrality of autopoiesis, emergentism, and the concept of dissipative structure, as essential mechanisms of macro-structural stability which eschew the inherent teleologies of vitalism associated with earlier strains of systemic thought. Fortunately, both complexity and resilience have had much to suggest concerning appropriate modes of measurement and empirical interrogation, and to this end, it is worth reiterating Ragin's concept of 'cases' as simultaneously theoretical, historically specific and substantive categories, which in turn suggests considering cases in terms of their specificity, diversity and nuance. The question of configurational diversity has been operationalised by applications of cluster analysis in the preceding chapter, according to which the data exhibited clear differentiation corresponding to distinct, theoretically consistent social-ecological regimes. However, the mode of progressive casing detailed in table 6.1 requires that 'casing' consist in the interrogation of complexity in terms of macro, *and* micro-systemic context.

Discussion thus far has explicated 'rundale' as a case of primitive communism, as a historically specific social form, and a key component in the internal differentiation of Irish social-ecological diversity. There is, however, a further degree of complexity which requires addressing; that of the potential for variation in modes of primitive communism *within* the aggregate case category of high-density rundale regions. To this end, a closer examination of cases exhibiting high degrees of communality, as were co-opted into a broader countrywide analysis in the preceding chapter, is warranted. Attention thus turns to the question of

measurement, given that any such exercise in analysis entails certain judgements concerning data selection; unfortunately, as established in previous chapters, the study of rundale is characterised largely by a paucity of site intensive data. This current exercise draws on the data utilised in chapter 7, albeit with the goal not of achieving summary measures of aggregate variability and association across cases, but of exploring diversity and similarity within cases.

8.1.1. Assessing complexity through QCA: data and method

Qualitative Comparative Analysis (QCA) is a comparative method based on the application of Boolean algebra, which seeks to strike a middle-ground between variable-oriented quantitative approaches, and the case-intensive specificity of qualitative inquiry. In this manner, it permits an alternative approach to data reduction which, rather than subsuming case diversity within a pooled model, works from the characteristics of cases themselves in order to develop parsimonious representations of cross-case diversity. Ragin summarises the practice of configurational research and QCA as follows;

> "Qualitative researchers especially tend to think in terms of combinations and configurations because of their interest in context and in understanding social phenomena holistically. In case-oriented research, investigators often think of causal conditions in terms of what might be called *causal recipes*—the causally relevant conditions that combine to produce a given outcome. This interest in combinations of causes dovetails with a focus on "how" things happen. To think in terms of recipes is to think holistically and to understand causally relevant conditions as intersections of forces and events" (Ragin 2000: 109)

Having established a tentative, linear-derived overview of such potential recipes in the previous chapter, the next stage of progressive casing mandates a focus upon the characteristics of high-density rundale cases themselves, in order to understand how the interaction of 'forces and events' manifested both within the condition of communality itself, and how they in turn conspired in the production of differential resilience outcomes. In this way, QCA addresses a central concern of the linear model, that despite its inclusion of a range of theoretically relevant controls and interaction terms, it may, in the process of reduction, subsume internal diversity within its additive output. QCA thus adds a further layer of rigour to the linear approach, by isolating specific cases of interest and subjecting them to further scrutiny. This is achieved by depicting cases in terms of configurations of presence/absence dichotomies, represented by a truth table (Ragin 1989: 86). Drawing a case from forthcoming output for illustration, the high-communality union of Millford (Co. Donegal) may be described configurationally as a case exhibiting lower valuation, lower extents of uncultivated land, lower corn yields, and higher potato cultivation, in a manner consistent with the statistical argument advanced in chapter 7.

However, the question inevitably presents concerning the potential for similarity and diversity *across* cases exhibiting a similar outcome of high communality. QCA permits this form of assessment by producing a summary of all permutations of input conditions – such as were here selected in order to describe the union of Millford – thereby allowing the researcher to assess the implications of alternative configurations leading to similar outcomes in terms of the specifics of the cases themselves. In this sense, it approximates the epistemology of complexity as essentially the combined study of dissipative stability and regimes, by articulating a typology of diverse configurations of systemic constitution.

The implementation of crisp-set QCA as a technique of data reduction initially requires the dichotomisation of variables measured above nominal level, or the representation of nominal variables with more than two categories as a series of binary categorical dummies. Crisp-set QCA was here chosen as the preferred method, owing to a comparative difficulty in establishing defensible calibration criteria for the designation of fuzzy sets. Although fuzzy-set QCA offers a number of potential benefits, such as the designation of degrees of set membership, such excessive – and in the absence of more comprehensive justification, arbitrary – calibration procedures could serve to compromise the parsimony of resulting output[257]. Since analysis presented previously has drawn on a comparatively large dataset, the cases of which are defined by arbitrary spatial units, there exists little intuitive basis for assigning degrees of membership based on anything other than numeric magnitude. Given that the case data are derived from interval measures, the reduction procedure of fuzzy-set calibration would here require a purely statistical approach, in the absence of either intuitive or objective thresholds. Furthermore, the crisp-set approach, as employed within this discussion, plays to the core strengths of QCA which offers a simultaneous reduction and representation of complexity, without according primacy to statistical criteria for case designation. Despite such premises, however, some balance must be struck between statistical criteria, theoretical intuition, and qualitative corroboration in variable selection (De Meur and Gottcheiner 2009).

Rihoux and Lobe offer the following general guidelines for dichotomisation; '...threshold-setting should not be performed mechanically and should rather rely on informed judgement, theory and/or case-driven. Therefore (within-) case knowledge also plays a crucial role here, especially because, in the social sciences at least, purely theory-informed cut-off points are seldom undisputed' (2009: 233). Mindful of this caveat, the approach to dichotomisation pursed below, proceeds on the basis of Gray's (2005) guidelines as outlined in an appendix to her

[257] According to Ragin, such calibration is '...possible only through the use of theoretical and substantive knowledge' (2008: 30)

QCA-based analysis of demoeconomic regimes amongst proto-industrial communities of nineteenth century Co. Cavan, using similar data to that used within this study. Gray's dichotomisation sought to '...[divide] the variables where there were clear gaps in the distribution of values, while also seeking to maximise complexity by choosing gaps that ensured relatively equal numbers of "present" and "absent" cases' (2005: 101). Before applying dichotomisation thresholds, all members of common groups 1, 2 and 3 were dropped from the complete union dataset (N=130), based on the cluster-derived typology of common holding groups presented in section 7.2. Since QCA is inherently case-intensive, and makes no assumptions concerning sample size, random selection, or representation, this reduction permits a focus on specifically those cases exhibiting higher degrees of communality, enabling inferences regarding diversity within the high communality category to be advanced. This initial stage yielded a set of 18 cases, occupying the higher end of the distribution of variable 'common' (in all forthcoming results, the untransformed original measure of 'common' was utilised to facilitate interpretation).

Furthermore, this reduction was essential in order to render the resulting truth table algorithm output interpretable. Elimination of cases was necessary due to theoretical criteria, the size of the union dataset, and a comparative lack of diversity at lower ends of the outcome measure. In short, a dataset including a complete set of cases would have yielded a data matrix wherein 70% of cases would score absent on the outcome (i.e. little or no traces of rundale would be evident within these cases). This would in turn result in an unwieldy, and inconsistent set of absent outcomes, and an even larger set of counterfactuals. Although these cells are of critical importance to conventional QCA, particularly where configurations contradict theoretical predictions, the approach employed here seeks not to engage with causal arguments, but rather to assess the potential for diversity *within and between regimes of communality*. Consequently, in a case-intensive fashion, consideration was limited to only those cases of common group 4. The resulting set of cases, along with their counties, extents of common holding, and standard deviation above mean uptake of gratuitous relief rations, is detailed below in table 8.1.

Table 8.1 QCA Unions			
Union	**County**	**common**	**rationheadz**
Ballina	Mayo	68.45	1.79
Dunfanaghy	Donegal	42.49	.12
Ennis	Clare	20.22	3.85
Ennistimon	Clare	52.62	1.52
Gort	Galway	32.21	2.27
Kanturk	Cork	19.69	1.03
Kenmare	Kerry	50.08	1.11
Kilkenny	Kilkenny	21.17	-.1
Kilrush	Clare	18.94	1.17
Letterkenny	Donegal	35.13	-.87
Millford	Donegal	44.83	-.97
Nenagh	Tipperary	20.43	1.09
Newcastle	Limerick	20.12	.2
Rathkeale	Limerick	19.26	1.49
Scariff	Clare	70.51	1.13
Skibbereen	Cork	42.91	-.14
Swineford	Mayo	55.49	2.11
Westport	Mayo	83.33	2.21
	Mean	39.99	1.06

Initially, an exploratory two-case clustering algorithm was applied to each variable, in order to establish a baseline point of difference between variable groups. This approach is similar to that employed by Byrne (2009), who constructed a composite, binary measure of 'adequate/inadequate performance' using school test achievement data. Unfortunately, this approach proved too ambiguous in the presence of low variance, and a more conventional approach was instead adopted in the absence of existing theoretical direction. Consequently, median values were designated for dichotomisation in all cases, in order to ensure consistency in the dichotomisation procedure across variables. The following analysis thus presents three separate models of distinct regimes in evidence amongst this sub-set of high-communality cases.

The manner in which discussion proceeds however, does not adhere to the typical confines of QCA based inquiry which often seeks to advance arguments concerning causation. Given the comparatively later date of the dataset used (1845-1849), arguments concerning the *causative* contribution of various conditions to higher extents of rundale should be avoided, given that the presence of communality was largely entrenched in these areas long before official data

collection began in the nineteenth century. It must therefore be acknowledged, that the intention is this analysis is not to forward arguments concerning the conditions under which rundale may *emerge* by comparing cases displaying both a presence and absence of common holding (such a line of argumentation concerning origins and emergence would prove futile in the absence of richer historical data). A typical QCA analysis proceeds by comparing configurations for which the outcome is both present and absent, and a core component of this comparison is its ability to infer the respective import of causal factors present in configurations leading to, and not leading to the outcome – such configurations challenge the researcher to examine the specifics of the cases in question, in order to account for such disparities. Analysis is instead restricted to differentiating greater or lesser extents of common holding *amongst that subset of cases which indicate some degree of existing communality*. This argument thus does not concern the respective import of various causal factors to the emergence of the rundale system – this line of inquiry arguably resides beyond the empirical boundaries of sociology – but instead concerns the *internal diversity* of modes of communality, such as they present in the mid nineteenth century, as a critical point of dialogue between the results of chapter 7.

8.1.2. Multiple regimes of communality: the internal complexities of production under rundale

Three principal analyses are presented in the forthcoming section, the first two of which deal with regimes of communality (i.e. conditions giving rise to greater extents of common holding), and the third of which deals with configurations giving rise to greater or lesser extents of ration uptake. The first analysis of communal regimes takes a set of conditions related to land quality and productivity; the second utilises conditions of systemic constraint. The first round of configurational analysis involves examining regimes leading to greater extents of common holding, in terms of their valuation, availability of uncultivated lands, yields, and potato cultivation. Following transformation of the conditions listed in table 8.2 into a set of presence/absence dichotomies, a crisp-set truth table was generated using fsqca's truth table algorithm (Ragin, Kriss and Davey 2006). Given the comparatively small number of cases (18), a frequency threshold was not required - typically, the analyst will discard configurations exhibiting fewer than 1 or 2 cases. Counterfactuals (configurations containing no cases) were dropped, and although consistency thresholds were invoked in the analysis of subsequent regimes, all those presented below displayed clear bands of consistency.

Table 8.3 displays these resulting configurations, including also the number of cases in each configuration, and their consistency (i.e. the proportion of cases scoring positive on the

outcome ‘logcommon’, indicating cases of high communality). This initial set of results examines the presence of greater extents of common holding in terms of configurations of land valuation (plvacre), the presence of uncultivated lands (uncult47), corn yield (ycorn49), and extent of potato growth (potato49). Variable descriptions may be obtained by referring to appendix 2, as these are drawn from the same set as was utilised in chapter 7. Presence and absence of each condition is denoted by either ‘+’ (present) or ‘-’ (absent). Configurations 1-6 in the following table (8.3) indicate those for which higher proportions of common holding were present; configurations 7-11 indicate those cases containing lower proportions of common holding.

Table 8.2 QCA dichotomisation thresholds for ‘common’ regime 1

Variable	Median	Min	Max
plvacre	.415	.08	.92
uncult47	81.64	62.85	95.1
ycorn49	660.5	400	836
potato49	14.1	7.69	31.42
common	38.81	18.94	83.33

Table 8.3 Truth table configurations, ‘common’ regime 1

	plvacre	uncult47	ycorn49	potato49	common	N	C
1	-	+	+	+	1	3	1
2	+	+	-	+	1	1	1
3	-	+	+	-	1	1	1
4	-	+	-	+	1	2	1
5	+	+	+	-	1	1	1
6	-	-	-	+	1	1	1
7	+	-	-	-	0	2	0
8	+	-	-	+	0	1	0
9	+	-	+	-	0	3	0
10	-	-	-	-	0	2	0
11	+	+	+	+	0	1	0

The next stage of QCA involves a process of reduction according to the rules of Boolean minimization. As may be observed in the above table, Boolean addition differs from

arithmetical addition in that the presence of multiple conditions contribute in a non-additive manner to either the presence or absence of an outcome. For example; taking the first line of table 8.3, the presence of high common holding, as a function of the presence of conditions 2, 3, and 4 (uncult47, ycorn39 and potato49) is observed. Therefore, this combination of characteristics leads to a 'true' outcome on 'common' (2+3+4=1). Configurations are thus interpreted logically according to the following simple rule; '...satisfy any one of the additive conditions and the expected outcome follows' (Ragin 1989: 89). Focusing on those combinations leading to the presence of high communality (a score of 1 in the 'common' column of table 8.3), configurations 1-6 may be stated according to their primitive expressions, by capitalising condition names where the condition is present. By this convention, the above table yielded the following results;

```
(1) plvacre*UNCULT47*YCORN49*POTATO49
(2) PLVACRE*UNCULT47*ycorn49*POTATO49
(3) plvacre*UNCULT47*YCORN49*potato49
(4) plvacre*UNCULT47*ycorn49*POTATO49
(5) PLVACRE*UNCULT47*YCORN49*potato49
(6) plvacre*uncult47*ycorn49*potato49
```

Typically, the next step in analysis based on Boolean operations involves the minimisation of primitive expressions according to the conventions of Boolean factoring (Ragin 1989). This general rule states that where a pair of configurations differs on only one factor, that factor may be eliminated. In such a manner, progressively parsimonious statements may be derived by the deduction of prime implicants, or statements which contain two or more primitive expressions. The above results present a degree scope for minimization, and statements 1+3, and 2+4 are reducible respectively to sets of prime implicants. This was the only stage of minimisation invoked, in order to preserve the descriptive diversity of regimes, given that this exercise relies on substantiating the potential for diversity, and of exploring the implications of contrasting regimes giving rise to similar outcomes. This procedure yielded the following prime implicants;

```
(1)+(3) plvacre*UNCULT47*YCORN49
(2)+(4) UNCULT47*ycorn49*POTATO49
(5)     PLVACRE*UNCULT47*YCORN49*potato49
(6)     plvacre*uncult47*ycorn49*potato49
```

Resulting in the following outcome expression;

```
COMMON = (plvacre*UNCULT47*YCORN49) +
(UNCULT47*ycorn49*POTATO49)         +
(PLVACRE*UNCULT47*YCORN49*potato49) +
(plvacre*uncult47*ycorn49*potato49)
```

Table 8.4 Regimes associated with higher communality, 'common' regime 1

Regime	Description	Unions
1+3	Lower valuation, higher uncultivated land, higher corn yield	Ballina (Co. Mayo), Swineford (Co Mayo), Westport (Co. Mayo); Scariff (Co. Clare)
2+4	Higher uncultivated lands, lower corn yields, higher potato cultivation	Skibbereen (Co. Cork); Dunfanaghy (Co. Donegal), Kenmare (Co. Kerry)
5	Higher valuation, higher uncultivated land, high corn yield, lower potato cultivation	Ennistimon (Co. Clare)
6	Lower valuation, lower uncultivated land, lower corn yield, higher potato cultivation	Millford (Co. Donegal)

The results of table 8.4 indicate a substantial degree of internal diversity within high-communality unions, and a first pass assessment reveals that much of this configurational diversity is accounted for by prime implicants (1+3) and (2+4). Of particular note, considering the geographical locations of the above regimes, is their consistency with the typology of social-ecological regimes derived in section 7.1, and their broad correspondence with the distribution of clacháns mapped by McCourt (1971 – see figure 7.1). Undoubtedly, correspondence between the exercises of this thesis owes much to their use of similar measures (i.e. extent of common holding) in the derivation of their respective typologies; nonetheless, their consistency is at least, mutually reaffirming, and permits a discussion of current results in dialogue with those of previous chapters. Regimes (1+3) and (2+4), also corroborate a particular mechanism of resilience introduced in the previous chapter, concerning the mediating effects of available wasteland for reclamation, which in turn acted as a hedge against the progressive *internal* parcellisation of the commune's infield, in order to accommodate new members.

It is thus interesting to note, that regimes (1+3) and (2+4), both of which are characterised by higher proportions of uncultivated land, are also distinguishable by the presence of higher corn yields (1+3), and its absence (2+4). Furthermore, regime (5), of which the union of Ennistimon is the only one to exhibit such a configuration, exhibits higher proportions of uncultivated lands, as well as higher yields, and lower rates of potato cultivation. It is thus tempting to assign causative status to the comparative absence of higher potato cultivation in regime (5), but this is

not necessarily a valid conclusion, considering that the reduction of configurations 1 and 3 excluded the condition of higher potato cultivation, rendering it 'causally' irrelevant to higher extents of common holding for these particular cases. Furthermore, regime (2+4) suggests that the presence of potato cultivation is of some importance; consequently, despite regimes (1+3) and (2+4) both exhibiting greater extents of uncultivated land, regime (2+4) is characterised by the presence of greater potato cultivation, and lower yield, suggesting that the mediating role of available land was to some extent tempered by characteristics of production. This was already substantiated by the models of chapter 7, which noted the diminishing effect of greater extents of potato cultivation on yield, controlling for extent of uncultivated ground.

The union of Ennistimon appears to fare somewhat better, in that its regime is characterised by higher valuation, as well as higher yields, in the presence of lower rates of potato cultivation. It is worth noting that the union of Ennistimon, site of the fieldwork of Arensberg and Kimball which in turn solidified the erroneous notion of a timeless peasant society (Gibbon 1973, Gibbon and Curtin 1978, Fitzpatrick 1983), should exhibit characteristics quite apart from neighbouring configurations, recording as it does the only instance in which higher land valuation constitutes a component essential to the presence of higher common holding. These results are very much suggestive that the effects of increased potato growth, noted as a negative contributor to yield and ration uptake in chapter 7, was somewhat tempered under rundale by contextual factors; thus the presence of uncultivated land features as central to the regime of communality (1+3) which also enjoyed higher yield, whilst the regime of (2+4) fared somewhat worse in the presence of greater extents of potato, despite the presence of uncultivated ground. The regime of the union of Millford, Co. Donegal (6) is further compounded in its low yield by its characteristic absence of uncultivated land, low land quality, and greater extents of potato. Extending the prospect of alternative modes of internal diversity, a further inspection of regimes of communality, based on the conditions of fragmentation, flax cultivation, presence of uncultivated lands, and consolidation, yielded the results presented below in tables 8.5, and 8.6.

Table 8.5 QCA dichotomisation thresholds for 'common' regime 2			
Variable	**Median**	**Min**	**Max**
onefive	16.5	7	45
flax47	.15	.01	7.91
uncult47	81.64	62.85	95.1
overthirty_chg2	4.045	-4.44	31.77
common	38.81	18.94	83.33

Table 8.6 Truth table configurations, 'common' regime 2							
	onefive	**flax47**	**uncult47**	**overthirty_chg2**	**common**	**N**	**C**
1	+	+	+	+	1	1	1
2	-	-	+	-	1	2	1
3	-	+	+	+	1	1	1
4	-	+	+	-	1	1	1
5	+	+	+	-	1	2	1
6	+	-	+	-	1	1	1
7	+	-	-	+	0	2	0
8	+	-	-	-	0	1	0
9	-	+	-	+	0	1	0
10	+	-	+	+	0	1	0
11	+	+	-	+	0	1	0
12	-	-	-	+	0	2	0

Configurations 1 to 6 of table 8.6 yielded the following primitive expressions;

```
(1) ONEFIVE*FLAX47*UNCULT47*OVERTHIRTY_CHG2
(2) onefive*flax47*UNCULT47*overthirty_chg2
(3) onefive*FLAX47*UNCULT47*OVERTHIRTY__CHG2
(4) onefive*FLAX47*UNCULT47*overthirty_chg2
(5) ONEFIVE*FLAX47*UNCULT47*overthirty_chg2
(6) ONEFIVE*flax47*UNCULT47*overthirty_chg2
```

These expressions may in turn be simplified according to the conventions of minimisation utilised in the preceding tables. Three opportunities for minimisation presented, according to

which the following prime implicants were derived. The resulting union names and locations of cases covered by these prime implicants are presented below in table 8.7.

```
(1)+(5) ONEFIVE*FLAX47*UNCULT47
(2)+(6) flax47*UNCULT47*overthirty_chg2
(3)+(4) onefive*FLAX47*UNCULT47
```

Resulting in the following outcome expression;

```
COMMON = (ONEFIVE*FLAX47*UNCULT47) +
(flax47*UNCULT47*overthirty_chg2)  +
(onefive*FLAX47*UNCULT47)
```

Table 8.7 Regimes associated with higher communality, 'common' regime 2

Regime	Description	Unions
1+5	Higher fragmentation, higher flax cultivation, higher uncultivated land	Westport (Co. Mayo); Dunfanaghy (Co. Donegal), Swineford (Co. Mayo)
2+6	Lower flax cultivation, higher uncultivated land, lower consolidation	Ennistimon (Co. Clare), Kenmare (Co. Kerry); Scariff (Co. Clare)
3+4	Lower fragmentation, higher flax cultivation, higher uncultivated land	Skibbereen (Co. Cork); Ballina (Co. Mayo)

The above results add yet another layer of insight to the conditions under which rundale obtained in the mid nineteenth century. In the first round of minimisation, consolidation was eliminated from all regimes (1+5) and (3+4), given that this was the only factor differing between these respective primitive expressions. In the presence of other configurations of conditions, consolidation is thus not central to the characterisation of these regimes; whether present or absent, the outcome is positive. The diversity of conditions under which flax cultivation obtained is further illustrated above, appearing as it does under conditions of high fragmentation (1+5), lower fragmentation (3+4), and higher proportions of wasteland, common to both (1+5) and (3+4). With regard to the Co. Mayo unions of Westport and Swineford (1+5), it was suggested by Eric Almquist that flax cultivation played an integral role in the increasing labour-intensity of rural life in Co. Mayo as the nineteenth century wore on[258]. Although flax

[258] In the region of Lough Swilly, Co. Donegal, the ordnance survey memoirs note; 'Farmers in Moville do not save flax seed or raise flax to sell in flax, but every inland farmer grows sufficient to employ the females of his family at home, and it is generally of good quality...' (Day and McWilliams 1997 [1835]: 141). MacParlane noted of the Baron of Burrishoole that; '...almost all of the cabins have every one a loom, some two, and they spin and weave pieces of linen for the Castlebar markets' (1832: 108).

was relatively labour intensive to produce, it worked well in rotation with root crops – particularly potato tubers – and as rents began to rise in the post-Napoleonic era, it quickly assumed a central role in the maintenance of rent obligations (Almquist 1977: 189). Accordingly, resultant population growth and a collapse in linen prices during the industrial revolution conspired to place Mayo in a markedly precarious position on the eve of the famine. Thus it appears, in light of knowledge of the excess mortality endured by Co. Mayo during the famine years that the presence of uncultivated land, as is evident in regime (1+5) was insufficient to forestall collapse – although elaboration of this dynamic is reserved for the forthcoming section. This regime is also characterised by higher degrees of fragmentation, which is characteristic of the capacity of domestic industry to absorb excess labour. Under the further constraints of communality, it is reasonable to suggest that this regime engendered a specific dynamic of constraint characterised by the presence of population growth-facilitating conditions of domestic industry and higher proportions of common holding, which in turn recursively facilitated fragmentation.

This conclusion maps well onto that of Gray, whose work on domestic industry and deindustrialisation in Co. Cavan has stressed the variable significance of domestic industries according to the specifics of place, with a particular emphasis on how such variance was mediated through inequalities of gender. In Cavan, within lands of poorer quality, the absorption of labour in domestic industry led to population growth independent of early nuptiality; in light of the inherent tendencies of rundale to facilitate subdivision, the unions of regime (1+5) undoubtedly prospered demographically under the dual facilitators of proto-industry, and easy access to land by communal entitlement; indeed, the clustering exercise of section 7.1 incorporated high early nuptiality into its criteria of a regime of compromised resilience, in which many of the above-tabulated unions resided – particularly those of Co. Mayo. Regime (3+4) further suggests that it was possible for areas of high density communality to congeal around higher flax cultivation with comparatively lower rates of fragmentation. The presence of this regime thus points toward a contradictory role for the availability of uncultivated land, which appears simultaneously capable of obtaining within higher rates of flax cultivation, as well as greater and lesser extents of fragmentation.

The necessity of this mode of interrogation is further underscored by the relatively poor performance of the linear approach in modeling the extent of communality across unions, as may be observed from the following tables (8.8 and 8.9).

Table 8.8. The formation of communality (OLS regression coefficients)

	(1) logcommon	(2) logcommon
plvacre	.035 (1.17)	.044 (1.79)
uncult47	-	.013* (2.52)
flax47	.054* (2.08)	.034 (1.28)
onefive	-.009* (-2.11)	-.003 (-.58)
ycorn49	-.000 (-1.10)	-.000* (-2.00)
potato49	.006 (.54)	.001 (.13)
rationheadz	.203** (3.28)	-
Constant	.874* (2.54)	.117 (.22)
F	(6, 122) 4.69**	(6, 122) 3.23**
R^2	.1474	.0948
AIC	190.215	197.9299
Mean VIF	1.21	1.25
N	129	129

*p<0.05, **p<0.01, ***p<0.001

t-statistics in parentheses

Table 8.9. The formation of communality (standardised regression coefficients)

	(1) logcommon	(2) logcommon
plvacre	.094	.117
uncult47	-	.290*
flax47	.206*	.129
onefive	-.160*	-.052
ycorn49	-.094	-.159*
potato49	.061	.015
rationheadz	.379**	-
Constant	-	-
F	(6, 122) 4.69**	(6, 122) 3.23**
R^2	.1474	.0948
AIC	190.215	197.930
Mean VIF	1.21	1.25
N	129	129

*p<0.05, **p<0.01, ***p<0.001

Although these additive models corroborate something of the explications offered in this and previous chapters, such as the contributory roles of fragmentation, uncultivated land, declining yield and subsidiary industry to the 'condition' of communality, the preceding configurational exercises have suggested that this representation does not offer a valid perspective on the variety of nuanced regimes under which higher proportions of communality obtained. In this sense, the core insight of this exercise resides not merely in its ability to discern the minute interaction of conditions within and across these configurations, but in the diversity of the configurations themselves; in short, the above results are suggestive that the narratives and conceptual structures typically imposed upon the rundale are in need of some augmentation. It has already been established, that existing scholarship has tended to remain at the level of 'prime movers' in its explications of communality (Whelan 1995, 2000), in a manner reminiscent of the above model, such that the conditions of poverty, available land and

fragmentation are cast in the role as ideal-typical conditions constitutive of a generalised ‘rundale system’, which is itself but an emergent property responsive to external signification. Indeed, even the pioneering works of Estyn Evans paid little attention to the task of imposing conceptual clarity on their subject; instead, Evan’s pronouncements veered from highly abstract extrapolations of communality into the distant past, which so provoked the ire of the broader geographical community (Andrews 1974, 1977; Evans 1939, 1992; Graham 1994), toward more nuanced, descriptive inventories of folk practice (Evans 1967a, 1967b, 1976). In the case of both extremes, little attempt was made by either party to the anthropogeographic debate to impose *summary* conceptual clarity on the internal diversities of communality itself, although some attempts were made by Currie (1976), and McCourt (1971), albeit in terms of physical structure, and modes of tenure.

Instead, rather than opting for a narrative of functional adaptation, or one which seeks conceptual order merely to reconstruct antecedent geographical conditions, emphasis must be placed on an approach to reduction which views organisational form as the outcome of an historical, natural-social dialectic, or the evolution of various institutional spaces in which structures are recursively produced and reconstructed, as criticisms of the natural-social dualism have suggested. Consequently, the derivation of these regimes speaks not only to existing restrictive theory regarding nineteenth century social structure, such as the archetypes examined in section 7.1, but also to the fundamentals of complexity which emphasise the potential for divergence and devolution from points of common origins; the preceding has here offered a glimpse of a number of such temporary, historically-specific manifestations of these divergent conditions.

Returning to the core heuristic capacities of resilience, namely that of its ability to assess robustness to perturbation, the following and final QCA exercise compares regimes associated with high *and* low levels of ration uptake, in terms of configurations consisting of the availability of uncultivated land, flax cultivation, valuation, and potato production. In the following exercise, regimes resulting in a positive, as well as negative outcome score are considered, thus making it possible to compare differences and similarities in configurations. Tables 8.8 and 8.9 present descriptive summaries, and a tabulation of truth table output respectively. Consistency scores were less clear-cut than in previous iterations, therefore certain decisions were made concerning cut-off criteria. Regimes 4 and 5, with consistencies of .75 and .5 respectively, were designated for positive inclusion, whereas regime 6, with a consistency score of .33 was assigned to the negative outcome category; all other configurations displayed

unambiguous consistency levels. Stages of reduction are detailed beneath the truth table, according to the conventions employed within previous tables.

Table 8.8 QCA dichotomisation thresholds for 'rationheadz' regime 3

Variable	Median	Min	Max
potato49	14.1	7.69	31.42
uncult47	81.64	62.85	95.1
flax47	.15	.01	7.91
plvacre	.415	.08	.92
rationheadz	1.12	-.97	3.85

Table 8.9 Truth table configurations, 'rationheadz' regime 3

	potato49	uncult47	flax47	plvacre	rationheadz	N	C
1	+	+	-	+	1	1	1
2	-	+	-	+	1	1	1
3	-	+	-	-	1	1	1
4	-	-	-	-	1	1	.75
5	+	+	+	-	1	4	.5
6	-	-	+	+	1	2	.33
7	-	-	-	+	0	3	0
8	-	-	+	-	0	1	0
9	+	-	+	-	0	1	0
10	+	+	-	-	0	1	0
11	+	-	-	+	0	1	0
12	+	+	+	+	0	1	0

Condition present (higher ration uptake);

```
(1)  POTATO49*UNCULT47*flax47*PLVACRE
(2)  potato49*UNCULT47*flax47*PLVACRE
(3)  potato49*UNCULT47*flax47*plvacre
(4)  potato49*uncult47*flax47*plvacre
(5)  POTATO49*UNCULT47*FLAX47*plvacre
```

```
(1)+(2) UNCULT47*flax47*PLVACRE
(3)+(4) potato49*flax47*plvacre
(5)     POTATO49*UNCULT47*FLAX47*PLVACRE
```

Condition absent (lower ration uptake);

```
(6)  potato49*uncult47*FLAX47*PLVACRE
(7)  potato49*uncult47*flax47*PLVACRE
(8)  potato49*uncult47*FLAX47*plvacre
(9)  POTATO49*uncult47*FLAX47*plvacre
(10) POTATO49*UNCULT47*flax47*plvacre
(11) POTATO49*uncult47*flax47*PLVACRE
(12) POTATO49*UNCULT47*FLAX47*PLVACRE
```

```
(6)+(7)  potato49*uncult47*PLVACRE
(8)+(9)  uncult47*FLAX47*plvacre
(10)     POTATO49*UNCULT47*flax47*plvacre
(11)     POTATO49*uncult47*flax47*PLVACRE
(12)     POTATO49*UNNCULT47*FLAX47*PLVACRE
```

Table 8.10 Regimes associated with ration uptake, 'rationheadz' regime 3

Regime	Description	Unions
Higher ration uptake		
(1+2)	Higher uncultivated land, lower flax cultivation, higher valuation	Ennistimon (Co. Clare), Gort (Co. Galway)
(3+4)	Lower potato cultivation, lower flax production, lower valuation	Kilrush (Co. Clare), Scariff (Co. Clare)
(5)	Higher potato cultivation, higher uncultivated land, higher flax cultivation, higher valuation	Ballina (Co. Mayo), Dunfanaghy (Co. Donegal)*, Swineford (Co. Mayo), Westport (Co. Mayo)
Lower ration uptake		
(6+7)	Lower potato cultivation, lower uncultivated lands, higher valuation	Ennis (Co. Clare), Kanturk (Co. Cork), Kilkenny (Co. Kilkenny), Nenagh (Co. Tipperary), Rathkeale (Co. Limerick)
(8+9)	Lower uncultivated lands, higher flax cultivation, lower valuation	Letterkenny (Co. Donegal), Millford (Co. Donegal)
(10)	Higher potato cultivation, higher uncultivated land, lower flax cultivation, lower valuation	Kenmare (Co. Kerry)
(11)	Higher potato cultivation, lower uncultivated lands, lower flax, higher valuation	Newcastle (Co. Limerick)
(12)	Higher potato cultivation, higher uncultivated land, higher flax cultivation, higher valuation	Skibbereen (Co. Cork)

Regimes giving rise to higher rates of ration uptake render insights gleaned from previous tables further intelligible. Regime (1+2), for which the extent of potato cultivation was not significant to the presence of greater ration uptake, is characterised by a configuration of higher proportions of uncultivated lands, lower flax cultivation, and higher valuation. It is interesting to note that the condition of valuation, a reliable indicator of land poverty, appears largely irrelevant to the presence/absence of distress across high-communality groups – although this is perhaps explicable in the case of Ennistimon by the proximity of large grazing tracts which may have elevated aggregate valuation levels. Although the overall distribution of valuation

within these groups is already diminished (these groups are of considerably lesser valuation compared to those of the remainder of Ireland dropped from the total sample), it is nonetheless significant that the presence or absence of distress appears more associated with the nuances of configurations around productive activity. The mediating roles of subsidiary industry and uncultivated lands again appear important; regime (3+4) thus appears compounded by the presence of low rates of root crop cultivation, lower flax, as well as low valuation.

Of particular interest, however, is the contradictory presence of the availability of uncultivated lands, which calls for a closer examination of the specifics of individual cases. Despite the presence of available land for reclamation, it appears that considerable difficulties abounded within Ennistimon (1+2) concerning the availability of manure, which was exacerbated by local desires to adhere to principles of communal allocation. However, the encroachment of notions of private entitlement, imposed from without by local landowners, intervened in the mechanisms of communality, resulting in profound disputes between rundale occupants. In evidence to the Devon Commission on the union of Ennistimon, Cornelius O' Brien commented on the nature such disputes;

> "15. Have any disputes arisen relative to the right of taking the sea-weed? – Never, until within the last two years. How did these disputes then arise? –
> 16. Some people in the neighbourhood, wishing to make it common property, came in crowds and destroyed the weed; they cut it, and cut each other too.
> 17. Do you mean they came in crowds to take the weed away, injuring it in doing so? – Yes.
> 18. In what manner had the right to the sea-weed been previously exercised? – By the owner of the estate adjoining – he either set it, or gave the privilege of using it, at all events, exercised a right of property that was undisputed. It was the subject of a lease, that is, the black weed; there is a difference between the wrack and the black weed.
> 19. To which weed do you refer? – The landlord claimed a right to both, but he leased the black weed, the growing weed; but if it was left open, it would not long be manure, for any person, either rich or poor, for they so drag it and pull it about, that they would destroy it and put an end to it as manure.
> 20. Do those differences still continue? – No, they do not now, the government interfered: The parties were summoned and brought to trial and found guilty.
> 21. In speaking of the injury which the public being allowed to appropriate the growing weed themselves might have, does that arise from its being necessary to protect the weed in its early growth? – It arises from the same cause that makes the commons of no value; where every one has a right, there is no one to protect it, for they will pull and drag it away from each other"[259].

These comments reveal a crucial layer to the nature of metabolic rift under rundale, and further underscore the heuristic value of Marx's communal-individual dualism outlined in chapter 4, in terms of its capacity to induce varying states of internal contradiction. Based on the above

[259] *Devon Commission. Evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part II.* 1845 [616] xx, p. 693

account, the positive effects of the availability of extensive wasteland were mediated through competing notions of entitlement and property; those of the state and landlord based on private right, and those of the rundale tenantry, based upon equalisation of opportunity. In the case of Ennistimon, the presence of uncultivated lands was rendered null by externally-imposed constraints which deprived the tenantry of a crucial source of fertiliser both for reclamation, and for manuring existing cropland. Under the burgeoning demographic regime of pre-famine Ireland, this condition doubtless exacerbated the state of diminishing returns under the metabolic rift, resulting in a state of diminished resilience, as indicted by the configuration of regime (1+2). The imposition of private right thus intervened to alter the dynamics of the communal-individual dualism, resulting in a state of profound dispute which appears to have critically undermined the adaptive capacities of local occupants. This condition is further substantiated by subsequent comments of O' Brien;

> "23. Was there any claim to the commonage of the shore in this country until of late years? – Certainly not; and the effect of making it common would make it very dear: it would be most injurious to the persons remote from the shore. Now the persons who are tenants to the shore can employ their children and their neighbours in collecting the weed, and they can sell it to persons from the interior at a cheaper rate than they could obtain it by bringing the persons themselves to collect it. In the one case, they are sure of getting it in abundance from the care of the tenants; whereas in the other case they could not be sure"[260].

Therefore, not only did the imposition of private right serve to crucially undermine the institutions of communality, it also added further impetus to the realisation of exchange value, and the generation of money by interior tenants in order to maintain fertility. As previously observed in the case of Clare Island, Co. Mayo, the worst excesses of this practice led to the elimination of oats from local diets, as the requirements of realisation of money-based obligations such as cess, tithes, rent - and in this case, fertiliser - mandated an ever-precarious reduction of dietary and ecological diversity. For Ennistimon, the comparative absence of flax in its configuration, as a source of subsidiary income, thus appears to have crucially undermined the resilience of local occupants, compounded their experience of the metabolic rift, and compromised their capacity to reproduce, as is evident from their higher rates of ration uptake. In the case of the Donegal townland of Farrellmacbride (5), sources of fertiliser were critically undermined by the prevailing system of rackrent, which led to the elimination of cattle from local production regimes. Owing to the particularly punitive levies exerted on the tenantry by the local agent with respect to the sale of livestock, many tenants were forced to eliminate livestock from their holdings, owing to a comparative absence of alternative sources

[260] Ibid

of earnings, resulting in dependence almost entirely on potatoes[261]. Evidence throughout the Devon commission variously attests to the practice of local landlords and agents increasing rents contrary to those stipulated by the ordnance survey valuation, which doubtless contributed to the diminishing of ecological diversity, as was observed also in the union of Ennistimon.

Regime (5) presents a number of interesting contradictions, particularly with regard to its positive outcome of higher distress, despite the presence of wastelands, and greater extents of flax cultivation. Comments from the Devon commission concerning the variability of conditions conducive to reclamation serve to underscore the non-linearity of the positive relationship between resilience and uncultivated lands identified in preceding linear models. In this respect, it was noted of Co. Mayo that it possessed; '...a greater extent of unimproved waste lands than any other in Ireland, yet a large portion of it presents unusual facilities for reclamation and cultivation...but, owing to the want of manure, which can be procured in abundance on the coasts of Erris and Burrishoole'[262]. Consequently, the mediating capacities of wasteland appear to depend here not only on the amenability of particular tracts to reclamation, but also to the adequate supply of manure, which was in available in abundance in the peninsular districts of Erris. Furthermore, the viability of domestic industry in Co. Mayo under competition from industrialised linen production both in Ulster, and abroad, doubtless tempered the capacities of domestic spinning to confer resilience to environmental vicissitudes, as noted by Almquist (1977) and Gray (2005). Indeed, Samuel Lewis observed in 1837 that Belcare, in the union of Westport, contained a number of cotton factories containing up to 26 looms (Lewis 1837: 1381). Consequently, it appears that despite the additive, positive properties of uncultivated grounds and higher levels of flax production, context is crucial; resilience, in the cases of these Mayo unions thus depended on a range of factors specific to its configuration, and the nuances of its position in the local-global panarchy.

Considerable diversity abounds within regimes of lower ration uptake. It is worth noting that regime (6+7) is particularly exceptional; the presence of Kilkenny cannot be taken as indicative of a typical region of high common holding, and chapter 6 has already qualified its exceptional nature, given that the clusters of Kilkenny represent devolved manorial settlements, with origins in the medieval three-field system which have left South Kilkenny, in particular, with a

[261] Evidence of James McCunningham (*Devon Commission. Evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part II.* 1845 [616] xx, p. 155-156).

[262] *Devon Commission. Report from Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part I.* 1845 [605] [606] xix, p.51

unique form of clustered habitation quite unlike that of other communal districts of Ireland (their similarities being merely structural). Similarly, the union of Nenagh, which enjoyed a prosperous trade in tillage produce and livestock, should be considered an exceptional case. The other unions of regime (6+7) conform to the classic conditions of resilience identified within the linear models of chapter 7, in which lower rates of potato cultivation – which in turn served to temper the swing from corn to increased root production experienced in many rundale areas – and high valuations conspired to confer conditions of resilience to collapse. The Donegal unions of Letterkenny and Millford (8+9), characterised by higher rates of flax cultivation and lower valuation are of particular interest. Vice-chairman of the board of Guardians of Glenties, John O' Donnell observed that in places where lands had largely been squared as private holdings, conditions were generally more favourable owing to the availability of multiple sources of manure, a diversity of crops, in which oats and potatoes were alternately grown, along with the keeping of cattle[263]. George Hill also noted that domestic industries had long served as a source of subsidiary income in the rundale-dense region of Gweedore, Co. Donegal (Evans 1971 [1887]).

The specifics of the union of Kenmare (10), characterised by higher rates of potato cultivation, absence of flax, presence of uncultivated lands and low valuation illustrates further the heterogeneous characters of locally resilient regimes. Within this union, an abundant source of fertiliser in the form of shell-rich sea sand was often carried 28 miles inland by water, which doubtless offered an important source of additional nutrients with which to hasten bringing new lands into productivity where required, and in hedging against potential losses within existing settlements.[264] Similarly, the union of Skibbereen (12) enjoyed an abundance of seaweed and sea sand, the collection of which was facilitated by favourable tidal patterns[265]. Thus, despite the preponderance of intensive tillage and rundale, the availability of alternative fertiliser sources – in the absence of constraining conditions such as those experienced in Ennistimon – appear to have conspired to enhance their resilience to distress.

[263] Evidence of James McCunningham, Donegal (*Devon Commission. Evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part II.* 1845 [616] xx, p. 147-148)

[264] Evidence of James McLure, Kenmare (*Devon Commission. Evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part II.* 1845 [616] xx, p. 908)

[265] Evidence of James McCarthy, Skibbereen (Ibid, p. 947-948).

8.1.3. Theoretical and substantive implications

To summarise, it appears a worthwhile exercise to have interrogated further the summary trends of chapter 7. In doing so, considerable heterogeneity in configurational organisation has been observed within rundale-dense regions, the analysis of which has above added another crucial layer of understanding to the variable ecological dynamics of Irish communality. When interrogated in terms of case-specifics, various unions such as those examined above, exhibit idiosyncrasies which add further layers of enrichment to an understanding of the distribution of resilience. With regard to existing narratives of social change, and Irish social structure, the above results underscore the necessity of such a complexity-oriented approach, as remaining at the level of net additive effects would here have imparted an erroneous view of the diversity of system variants inherent *within* the mode of production of rundale in Ireland. It is clear that not only did such systems encompass much structural diversity, contrary to the limited diversity that should be found under either fully capitalised, or subsistence-oriented modes of production, but that their ecological and reproductive dynamics, in certain regimes here outlined, ran quite contradictory to dominant depictions of rundale as a homogenous archetype.

The conceptual and theoretical implications of this exercise are thus numerous, and the explication of the preceding regimes has revealed a number of crucial shortcomings in existing pronouncements on characterisations of macro-social structure and change. As discussed in chapter 6, existing theoretical constructs have tended to over-empahsise both the penetration, and the primacy of certain aspects of capitalist exchange, such as the presence of a developed cash nexus, as an indicator of the dominance of particular modes. This is a prominent mode of reasoning in certain strains of world-systems theory, which has tended to empahsise the transformative potential of markets and trans-national circulation, a perspective which ignores fundamental continuities in non-capitalist social forms. The works of world systems theorists considered in chapter 5, for example, have tended to locate such distinctive breaks within the sixteenth century. Such pronouncements, drawing on Wallerstein's seminal work on the emergent world system, interpret this discrete transition phase as the outcome of a shifting balance of land-labour ratios, which when relatively high, conditioned the capacities of the peasantry to devolve from their feudal-manorial ties, to middle-sized semi-autonomous petty capitalist enclaves (Moore 2000: 130). Coexistent modes of production are often subsumed within such accounts as 'tributary' social forms, carrying the undesirable connotation of homogenising the complexities of pre-capitalist forms under a reductive commonality of 'simple extractive relations' between direct producers and local ruling classes (see Banaji 2010:

17; Patterson 2003: 21). Such a conceptual approach constitutes an inadequate reduction, ignoring as it does the complex relations between modes, the varied effects of encroaching capitalisation, and the effects of market imperatives and those of landlordism on the direct production process, such as the internal diversity of the above regimes has revealed. As detailed in chapter 5, although approaches such as those of world-systems theory offer an insightful macro-context to the historical period of interest in this work, and a useful integration of multiple systemic dimensions such as ecology, imperialism and the global market; its circulationist emphasis renders it incapable of dealing with the many components implicated in the concept of 'mode of production'. Considering the specifics of Ireland's complex web of modes, such an approach ignores crucial continuities in communal and feudal forms within Ireland, and across wider Europe[266].

This exercise has demonstrated that a more productive line of theoretical and empirical inquiry should seek not a reduction, but a representation of complexity, in order to advance more holistic, and representative structural typologies. Deployed within a complexity-informed methodology, the concept of mode of production here serves as a useful basis both for imposing conceptual order on the grand sweep of historical change, whilst simultaneously offering latitude with which to grasp the coexistence of multiple modes in various states of interpenetration and devolution. Considering Hazelkorn's contention that '...the famine of 1845 provided a convenient mechanism through which England intervened in the Irish economy, transforming its agrarian economy from a semi-feudal to a capitalist mode of production' (1981b: 286), this is a difficult dichotomy to maintain given that the above regimes demonstrate contradictory cases of continued regulation of access to the means of production by labour, and cases where the wresting of control over the means of production from its embeddedness in communal governance structures was ongoing[267]. It is therefore clear that considerable heterogeneity abounded within the broad category of 'high communality', according to which certain locations were imbued with profound contradictions in the individual-communal dualism which Marx invoked in order to characterise the devolution of communes from their

[266] As detailed in preceding chapters, the subsumption of Romanian serfdom was a long process of struggle between the feudal Boyar and the peasantry which continued long into the eighteenth century. Outliers of communal villages, the 'underlying fabric' of this social form survived in Romania into the twentieth century (Stahl 1980). Marx's correspondences with Zasulich and Engel's writings on the Mark also reveal a process not of abrupt subsumption, but of complex coexistence. In Ireland, Dáil debate transcripts record questions concerning the continued existence of rundale within parts of Mayo into the mid twentieth century (Dáil Eireann 1947)

[267] Although Hazelkorn later refers to Marx and Engel's failure to recognise the existence of complementary modes of production, her conception of class complexity speaks not to the concept of mode of production as differentiation in terms of relations of relations and forces of production, but instead adheres to Lenin's stratification of the peasantry into semi-proletarians, middle peasants and rich labour-hiring peasants (Hazelkorn 1983).

‘archaic’ origins (1983 [1881]: 120). The final component of this discussion therefore delves into to the concrete practices of rundale in an attempt to more pointedly enunciate the ways in which the institutions and practice inherent within the social form of Irish communality augmented adaptive capacity, and how they were ultimately, and critically, undermined by internal and external contradiction.

8.2. The mediation of adaptive capacity: the institutions, techniques, and productive strategies of rundale

Thus far, the adaptive cycle has proven a useful heuristic on a number of fronts, due to its ability to confer a cursory metanarrative of ‘evolution over time’ on complex systems, as a result of their internal dynamism, and subjection to external influence (Walker et al 2006). At a high level of abstraction, this heuristic has assisted in characterising the developmental trajectories of the rundale under its characteristic burgeoning demographic and ecological regimes, as illustrated in figure 3.6. According to Berkes, Colding and Folkes; ‘...the adaptive capacity of all levels of society is constrained by the resilience of their institutions and the natural systems on which they depend...the greater their resilience, the greater is their ability to absorb shocks and perturbations and adapt to change’ (2003: 14). The preceding analysis has elaborated on the inherent nuances, and configurational diversity evident within the broad category of communality in Ireland, and the variability of conditions under which this capacity to absorb shock obtained; this is here augmented through an examination of the rundales myriad ‘institutions and natural systems’, taking the ideal-typical identity model derived at the conclusion of chapter 6 as its template (table 6.4).

The concept of adaptive capacity, as an essential property mediating the nature of particular adaptive cycles, and the extent of resilience within systems as they transition through various adaptive cycle stages, maps well onto the complexity-derived epistemology of systems as dissipative structures; as concluded in chapter 1, systems must be conceptualised as interacting dissipatively with their environments, in order to counter the excesses of homeostatic stability conferred by previous strains of systems theory. As a result, this mode of explication approximates the concept of metabolism as invoked by historical materialists, in order to recast the natural-social relation as mediated through the labour process. According to Benton (1996), ecoregulative labour differs from that of the typical ‘productivist’ labour process, insofar as it involves the augmentation of extant conditions; as detailed in chapter 3, the maintenance of systemic fertility within bounded ecosystems, inevitably confronts a state of ever-diminishing returns characteristic of dissipative systems, owing to the inherent inefficiencies of energetic

conservation across various stages of the production process, as illustrated by the tropic pyramid (figure 3.1).

Physically, the net primary productivity of a system, or the amount of total solar energy fixed by photosynthesis, varies from system to system as a function of parameters such as climate, land quality and nutrient availability; fertility is in turn determined by the systems '...capacity to produce over a long period of time vegetal organic matter useful to humans or domestic animals' (Mazoyer and Roudart 2005: 52-53). Given that systemic energy flows are unidirectional (i.e. energy is not recycled), and that nutrients, by contrast, are subject to repatriation, attention must therefore be given to the manner in which the concrete practices of particular systems serve to maximise energetic capture, and ensure the efficient circulation of its nutrients. The capacities of commodity production, under the Irish feudal rental regime, to engender the removal of agricultural produce for sale have already been elaborated as a central mechanism within classical accounts of metabolic rift; the rundale system, however, exhibits a number of unique concrete practices, manifest within its specific form of eco-regulative labour process, which operated under the auspices of communal regulation. Table 6.4 has identified a number of these components central to the systemic identity of rundale, such as governance by communal council / headman, open fields with collective share allocation, grazing allocation mechanisms, customary legal code, and transhumance. Together, these concrete practices formed the crucial locus of the adaptive capacity of rundale. Throughout the following discussion, specific attention is paid, in light of foregoing accounts emphasising the ecological tenuousness of mid nineteenth-century rundale, to the manner in which contradictions and conflicts manifested within these institutions.

8.2.1. The field systems of rundale

The famine of 1845-1852 was neither the first – nor by some accounts the worst – ecological disaster to befall the inhabitants of Ireland; indeed, much of Ireland's recorded climatological and epidemiological history is characterised by the persistent rise and fall of periods of distress. The Annals of the Four Masters refer to an 'evil state' prevailing over Ireland during the reign of Cairbre the Cat-headed in A.D. 10, during which '...the earth did not yield its fruits to the Attacotti after the great massacre which they had made of the nobility of Ireland, so that the corn, fruits, and produce of Ireland were barren...fruitless were her arbours, milkless her cattle, so that a general famine prevailed over Ireland during the five years that Cairbre was in the

sovereignty[268]'. The Annals of Ulster refer to a 'great pestilential period' of the eighth century, characterised by; '...extreme cold, fearful thunder, scarcity and Dysentery, with smallpox and Murrin, began about the year 760, and continued for upwards of twenty years'[269]. The table of Cosmical Phenomena, Epizooitics, Famines and Pestilences, provided within the abstracts of the census of 1851 paints a bleak picture of Irish natural history, punctuated by periods of immeasurable snow, crop failure, fever, leprosy and scarcity. In 1739, a period of intense storm activity and severe frost led to widespread destruction of the potato crop which, followed by outbreaks of influenza, typhus, cholera and smallpox, resulted in an estimated 300,000 deaths[270]. The pre-famine decades saw widespread hardship as a result of severe weather events and influenza outbreaks, punctuated by periodic crop failures in 1816, 1821, and 1834[271]. In short, the existences of the Irish tenantry were, at all points throughout history, characterised by intrinsic ecological precariousness.

Under the rundale system, which as preceding analyses have shown tended overwhelmingly toward marginal areas of lower valuation, sources of fertiliser were often scarce, rendering the maximization of available resources crucial. In light of the inherent vulnerability of Ireland to climatological and epidemiological perturbation as detailed above, this criticality of seasonal continuity was doubtless compounded further. Classic accounts of rundale have depicted the institutions of communality as inherently conducive to the reclamation and breaking in of new arable grounds, and the facilitation of combined grazing and tillage. Under the Irish rundale, this form of adaptability was provided through the practice of openfield farming, which in turn offered a mechanism for ensuring the efficient distribution of fertiliser under favourable conditions. In their simplest forms, the openfield systems of rundale centered on a single townland, the area of which consisted of approximately 300 acres. A typical common field system was described as follows by Buchanan;

> "The system varied greatly in detail, but had five main components: common or arable infield, an outfield used for pasture and periodic cultivation, common meadow, rough grazing which usually included peat bog, and small enclosures near the farmhouse for gardens and haggards...The infield was normally held in rectangular strips, varying in

[268] *The Census of Ireland for the Year 1851. Part V, Table of Deaths, Containing the Report, Tables of Pestilences, and Analysis of the Tables of Deaths.* 1856 [2087-I & 2087-II], p. 43.

[269] Ibid, p. 56

[270] Ibid, p.124

[271] The Royal Dublin Society offered a gold medal for the best essay on causes of potato crop failure in 1834, which was attributed by essayists to '...the dry parching weather of spring, and the premature severe frost on the night of the 1st of September, which in many places blackened the leaves and stalks, after which the potato does not grow...many such rotted and were thrown out.' Ibid, p. 214

> length from 50 to 250 yards according to slope and soil conditions, and not more than 20 yards in width...Plots were demarcated by low, earthen banks known by such terms as mearings, ribs, roddens, keelogues or bones, and a higher earthen bank frequently bounded the infield. Individual plots were widely scattered throughout the infield to ensure equality in the share of different qualities of soil, and they varied widely in size" (Buchanan 1973: 596)[272].

In order to facilitate the movement of plots and their distribution across tracts of varying quality, such temporary boundary embankments were typically employed, which could be easily removed or ploughed out in order to facilitate the addition of new members, or where practiced, the redistribution of plots (Bell 2008: 50)[273]. Such was the extent of this subdivision of plots, that in cases, individual plots were as small as one rood, or the width of a single cultivation ridge; a case recorded by McCourt (1947) noted the distribution of one individuals plots across a single townland in 30 different locations. Central to the ecological integrity of the openfield system was the necessary balance of fertiliser maintained by the seasonal movement and herding of livestock, and the custom documented by Evans in South Co. Down refers to the taking of livestock to the hills while the crops were in the ground (Evans 1967b: 123). During the winter seasons between November and March, livestock were permitted free reign of the commune's infield, during which they grazed the stubble of the previous seasons crop; in such a manner, livestock facilitated a crucial circulation of nutrients within the openfield system by depositing manure on the infield;

> "But most of the grazing had to be found elsewhere in summer, and especially in mountain districts there are traditions of moving livestock long distances to seasonal pasture. In Achill Island, County Mayo, for example, milch cows were driven from coastal townlands to graze on Slievemore mountain, where they were tended by girls who lived on the hill pastures from early May until Hallowe'en" (Buchanan 1973: 587).

This practice, known as 'booleying' was typically organised on a communal basis, where young people were often charged with tending stock on higher grounds in shelters known as

[272] On County Antrim in 1776, Arthur Young writes; "There is a custom here called *rundale*, which is a division of their farms into spaces by balks, without fences, which they take here and there, exactly like the common fields of England. It is a most pernicious custom which gives to all these farms the mischeifs of our open field system in England" (Young 1982 [1796]: 150-151).

[273] As detailed in chapter 6, grazing and tillage entitlements were reckoned by the sum or collop, a qualitative measure of the amount of land necessary to feed one cow; in such a manner, an appropriate stock balance was maintained which prevented overgrazing. Patrick Bradden, in his deposition to the Devon commission noted that he held the sum of 'two cows grass' (*Devon Commission...Part II.* 1845 [616] xx, p. 155). An account of Fr. Doherty on Gweedore, Co. Donegal illustrates the extent to which this notional equality was maintained in practice; "They (the tenants) managed it so that every townland had a certain portion of mountain land allotted to it. I believe they managed it amongst themselves. There might be a poor man in the townland who had no stock to put on the mountain. Supposing there are 20 men living on a certain townland, and of that twenty, there were five who had not sufficient stock of their own to put along with their neighbours, then in order to compensate themselves for the loss of their stock, they used to get grazing cattle from other parties and put them with the others, and the other fifteen did not object to it" (*Fr. Doherty's Evidence before the Select Committee on Destitution in Gweedore and Cloughaneely, 1858* cited in Mac Cnaimhsi 1970: 183).

Booley huts (Bell 2008: 51)[274]. The adaptive cycle heuristic of rundale in figure 3.6 depicts the essential spatial relation between village and booley; accordingly phase r-K, or the foreloop phase of exploitation-conservation, was facilitated by the maintenance of livestock movement, in the absence of restrictions on their seasonal rotation between the outfield commonage and the infield arable. Once crops were harvested, it was therefore essential that the entirety of the infield should receive the benefits of stock manuring; hence, an absence of fixed boundaries served not only to facilitate the continuity of communality, but also to equalise nutrient distribution across infield plots. In Co. Mayo, MacParlane observed; '...among the villagers...their only fences are bad ditches, made of sods' (1832: 71).The ubiquity of this practice in Donegal is borne out by the ordnance survey memoirs of 1835 which note, of the Parish of Clondavaddog; 'Run and dale keeps down the fences...Hundreds of acres may be seen without an attempt at an enclosure and it is, without exception, the worst fenced district I have yet met with' (Day and McWilliams 1997 [1835]: 6). The following image from the Robert Welsh collection illustrates the essential physical form of this arrangement; hence the use of mearing stones which were sufficient to demarcate territory, but not so robust as to restrict stock movement between plots.

Plate 8.1

Field plots demarcated by mearing stones[275]

[274] Herders living in booley huts during the outfield summer grazing months engaged in butter making, and the production of 'whitemeats', or by-products of the milk such as curds and why (Evans 1967a: 53).

[275] Welch, Robert. 1906-1914. "Grass Farm in Kilree, Co. Mayo showing lines of old undivided holdings." *National Library of Ireland, The Congested Districts Board Photograph Collection*, CDB25

According to McCourt (1955), the openfield system was particularly suited to regimes of intensive oat growth, the stubble of which provided sufficient winter grazing, and thus permitted a pattern of continuous cropping on the same arable plots. Fallowing was uncommon, and the introduction of wheat and green crop was difficult, owing to the necessity of sowing wheat in autumn, which would have critically interfered with winter pasturing, whilst an absence of plough technology ensured that green crops were kept from tillage until later into the nineteenth century (Slater and Flaherty 2010: 18). Consequently, the resilience of this particular mode of cropping depended intimately on the unrestricted movement of stock, and although an efficient mode of collective resource maximisation, in light of accounts provided above attesting to the high historical prevalence of ecological perturbation across Ireland, such a system doubtless occupied a particularly tenuous position relative to its counterparts, dependent as it was upon a diverse array of variables for its viability.

Within the matrix of elements conspiring to maintain infield fertility, the rundale system depended upon a particular mode of intensive cultivation based on the construction of ridges known as 'lazy beds', which have been given cursory attention in chapter 7. Ubiquitous as a contemporary archaeological survival of rundale, the lazy bed integrated well with the modes of intensive spade husbandry employed under rundale. An experiment recorded in an appendix to the Devon Commission attests to its productive superiority;

> "Six ridges were laid out, four feet wide, with two feet furrows – an equal quantity of manure laid down for each. Two ridges were planted, the cuts being laid thick, without any regularity, according to the usually mode of planting lazy beds; two ridges had the cuts placed in tows fourteen inches apart, five sets in each row; and two ridges, according to Mr. Barklie's plan, rows seventeen inches asunder, five sets in each row...I had the potatoes dug and weighed on the 14th instant, and I find the return to be as follows: -
>
> From the old mode of planting.....87 stone
> " those in rows at 14 inches.....97 stone
> " those in rows at 17 inches....103 stone
>
> So I find that the plan recommended by Mr. Barklie for planting potatoes in lazy beds, is the best as yet known in this country, not only for the produce, which is the chief object, but throughout the whole season there is decidedly a great advantage in every operation which takes place, from the very time of planting them to the time of digging them. The ridges take less seed, require less labour, they can be freed from weeds with greater ease and less danger to the tender stalk, and dug with greater facility, and without the slightest injury from the spade"[276]

[276] *Devon Commission...Part II.* 1845 [616] xx, Appendix 30, p. 108. Jonathan Bell cites observations from Arthur Young, suggesting that lazy beds yielded to prolific a volume of crop, that they were, in places, used by gentlemen farmers; 'Mr Herbert has cultivated potatoes in the common lazy-bed method, upon an extensive scale, and he is convinced, from repeated experience, that there is no way in the world of managing the root that equals it...by the

The lazy bed was particularly suited to the exploitation of marginal lands which often consisted of shallow soils, given that the formation of the ridge itself, through the incising and stacking of sods served to increase soil depth and facilitate drainage through the resultant furrows. Furthermore, it was inherently adaptable to local morphology, the course of ridges typically following contours in order to maximise their drainage capacities. Ridge height was variable according to local requirements, as was its width, which could be adjusted to accommodate corn, as well as potatoes (Evans 1967b: 120; McCourt 1955a: 372). As noted in chapter 7, the ridge exploited underlying humus, and decaying grass, whilst preventing tubers from becoming waterlogged by raising the seed above the water table (Evans 1967a: 143). During planting, manure could be selectively applied to seed, following the turning of sods; 'Seaweed, farmyard manure or, in recent times, artificial manure...is spread over the broken-up strips. The seed is spread. In the case of potatoes, the cut tubers are laid directly on the manure at suitable intervals. Grain was sown by taking pinches of the seed between the thumb and finger tips and casting these straight down upon the ridges to obtain an even spread, or by putting pinches of grain into holes made with a dibble' (O' Danachair 1970: 53). When combined with reclamation practices such as paring and burning, which secured additional supplies of phosphates by burning pared sods, and spreading their ashes upon the arable infield; periodic outward expansion, along with temporary boosts of yield was made possible, given the ready availability of pooled labour as was required in order to efficiently undertake such exercises (Evans 1976: 62; Lucas 1970). In Mayo, beds were typically prepared by burning furrows, followed by the manuring of beds with the ashes of the burned clay, which enabled the production of one crop of potatoes and oats with very little additional manure (MacParlane 1832: 71).

There is considerable evidence that selection of particularly prolific seed variants – particularly of potato – was employed in order to maximise returns, and experiments later reported in the Department of Agriculture's Technical Instruction Journal noted that selection of prolific seed variants produced remarkable differences in yield (Davidson 1922: 378-379). In many cases, the lumper potato was preferred due to its prolific output, albeit with a critical susceptibility to blight (Downey 1996: 102)[277]. The following image depicts the setting of ridges, and illustrates

early nineteenth century some agriculturalists were claiming that larger crops of potatoes could be obtained from lazy-beds than from potatoes grown in raised drills' (1984: 90).

[277] The lumper was criticised extensively in the comments of medical dispensarians to the poor inquiry, noting its tendency to produce '...the worst kind of indigestion'. In the Erris dispensary, the local diet of 'sale fish with a bad description of potato, called lumpers' was singled out for specific mention (*First report from His Majesty's commissioners for inquiring into the condition of the poorer classes in Ireland, with appendix (A.) and supplement.* 1835 [369] xxxii, p. 180). At Outerarde [sic] dispensary, the dispensarian observed; 'I have found that species of

their inherent adaptability to morphological nuances; the furrows permitted efficient down-slope drainage, whilst the height of the bed and underlying sod prevented downward leaching of nutrients

Plate 8.2

Setting of lazy beds[278]

The viability of this system, as noted above, thus depended on a successful interaction of elements under the auspices of communality. As the nineteenth century wore on however, number of crucial interventions in the grazing cycle came to bear in a profound manner upon the rundale system. The coefficients of table 7.15 on consolidation (overthirty_chg2) have noted that this particular parameter exerted a significant negative effect on yield, and its seasonal consistency. The structural regimes of table 8.7 also show that consolidation and fragmentation were distributed to varying extents and in varying configuration across regimes of higher communality, a factor of particular importance to the unions of Ennistimon, Kenmare and Scariff. However, the preceding discussion of section 8.1 has suggested that the

potato called lumper cultivated in boggy soil, or newly reclaimed ground, and rape ground, to promote disease' (Ibid, p. 179).

[278] Welch, Robert. 1906-1914. "Girls Setting Seed Potatoes, Breaking Clods with Spade, Glenshesk, Co. Antrim" *National Photographic Archive,* Image kindly supplied by Dr. Jonathan Bell of the Ulster Folk and Transport Museum

encroachment of notions of private right, imposed from without upon the commune by opportunistic agents, and the annexation of common grazing lands led to a crucial disruption in the metabolism sustained within the system of infield-outfield rotation. As a case in point, Evans remarks on enclosures and subsequent hardships endured on the Hill estates in Co. Donegal;

> "It was in the outfield that the tenants found readily accessible grazing and enjoyed rights of turbary, but it was also utilised to grow occasional crops on shifting plots of ground, often prepared by burning the surface sods. It was claimed that the outfield sometime provided as much corn as the infield, which was kept in permanent cultivation with heavily manured crops of potatoes and oats...In 1841 Lord George had reserved 12,000 acres of mountain grazing – nearly half the area of the entire estate – for his own use, employing two herd to look after his livestock. There were no fences, however, and any cattle found straying on the portion thus 'stolen by the landlord' were impounded. Matters came to a head in 1855 when he let portions of the mountain to Scottish graziers who imported large numbers of sheep. The tenants complained that they had no grazing land 'except the ridges, waste patches and roadsides' (Evans 1971: xiv-xv).

By 1857, Hill's transgressions had come to the attention of the houses of commons in a petition from local Gweedore priest, Fr. Doherty, where he declared;

> "That the landlords, who are the only magistrates in the district, have with one exception entered into a combination to oppress, rack-rent, harass by taxation, and by a corrupt administration of the law and other means, your memorialists from the face of the earth to make way for sheep. Our unhappy memorialists are confirmed in this belief by the following facts: The mountains round their farms are taken from them. They are now reduced to misery, and are oppressed by rents and taxes enforced by their landlords, who are also the administration of the law. At the head of this combination of magistrates is Lord George Hill" (Doherty 1857 cited in Mac Cnaimhsi 1970: 187).

Numerous instances of the undermining of communal regimes are noted in the Devon Commission, such as the case reported by James Donleavy, holder of 'four cows grass' in Glenties, Co. Donegal. Complaining of want of capital, elevation of rents above poor law valuation levels and heavy cess obligations, Donleavy refers to the practice of seizing the property of a neighbour held liable for the arrears of another;

> "51. Do you mean to say that an agent in this country can drive one man's stock for another man's rent? - Yes
> 52. Even without a joint lease? – Yes
> 53. In what case have you known it done? – I saw four cows belonging to Edward McCabe, sen., impounded and auctioned for the arrear due by another man, who was his brothers son. That was in the last winter.
> 54. How long were those arrears due? – I cannot say.
> 55. On whose estate? – The Marquess of Conyngham's.

> 56. Were the parties joined in the same farm? -The two brothers were joined. The eldest brother died and the son became his heir, and he fell into poverty and the uncle's cows were taken."[279]

Coupled with the privatisation of fertiliser sources noted in discussion of the above regimes, many agents were quick to appoint bailiffs to shores in order to check the removal of seaweed, a prolific source of fertiliser. On the Leitrim estates, bitter disputes erupted between neighbouring tenants over the construction of a wall between an adjoining estate in Fanad, which blocked right-of-way to the shore (Mac Cnáimhsí 1970: 184). Therefore, despite the inherent adaptive capacities of the plethora of techniques mobilised under rundale, the presence of contextual constraints, such as those detailed above was critical in determining its resilience. When the pressures of population came to bear, in the context of restrictions to outward expansion, and the ever-increasing necessity of money in order to meet a host of new charges such shore tariffs, the result was a critical diminishing of resilience, as the rundale gave over more of its increasingly parcellised lands to the production of cash crops, and sought to reduce its subsistence to the most prolific, yet ultimately most disease-susceptible varieties of potato crop. Under this regime of constraint and continuous cropping, it is not surprising that returns tended to diminish; thus the commune, as it transitioned through the stages of its adaptive cycle, came to depend on this form of expanded communal production which tended inevitably toward soil exhaustion. In the most extreme cases, where the effects of enclosure set in particularly early, settlements were effectively pushed onto more marginal uplands; 'By 1720, the demand for store cattle from the south had reached us (in Connacht) and the breeding business grew more profitable. Many villagers were turned off and the lands which they had occupied were stocked with cattle. Some of these village tenants took mountain farms but many more went away. About 1726, the graziers, encouraged by the markets, first raised the price of land in order to cant all the cottagers out of their farms' (Whelan 1999: 78). In terms of identity, the contradictions of enclosure and privatisation thus served not only to direct the system toward an increasingly tenuous domain of attraction, but also to induce movement toward thresholds of identity loss, as an essential catalyst of systemic change. The essential components of the field system struggled to maintain efficient share allocation, whilst its productive activity and composition became ever more complex. Mediating this assemblage of constraints, the social institutions of rundale in turn struggled to maintain their essential principles of equality of access under increasing conflict.

[279] *Devon Commission...Part II.* 1845 [616] xx, p. 152

8.2.2. Governance and conflict

Contrary to idealised depictions of rundale, such as those addressed in chapter 6 under the 'residual-communal' subheading, life under rundale was, in many cases, characterised by a degree of internal dispute. In his pronouncements on the modes of production of primitive communism, Marx remarked on the capacities of its characteristic individual-communal dualism to '...endow it with a vigorous life' (Marx 1983 [1881]: 120). It is therefore of note, that recent work has emphasised not the harmony of communal life, but rather its inherent conflict. Ostensibly, the central mechanism of governance under rundale resided within the communal council, deputed headman, or 'king'. In his travels in Erris, Knight (1836) remarked on the role of king, to whom responsibility for the deputation of improvement works, and the handling of rents resided. The required qualities of the king are summarised as follows by O' Danachair;

> "As to the qualities desired in the king, we are not left in any doubt. Stature, strength, comeliness of person are mentioned, as are justice, wisdom and knowledge. Literary attainment is desirable; a good talker, a good storyteller, knowledge of two languages, the ability to read and write, all of these were laudable in the King. A degree of economic well-being or independence was also thought fitting. He had very positive and definite functions. The regulation, division and apportioning of fishing and shore rights and the allotment of tillage and pasture land was left to him, and in some cases, he appointed subsidiary officers such as herdsmen. He was expected to maintain traditional laws...in some instances we are told that he specifically punished wrongdoers. He was expected to speak for his community in their relations with the outside authority" (O' Danachair 1981: 25-26).

In his commentaries on Westmeath in the seventeenth century, Piers refers to a surviving law or Brehon code which entitled the tenantry to seasonal seed from their landlord, were he unable to provide labour for the harvest (1682: 119), and on Tory Island, Robin Fox (1966) gathered numerous observations concerning the islanders' regulation of land access rights through kin-reckoning, where he states that in the case of arising land disputes, the islanders had recourse to a 'king' to resolve their claims; 'an appeal would be made to the "king" (An Rí) to sort them out…whether or not his position was hereditary or elective, no one remembers. In the old days, they say, he would have had to have been of a 'royal' (Brehon) family' (Fox 1978 cited in Ó' Danachair 1981: 24). Tory itself must be considered an exceptional case in point, as the island itself appears to have been capable of adequately absorbing subdivision, as Fox notes an overall decline in population, and rise in the number of owners (Fox, 1966). Intriguingly, allusions are made to the ability of the tenants to undermine landlord and state right of exclusion, and retain direct control of the means of production. In his later ethnography of Tory, Fox remarked on

the autonomy of the King of Tory regarding the regulation of access to items of some contention within other regimes noted in section 8.1;

> "The king of Tory was probably a true descendent of the old Brehons – the lawgivers: those who knew the customary laws and usages particularly with reference to inheritance...The "Eldest Duggan" was already the ritual leader of the island...He recited the prayers on Sunday mornings in front of St. john's alter, when there was no priest on the Island. The king – as on other islands – was primarily an arbiter of land and shore disputes; the shore being as meticulously divided as the land itself, and like the land periodically redistributed: Common opinion has it that this was annual" (Fox 1978: 16)

In his earlier observations, Fox noted that the interventions of the Congested Districts Board were limited to the east town, leaving the main townships of Tory largely intact. The nature of limited subdivision on Tory in particular, checked the worst excesses of monoculture subsistence, given its inherent flexibility in the absence of external constraint. Later, landlord consolidation ended Tory's annual/triennial plot redistribution consistent with past rundale forms: 'Left to themselves, however, the islanders had probably to evolve some novel controls to replace landlord supervision. In this, kinship was perhaps important...' (Fox 1966: 2). Fox's account thus raises the curious possibility that under favourable conditions, the mechanisms of communal governance, as an inherent component in the overall adaptive capacities of rundale, was sufficient to ensure resilience by virtue of its ability to maintain equity. Comments on similar locations of comparative autonomy serve to corroborate the relatively placid mode of existence in locations where outside interference was not an issue, as the following comments on the Donegal Parish of Mevagh in 1835 suggest; 'The present race are a fine-looking, robust people, subsisting on the produce of the land and seas, but apparently unaided by their landlords, farming societies, government fishing, bounties of private premiums. There are no ancient customs among them except run and dale, no peculiar tenures or legal disputes about rights of land, but all complain of high rents and taxes (general throughout the north of Ireland)' (Day and McWilliams 1997 [1835]: 59)

Under conditions less comparable, or indeed favourable to those of the relative autonomy enjoyed in locations such as Tory, the result was decidedly different. On the counties bounded by the clustering exercise attempted in section 7.1, McCabe (1991) noted unusually high levels of homicide and petty crime prosecution in Mayo and Galway. According to McCabe, 'Rates of common assault (cases at petty sessions) in Mayo outdid those of all other Irish counties (698 per 100,000). The nearest to approach these rates were Longford (685), Galway (643), Clare (633) and Kerry (623).' (1991: 64). Of particular relevance is the manner in which McCabe deals with the encroachment of modes of civil arbitration upon the customary frameworks of rundale in the early nineteenth century. Contrary to depictions of rundale as exhibiting little

concern for notions of property or proprietorship, McCabe's analysis claims; "That the villagers had in fact an astute and unabashed regard for the right of property explains, what was to Wakefield, a mystifying penchant for 'continual wrangling...for trifles scarcely worth a straw' which seemed not to fit with 'the boasted generosity of the Irish character'" (1991: 384). In cases of minor dispute, arbitration was often enacted under the auspices of the commune's governing institution (king or council);

> "The principal cases of crime handled within the village were assaults and thefts. It was particularly important that theft was seen to be dealt with effectively as this was an offence corrosive of village solidarity. The village code urged respect for private property together with willingness to share. If an offender owned up to a theft then the article would be returned, or if consumed, money would be awarded under arbitration as a penalty" (McCabe 1991: 390).

With regard to cases of minor transgression within the commune, the internal institutions of communal governance thus appear to have been capable of adequately coping with a natural degree of petty crime. Under the decree of Chichester discussed in chapter 6, inheritance under gavelkind was rendered illegal; on this point, McCabe draws attention to a fundamental discontinuity between the principles of civil and customary law, insofar as the former were incapable of quickly mediating in such a harsh, variable environment, whereas the latter were ill-equipped to cope with the considerable vagaries of subdivision inherent under rundale, which often rendered complex physical arrangements in cases of boundary dispute. Furthermore, the conditions under which commissions of peace were awarded did not engender a sense of confidence or equity in the tenantry, given that such appointees to the magistrate's bench were often local nobility with little formal legal training.

Nonetheless, the impression from official statistics is one of a state of abundant conflict; a summary of complaints presented at Westport petty sessions in 1823 for example, lists 95 cases of assault, 32 of theft, 33 of trespass, 31 of land dispute, and 11 of property dispute (McCabe 1991: 428). The dominant sense is one of a profound state of conflict between competing modes of legal reckoning - those of the civil and customary code which, as noted above, formed a particular locus of contention where components under communal regulation, such as shore and grazing rights, engendered conflict when met with competing notions of private right from without. Consequently, despite the inherent adaptive capacities of the institutions of governance under rundale, insofar as their presence functioned as a hedge against internal dispute; aforementioned instances of interference from without appear to have imbued a system prone to minor conflict with a particular susceptibility to dispute which doubtless cut to the very foundational principles of egalitarianism on which the system depended for its resilience and

reproduction. Indeed, it was suggested in chapter 4 by Orebech (2005) that modes of customary governance antithetical to those of civil law were, in cases, capable of augmenting adaptive capacity due to their ability to develop tacit rules based on local systemic feedback. Such rules were clearly already conducive to minor dispute in the Irish context; 'The least trifle is a cause of disagreement. They were formerly quarrelling about their share of stock, and about what ground should be tilled, and who should occupy the different parts of it' (McCourt 1947: 233). McCourt also provides evidence from fieldwork in the Sperrin mountain region, specifically that of Patrick Deany of Ballyrory which states; 'There were no fences at that time and cows were continually trespassing on neighbouring plots, so that fights were common in the community' (McCourt 1953: 70).

In the case of rundale, it appears that these inherent tendencies were, in cases, amplified by the contradictions of individualism which manifested both within, in the form of internal boundary disputes, and without, in the form of privatisation and enclosure. As Dowling concludes, in consideration of the elimination of rundale within the estates of the Drapers company, context both micro and macro determined the extent of conflict, rather than any intrinsic tendencies of competing modes of tenure; 'The judgement by estate managers against the rundale system masked the real reasons for the internal strife of rundale communities: the strain of reaching the productive limits of the land and the enormous macroeconomic disaster facing heavily indebted smallholders' (1999: 198). As a concluding movement of progressive descent from the institutional to the concrete, the final component of this examination of resilience from within thus addresses the lowest level of systemic aggregation and contradiction; that of the habitation and physical wellbeing of the commune inhabitant.

8.2.3. Health and living conditions

Commenting on the Parish of Mevagh, Lieutenant Lancey of the Ordnance Survey offered the following remarks on the habitations of the local tenantry; "They live in low stone cabins with glass windows and thatched roofs bound down with straw ropes...The cabins consist of 1, 2 or 3 rooms. those of 2 rooms prevail. They are not clear or comfortable...The food of the people is potatoes, water, milk and some meal. Most people keep a cow and all burn turf and a little bog wood" (Day and McWilliams 1997 [1834]: 27). There is little doubt that the living conditions singled out in Lancey's comments, such as were engendered under extensive subdivision, and high-density clustered habitation, were derided by agricultural and medical commentators of the time not merely for their levels of comfort, but for their facilitation of the passage of disease. The rapid spread of fever following an outbreak in 1817 was quickly attributed by the

Select Committee on the Contagious Fever in Ireland to conditions of overcrowding engendered by rapid population growth[280], and a report of Dr. John Crampton (1819) on the state of disease in Conaught [sic], suggests that the rural poor of Galway were especially vulnerable to harvest failures which, in the absence of alternative sources of income through employment, led to extensive shortages of food and fuel. Such settlement forms as existed under rundale, tended to spring up on peripheral lands where subdivision was either tolerated or impossible to check, but were also particularly vulnerable to the vicissitudes of the Atlantic climate, all of which wrought damaging consequences on the physical wellbeing of their inhabitants;

> "In the suburbs of Loughrea fever prevailed much, also in the mountain villages which are situated on swamps and bogs. Loughrea is much exposed to cold damp winds, which blow across the lake from the south-west; and a considerable quantity of rain falls there, from the vicinity of a mountainous range to the southward, which attracts the clouds"[281]

There appears to have been a degree of functional imperative to the clustered habitations characteristic of rundale however; such nucleation was an inherent result of the pace of subdivision under the openfield system, which mandated the collective maximisation of infield space in a single location, and the concentration of fertiliser within the core tillage zone. Furthermore it was suggested by Evans (1967a, 1979), that the layout of the clachán itself was often oriented to local topography in order to maximise sunlight capture, and to minimise the effects of wind shear in inhospitable climates. In certain cases, livestock were brought into houses during the winter infield grazing season, which in turn gave rise to a characteristic style of house construction known as a byre dwelling; 'The space at the opposite end of the house from the hearth was often partitioned off and use as a store-room and, subsequently, an additional bedroom. Before partition this space may in numerous cases have serves to accommodate livestock. In this way the three-roomed plan was established...The location of the hearth away from a line of the doors in the western house as well as existence of the double doors must be linked to the continuation of the habit of accommodating livestock in the dwelling' (Aalen 1966: 51, 58). On Rhaitlin Island, village architecture consisted of a 'direct-entry' style of building, which appears to have evolved over time to partition livestock within the dwelling, and eventually, to exclude them completely (Forsythe 207: 229). The 'byreing' of livestock thus satisfied a number of ecological functions; by containing animals within the house, a primitive source of heating was offered during winter months to inhabitants, whilst

[280] *First Report from the Select Committee on the Contagious Fever in Ireland.* 1818 [285] vii

[281] *First Report from the Select Committee on the State of Disease, and Condition of the Labouring Poor, in Ireland.* 1819 [314] viii, p. 42

also facilitating the collection of manure. Indeed, it was characteristic of many habitations within the clachán to maintain a 'dung heap' outside the front door, which was a critical exercise, given the necessity of selectively applying manure to lazybeds during the sowing of crops (Slater and Flaherty 2010: 29).

Comments from the Poor Inquiry on conditions in Co. Mayo further underscore the precariousness of habitations, in which interiors were often plastered with dung, and barely capable of withstanding inclement weather. On the Parish of Kilcommon, Co. Mayo; 'Badly built, open to the rain and wind; in general there are few exceptions. Some have beds and bedding but not comfortable in the eyes of a stranger; all are filthy in the extreme, even those who are above want, and could well keep themselves and houses clean'[282]

In his comments to the poor inquiry concerning causes of the spread of disease, Edward Kelly of Loughlynn dispensary, Co. Roscommon offered the following observations on the effects of close confinement and poverty;

> "It is not easy, in a report of this kind which must be limited, to convey the distress of the poor in my district; they are generally in great want and misery; their food and clothing as bad as can be; their houses or cabins miserably bad and dirty, and their night-covering wretched in the extreme; perhaps one indifferent blanket and sheet to cover a family of six, a cold winters night on a straw bed; fresh meat they scarcely ever taste; and very many of them seldom have milk or butter, and are therefore obliged to live on potatoes and salt, their furniture scarcely deserves the name, being only a very few indifferent articles of the poorest kind"[283]

Furthermore, comments abound within the report appendices of extensive overcrowding, with multiple families often co-resident within a single habitation. A state of poor ventilation was doubtless compounded by the presence of taxes on additional windows, of which MacParlane noted; 'The richest of the yeoman farmers have not a second hearth, nor windows to subject them to that tax' (1832: 66). Doubtless, such depressed standards of habitation, coupled with their tendencies toward overcrowding were not conducive to epidemiological resilience, as suggested by the dispensarian of Riverstown, Co. Sligo;

> "All fevers and epidemics assume a worse type and generally have their origin among the poor; the cause of this seems to be their extreme poverty and filthy mode of

[282] *Poor inquiry (Ireland). Appendix (C.) – Parts I. and II. Part I. Reports on the state of the poor, and on the charitable institutions in some of the principal towns; with supplement containing answers to queries. Part II. Report on the city of Dublin, and supplement containing answers to queries; with addenda to appendix (A.), and communications.* 1836 [35] [36] [37] [38] [39] [40] [41] [42], p. 25

[283] *First report from His Majesty's commissioners for inquiring into the condition of the poorer classes in Ireland, with appendix (A.) and supplement.* 1835 [369] xxxii, p. 181

> living...Clothes of the worst, and sometimes naked; food the coarsest, and even that very scanty; bedding and furniture bad and filthy; ventilation none, except what the door admits. Of all human beings, there are none more void of comfort"[284].

The question of the dietary adequacy of the poor is somewhat more contested however. Medical reports are rife with condemnations of the potato diet, claiming that it gave rise to severe indigestion, and other forms of digestive discomfort; "...hundreds, perhaps four-fifths of my cases are immediate or remote gastrointestinal irritations, induced by the unvaried consumption of the potato, which is too frequently eaten in a part boiled state, and without even the adjunct of milk"[285]. The dietary adequacy of the Irish poor is, however, asserted in the work of Clarkson and Crawford (2001) who note that although excessive boiling of the lumper gave rise to loss of weight in the cooking process, the ingenuity with which the peasantry exploited their food sources was considerable; '...people threw away as little as possible. Bones were boiled to make soup, bacon fat was rendered down and used to flavour cabbage and other foods' (Clarkson and Crawford 2001: 171). The protein content of the nineteenth century diet was even on a par with that of the following century; 'Individuals in labouring families in 1859, eating Indian meal, bread, potatoes and milk, obtained 44 per cent of their protein from meal and bread. By 1904 the protein content of labourers' diets had fallen by roughly 25 per cent compared with 1859...The quantity of protein eaten before the famine had been high because of the large consumption of potatoes' (Ibid: 184).

Despite the physiological resilience afforded by diet however, the nature of living conditions, as detailed above, conspired to mitigate any beneficial consequences. The close, confined conditions characteristic of the rundale clachán exacerbated both the prevalence and severity of communicable disease, and the following comments offered by medical superintendents throughout 1846 draw many connections between the cultivation practices, habitations and living conditions prevalent amongst those dwellings of lower standard. They also make reference to the capacity of diet, despite its attested calorific adequacy, to exacerbate gastrointestinal symptoms.

[284] *Ibid*, p. 183

[285] *Ibid*, p. 178

Table 8.11. Physiological and epidemiological implications of food shortage, 1846[286]

County and Date	District and Medical Officer	Comments
Armagh, February 16, 1846	Markethill, John M. Lynn, M.D.	Fever, diarrhoea and dyspepsia have increased considerably, and are in many cases traceable to the use of unsound potatoes. It is very probable that fever will break out and spread, especially among the lower orders.
Kerry, February 16, 1846	Dingle, Robert Hickson, M.D. & George Williams	A great increase of fever and small-pox. The number of patients at dispensary increased one-third. A thousand labourers unemployed in district. Fever very rife. No fever hospital within thirty miles. Suggests the giving of employment and the establishment of a fever hospital; the poor in district having generally but one bed, and therefore obliged to sleep together.
Limerick, February 28, 1846	Murroe Dispensary	States that fever of a fatal character is more prevalent than usual, which he attributes to use of unwholesome food, extreme wetness of the winter, together with bad night covering and confined air. Potatoes not fit food for man or beast. Two-tenths of labourers unemployed, dreads the breaking out of disease.

The core problem, in many cases, was undoubtedly proximity, and the presence of fever within a single cabin often persisted for weeks in the absence of adequate ventilation. In 1813, a particularly virulent outbreak of typhus befell Ireland; '...its most alarming symptoms were sudden prostration of strength, discoloration of the skin, and diminished temperature, congestion in or excessive haemorrhage from the bowels, and alternately with these, coma, sometimes delirium tremens – putrid peripneumonia, extensive dark petechiae, with ecchymyosis and bubonic tumours'[287]. Typhus is caused by microorganisms which are transmitted between humans through louse which enter the skin through minor cuts, or by inhalation, and the lice themselves thrived in the cramped, overcrowded conditions of the poor as noted by medical superintendents in the above table (Geary 1995: 75).

[286] *Disease (Ireland). Abstracts of the most serious representations made by the several medical superintendents of public institutions (fever hospitals, infirmaries, dispensaries, &c.) in the provinces of Ulster, Munster, Leinster and Connaught.* 1846 [120] xxxvii, p. 2-8

[287] *The Census of Ireland for the Year 1851. Part V, Table of Deaths, Containing the Report, Tables of Pestilences, and Analysis of the Tables of Deaths.* 1856 [2087-I & 2087-II], p. 172.

As a result, despite the pretensions of habitation to engender efficient resource exploitation, and the apparently adequate calorific content of the labouring diet, it appears that the tendencies typical of rundale, such as the proliferation of subdivision, accommodation of members within the community, the housing of stock and the accumulation of dung, merely gave rise to a configuration of conditions optimal for the proliferation of disease. As such, the adaptive capacities of their residents, in terms of their physiological resilience to infection, were critically compromised to the extent that such districts bore the brunt of mortality in times of epidemic, and indeed during the famine of 1845-1852. Consequently, having transcended through myriad levels of aggregation and abstraction within this chapter, a point has now been reached where the manifest tendencies of compromised resilience at the level of individual physiology, may be contextualised as embedded within the panarchical configuration of the complex rundale system itself. Reduction of dietary diversity is thus manifest within the aforementioned tendencies of biodiversity reduction, and a comparative preponderance of subsistence on the potato as a consequence of the growing necessity of commodity production, which in turn compounded the capacities of land to yield sufficient produce under the metabolic rift. To conclude, a degree of summary conceptual order is imposed on the process by which the rundale ultimately transcended its individual-communal dualism, toward a critical loss of systemic identity.

8.3. Was the rundale system sustainable? - transcending the individual-communal dualism

A core element of the apparatus of resilience heuristics, and indeed of constructivist environmental sociology, is its contention that the assessment of what might be termed ‘sustainability’ is not possible through conventional ‘engineering’ approaches to resilience which assess systemic integrity in terms of return times to base-state parameter values. Instead, it is rooted in a mode of assessment centered on the multidimensional concept of identity, which mandates analysis in terms of; ‘...the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks’ (Walker 2004 cited in Grimm and Calabrese 2011: 8). In terms of identity, the preceding configurations have revealed that resilience, as tentatively captured by comparative extents of ration uptake and yield, manifested in a variety of ways, under a variety of possible regimes contrary to the contentions of the archetypal models typically deployed in conceptions and theoretical pronouncements on rundale, as discussed in chapter 6. On the basis of the foregoing explication of adaptive capacity across institutions and practices however, it appears that the rundale mandates consideration of a form of resilience not readily explicable

with conventional panarchical heuristics. Instead, the diversity of practice under rundale points toward the significance not only of cross-scale interactions across organisational levels as depicted in figure 6.1, but also toward the presence of differential conditions of *lateral* or horizontal resilience, conditioned by factors such as the range of practices inherent under the openfield model, modes of customary governance, the physical form of the village itself, and individual physiology. Accordingly, the preceding discussion has emphasised not only attention to conventional 'hierarchical' forms of systemic conceptualisation, such as the interaction between economy, state and locality, but also the necessity of considering resilience in terms of discrete analytical levels, such as those of the household (in terms of epidemiology), the cultural institutions of governance (in terms of their ability to mitigate dispute), and the field system (in terms of its capacity to sustain yield through intensive cultivation practice).

Furthermore, on the question of the decline and eventual elimination of rundale, it is clear that the dynamics of decline were quite variable from location to location; on Rhaitlin Island, rundale remained the dominant mode of land organisation well into the twentieth century (Forsythe 2007), and questions abounded within Dáil Eireann in the 1940's concerning the need to impose regulatory guidelines upon common grazing lands in the West of Ireland, which still employed children as seasonal herders. Following passage of the land act in 1950, the land commission were confronted with a complicated litany of scattered plots which often led to complex litigation; 'The 1950 act also attempted to address the rundale problem...In 1951 the land commission admitted that the rearrangement of these communal strips of land to form compact viable holdings was 'extremely intricate and tedious, and requires much tact, discretion and skill to formulate proposals which will be practicable, and at the same time, will be acceptable to the tenants' (Dooley 2004: 159). In certain cases in the nineteenth century, the dynamics of elimination were somewhat more abrupt; as noted in chapter 6, the Ballykilcline rent strike of 1848 was ultimately resolved by the visitation of blight, which rendered the tenants incapable both of meeting their arrears, and of providing for their own subsistence. Orser (2006b: 180) has also offered evidence attesting to the eviction of between 200,000 and 250,000 individuals during the famine years. In such cases, the rundale system was particularly susceptible to encroachment; medical reports attest to the virulence with which disease spread through the congested districts, and estimates place the higher-density rundale regions toward the upper tail of famine mortality distributions (Almquist 1977).

During the Ulster plantations, conditions of subsumption were more straightforward, where landlords exercised absolute right of control over all lands within their estate, under which they forcibly sought to eliminate rundale, serving as it did to dilute their political powers (Dowling

1999: 180). Furthermore in Ulster, the conditions under which communality eventually became subsumed beneath individualism were more gradual, as landlords often forced changes in productive activity over generations by stipulating clauses in leases concerning appropriate methods of cultivation and enclosure (ibid). Although it is not within the remit of this thesis to explicate the dynamics of post-famine decline, limited as this discussion is to an examination largely of the ecology of pre and intra-famine rundale; in terms of systemic identity, it is clear that the system was, throughout the time covered by the preceding quantitative data, undergoing profound and varied changes in the integrity of its institutional configurations. Population growth and fragmentation taxed the capacities of the system to confer seasonal yield consistency, and the vicissitudes of socioeconomic change and landlordism, conspired to confer an ever-increasing necessity for cash realisation on the part of the tenantry. The productive strategies on which the system depended, intervened to facilitate temporary solutions to the problem of diminishing returns, augmented in certain locations by subsidiary industry, but this doubtless compounded the internal ecological stresses inherent under rundale.

As a case in point, Buchanan (1973) and Dowling (1999) empahsise the critical factor of continuous cropping, and the necessities of balancing root, corn, and livestock within a single, ever-expanding system;

> "Buchanan organises evidence from *A view of the great tithes of the deanery of Down for the year 1732* to distinguish partnership farms from individual farms...There was no difference between the two forms of tenancy in the cultivation of subsistence crops, and very little difference in the cultivation of cash crops, wheat and barley. For both, a high proportion of land, 45.1 percent, was devoted to cash crops, and in fact, partnership farms devoted proportionally more land to wheat cultivation. Buchanan argues that this wheat cultivation must have put a severe strain on the livestock-producing capabilities of the rundale system, since it must have reduced the availability of winter pasture. This may be one explanation for the severity of harvest crises early in the century, with cattle hard pressed to survive what was routinely a hungry winter" (Dowling 1999: 187)

It must be remembered, that the above dynamic presents at a time when population pressure was at considerable ebb; it was not until later in the century that the rundale fully began to exert its demographic capacities, where populations sprung forth on marginal grounds, buoyed by the prolific capacities of the potato. As the potato assumed greater importance in cropping rotation, and as oats became eliminated from diet and consigned to the market (Whelan 1999), it is not difficult to envisage a growing decrease in the magnitude of perturbation required to induce systemic collapse, loss of identity, and a profound regime shift as illustrated by the adaptive cycle. Indeed, the preceding regression analysis has shown how the disastrous response of a shift away from corn toward potato in 1849 was exacerbated concentrically according to extents of communality. Furthermore, this negative relationship, in terms of changes in productive

structure, was tempered in other statistical models by the presence of greater extents of uncultivated lands and subsidiary industry. In context of a countrywide decline in fertility under intensive cropping, which was often continued without regard for fallowing, the magnitude of resilience loss induced by such regimes cannot be understated.

Slater and Flaherty (2010) have suggested that the rundale system, based as it was upon maintaining such a balance of livestock and crop in order to ensure uninterrupted nutrient flows was an inherently 'leaky' solution to the metabolic rift. Under the increasing complexities of production required by the system, components such as the reckoning of grazing in terms of collops, and the equalisation of opportunity through plot scattering and distribution became ever more critical. Myriad attempts to thwart its diminishing returns thus appear unsuccessful, in light of the negative relationships noted in chapter 7 between the productive responses of communality, and fertility. The necessities of outward encroachment inevitably undermined this tenuous system of fertilisation further, by altering the critical balance maintained by the institutions of communal governance such as the reckoning of stocking levels by collops, and the setting of bins. McCourt summarises the dynamics of change and decline in rundale throughout the late eighteenth and early nineteenth centuries, such as they served to exacerbate the tendencies noted above by Buchanan, as follows;

> "By the time population reached a peak in the 1830's, holdings in Ulster had become impossibly small, 43 per cent being five acres or less, and only 4 per cent over thirty acres...A situation developed where holdings of diminishing size were expected to produce an increased surplus of cash crop to pay rent. This was achieved in two ways: firstly by combining farming with subsidiary activities...secondly, on rundale holdings, by expanding the outfield to increase the acreage under potatoes, now the main subsistence crop, and devoting more of the infield to oats and barley. The effect was to set off a renewed wave of colonisation. The movement accelerated after 1800 and continued till the Famine, with perhaps some slackening in the recession of the 1820's. Consequently, the grazing-tillage balance, vital for the maintenance of infield fertility, which was already in jeopardy, was completely unhinged" (McCourt 1981: 127-128).

Subsequent to the famine, both state and landlord intervened in order to redistribute the former rundale plots as individual holdings, inducing a new regime which had transcended the communal pole of the individual-communal dualism, and erased all traces of systemic identity. This manifested in a variety of ways, such as planned interventions on the Hill estates (Evans 1971 [1887]), and various forms of government intervention (O' Donnell 1996, 1998). Therefore, although Dowling claims that '...there was no unilinear drift toward individualism and private property embedded in the system', it is clear that the opposing poles characteristic of communal dynamics were quite capable of alternately waxing and waning according to local

circumstance, with decline ultimately arriving in the varied forms of eviction, emigration, or intervention. It further appears that individualism won out 'spontaneously' in cases prone to internal population stress, where the enclosure of outfield and reclaimed commonage began in an attempt to cope with diminishing resilience (Slater and Flaherty 2010: 30-31). This summary dynamic of change is in turn substantiated by Mitchell and Ryan, who note;

> "As the potato expanded to take up the whole of the arable field, it left no aftergrass to feed stock and to receive the dung in return. If stock numbers were reduced, the total amount of manure available for the arable field fell. Ultimately if everyone was not to be reduced below the subsistence level, there had to be movement either up to higher levels up the hill slopes to the east, where potato-patches could still be rented to the further detriment of the existing field, or out of the country altogether to England or America" (2007: 337-338).

On the question of sustainability, no definitive answer may be forwarded; the very porousness of the concept, and its inherent ontological ambiguities concerning the manner in which persistence may be reckoned, renders its operationalisation undesirable. As to the question of resilience, as the capacity of systems to respond to perturbation whilst maintaining systemic identity, it is abundantly clear, on the basis of the foregoing discussion that resilience was distributed profoundly across the category of communality according to the vicissitudes of context. The epistemology of complexity has rendered conceptualisation of the entity of rundale possible, and in the process, resilience has supplied both a methodology of assessment, and a means with which to grasp concrete configurational complexity across the ideal type, in a manner which imparts explanatory validity to the specific dynamics of rundale itself, rather than reified categories of population or economy. In the discussions of this latter volume, the myriad institutions of rundale have offered critical insight into how the vicissitudes of context interacted within this broad systemic identity to the production of differential local outcomes, hence the explanatory utility of the heuristic of 'simple initial conditions'. These differential outcomes may be contextualised as determined, in turn, by the dynamics of metabolic rift endured under the social form of Irish communality. Thus the identity of the mode of production of rundale renders the exceptionalism of its ecology intelligible in a comparative sense. As a final task, the following conclusion summarises the various conceptual and theoretical informants of this thesis, and the success of its modes of measurement, in order to substantiate the generalizability of the methodology here developed.

Conclusion

In their recent paper, Cabell and Oelofse (2012) have reasserted that the complexity of agroecosystems, comprising their internal composition, and degrees of internal and external connectivity, renders precise measurements of resilience decidedly difficult. Deriving transferable metrics for application across different case contexts and indeed for assessing change over time *within* rapidly changing social-ecological systems further compounds this analytical task, suggesting a need both for conceptual openness, and methodological plurality. What makes the resilience approach quite so appealing in this regard, compared to other approaches within established environmental sociology, is its willingness to engage in a concrete sense with the problem of operationalisation, rather than theorising such concerns away through relativist ontology. It is a core contention of this thesis that this latter line of inquiry has served merely to stunt interdisciplinary dialogue, despite the presence of numerous points of conceptual and methodological compatibility between this more recent wave of human ecology, existing approaches to historical analysis rooted in classical social theory, and the promising, albeit under-exploited informants of complexity.

At this point, it is worth reiterating the overall logical structure of the approach employed within these volumes, in order to clarify precisely where future research should be targeted, and which particular debates stand to be enriched - however modestly - by the foregoing contributions. The initial stages of this research were, in contrast to their manner of presentation within this thesis, decidedly empirically driven, and the structure of the foregoing work belies the inverted manner in which research and investigation was carried out. Initially, a range of empirical sources – cartographic, archival and visual – were sought and subjected to scrutiny, in order to elaborate a number of specific, outstanding oddities in the concrete practices of the Irish commune. Components of the system which nominally presented as antithetical to the contextual structures of individualism and colonial administration, initially offered many fascinating points of digression. And yet, the core intellectual issues which form the basis of the initial volume of this thesis, presented only when the need for conceptual clarity became apparent. The apparent homogeneities of structure implied by existing accounts of Irish communality confronted the simple fact that concretely, considerable diversity abounded within the broad case construct of rundale, a situation which in turn suggested a need for greater theoretical attention to the fundamentals of ‘casing’ itself. In pursuit of this goal, the complexities of case material initially threatened to overwhelm the possibility of reduction, and to this end, an alternative route to typology and analysis was sought.

Chapters one to three represent the outcome of a desire to transcend the limited confines of current theory and practice in environmental sociology, whilst developing new conceptual ground through a synthesis of cross—disciplinary informants. Essentially, this alternative conceptual model originated in dissatisfaction with the excesses of actor-network theory which, despite the sophistication of its epistemological grounding, retained on ontological relativism which rendered the task of 'structural' elaboration decidedly difficult. To the actor-network theorist, questions of structure are subsumed beneath an epistemology which emphasises merely the porousness of the natural and the social, and the politics of knowledge and inequality manifest and reproduced in deployment of such concepts in the public sphere. In doing so, the ANT-oriented approach, rather than seeking to articulate an apparatus which seeks to grasp systemic complexity in a comparative sense, instead resorts to a methodology of particularism which denies the ontological stability of the myriad domains of the natural and social. Such an approach renders the comparative task decidedly difficult, given its inherent hostilities to notions of regularity, which in turn form the basis of much case-oriented historical sociology.

The necessities of this alternative avenue of conceptual articulation were further underscored by the seminal works of human ecologists such as Elinor Ostrom (1990), whom had advanced intriguing propositions concerning the abstract potentialities of modes of communality and customary resource governance, given their capacity for tacit augmentation, compared to those of a more individualist, 'top-down' orientation. In asserting such possibilities, a further dimension integral to the approach developed in this thesis was implicated; that of the assessment of qualitative differences of outcome state, in a manner which defied the excesses of conservatism so criticised in Latour's depiction of the modern constitution. The necessity of measurement thus underscored the incapacities of relativism as a foundation for methodology; the informants of complexity and resilience instead assumed these roles, rooted as they were in homologous conceptions of social-ecological systems as panarchically constituted, complex, and yet inherently amenable to representation and measurement. In this sense, chapters one to three affirmed not only the possibility of interdisciplinary dialogue, but further pointed toward a synthesis of informants, to the production of a new methodology.

To this end, chapters four and five sought a means of theorising the dynamics of resource circulation and inequality in terms of their manifestation under historically variant social forms, as concrete manifestations of generalised modes of production. In the process of articulating this informant, the concept of 'metabolic rift' offered a crucial contextual narrative with which

to align the prospect of qualitative state assessment, a core objective implicated in forgoing chapters which in turn permitted not only conceptual articulation, but also the alignment of theory with concrete metric. Ultimately, this synthesised 'metric' resided within a methodological framework of progressive descent and elaboration, involving varying degrees of case-based abstraction and empirical engagement; the success of this mode of inquiry thus hinges on the extent to which the general research questions raised during the introduction of this work have been addressed, or resolved. These questions sought to establish;

1. How might social-ecological systems be conceptualised as combined *social*-ecological systems? Where can the ontological lines between nature and society be drawn? How might change within complex systems be represented or explained?

2. How might information about such systems be organised and represented in a way that approximates their 'actual' dynamics? – is such an approximation of reality possible or desirable?

3. Should such representations conform to an abstract depiction of relations, linkages and mechanisms - as one variant of systems analysis – or should they be quantified?

4. Can such an approximation be triangulated with multiple data sources or modelling strategies? Does this reflect a hierarchy of ontology? Are some systemic dimensions more amenable to certain forms of measurement such as demography or culture?

5. Can stability or sustainability be assessed in a non-normative manner? Is it possible, or desirable to specify 'healthy state' criteria as normative assessment guidelines?

Concerning those of chapters 1-5, Swyngedouw (2004a) has suggested that the advancement of valid casework and knowledge depends intimately on discarding ontological binarism in favour of one of hybridity, in which distinct boundaries between natural and social entities are rendered obsolete, in light of their intrinsic interconnectedness. This is doubtless a valid proposition; however it is one which has often been carried too far. The critical realist conception of being emphasises, to some extent, the solidity of competing conceptions, to the extent that some degree of ontological stability must be assumed as *preexisting* the appropriation of social and natural phenomena through the practice of research. This strikes a crucial middle ground between localism and abstraction, and between competing epistemological bases of methodology which often reproduce the false dichotomy of 'social as construct vs. 'social as objective structure'. To the critical realist, both propositions are equally tenable, and the absurdity of much existing debate on social science methodology is revealed; selection of methodology is thus often reduced to one which prefigures the process of research, based on foregone ontological conclusions, rather than such decisions being based augmented inductively, based upon the specific complexities of the case or phenomenon in question. The

methodology suggested at the conclusion of chapter 5 has attempted to subsume this ambiguity by formalising such considerations of multidimensionality into a series of coherent logical steps which mandate attention to all levels of systemic complexity in terms of case specifics. As such, this is not a methodology suited only to the examination of precapitalist modes of production; it is one which stands to inform the process of mixed method case-based inquiry beyond the empirical confines of the subject matter of this thesis.

As to the question of ontological separatism, the informants co-opted for this task, namely those of the labour process and mode of production, have shown how the concept of metabolism is quite capable of articulating a periodisation of historical modes of production taking the labour process as its typological cue. According to this resultant model, such modes of historical natural-social mediation are differentiated according to the manner in which the surplus produce of labour is appropriated throughout various historical epochs. In such a manner, the specifics of the social organisation of the production process render local ecology intelligible, augment the task of measurement, and collapse inherent the ontological binarisms. The organisation of this resultant knowledge should not, as per classical systems theory, be simply returned to an exhaustive structural model poised for deductive enrichment (Boulding 1956, 1964; Miller 1955; Miller and Miller 1992; Skyttner 2005), but instead articulated within a flexible conceptual model, such as is offered by the heuristics of complexity, resilience, and the mode of production which emphasise both structural regularity, and cross-case conceptual applicability. Nor should articulation remain at a high level of abstraction (Gerhardt 2002; Parsons 1954, 1979, 1991 [1951]; Turner 1991), as per the articulation of social form and ideal type attempted in chapter 6. Instead, the task of measurement must be carried further, as was here attempted, according to stages 4 and 5 marking further levels of progressive descent, according to table 5.1. Therefore, although organisation of information can never approximate 'true dynamics', a degree of 'asymptotic convergence' is possible, provided there is willingness to engage further with measurement. There is an implicit hierarchy of ontology in such endeavours, which inherently calls for methodological pluralism, according to the amenability of such systemic levels to measurement (both ontologically, and in terms of data availability), theoretical criteria concerning the relatedness of systemic components, levels, and systemic dynamics, and the requirements of specific research questions.

As to the questions of sustainability and change, both are inherently interdependent, insofar as assessments of change are predicated upon the mode of measurement adopted by resilience. This form of assessment seeks to retain a multidimensional conceptualisation of systemic identity, assessing 'sustainability' not mechanically in terms of optimised control parameters

which present as constant across cases, but as the capacity for perturbation to induce changes in systemic identity as a function of adaptive capacity. This approach is fundamentally non-normative, in that its operationalisation depends on case nuances; and yet, it entails sufficient reduction to render a degree of subjective judgement possible – in terms of the future potential of this framework, as a means of developing policy, this latter component is essential. Critics of postmodernism have, for some time, pointed out how such ambiguities of structure translate into more sinister aversions of judgement (Eagleton 1996). In light of the capacities of the informants deployed within this thesis to advance profound criticisms of prevailing methodological-individualist research, such as arguably dominates in the contemporary public arena, this is a prospect which cannot be ignored in future study. As to the empirical concerns of this work, which sought to engage with the following questions, a number of further avenues of inquiry remain to be addressed;

1. How might an understanding of the social form of rundale be advanced which is both historically grounded, yet open to incorporate its many variants? What is the essential category with which this explication might be grounded?

2. In what sense have previous studies succumbed to various forms of restrictive determinism in their analyses of rundale? In this respect, how might a complexity-informed framework address the prospect of balancing generalizability and specificity through the development of ideal types?

3. How might the differential distribution of ecological risk, in the form of diminished capacity for resilience, be quantified? How does communality feature within, and inform the generation of, this macro-typology?

4. What forms did the relationship between communality and resilience take, and what specific variables functioned to augment, or diminish probabilities of resilience at settlement level? How might such an assessment be operationalised?

5. What were the concrete forms of configurational diversity within rundale, what did these regimes look like, and where were they located?

6. How did rundale communes augment their adaptive capacities from below through purposive intervention? How did these specific strategies work, and what forms did they take? Was the rundale system sustainable?

Explication of the social forms of Irish communality, and a closer examination of its configurational diversity has arguably satisfied the requirements of questions 1 to 3; the historical grounding of an open, working concept is made possible through the adoption of a mode of production approach, which in turn permits the elaboration of an ideal-typical identity which subsumes variant structural complexity. However, unlike classical systems theory, analysis does not end with the reduction of variability; instead, the essential category of the

dualism of communality and individualism which forms the locus of the social form and ideal-type, also forms the basis of an assessment of the specific dynamics of metabolic rift, such as they manifest at system level, in light of the historical specifics of the social form in question. In combination with the informants of resilience, an avenue toward measurement is provided, in light of the theoretical direction on 'key systemic variables' offered by initial methodological stages of abstraction. In this sense, the synthesised methodology of this thesis rises adequately to the task of explaining the differential distribution of resilience in a non-reductionist manner (i.e. without interpreting model parameters as merely the trans-historical reified effects of variable such as 'population', as per those forms of analysis criticised by Brenner(1976)). Unfortunately, this line of *operative* inquiry is arguably lacking in current pronouncements on metabolic rift, to the extent that the majority of existing work remains at the level of conceptual clarification, and historical-theoretical archaeology (Foster 2000, 2002; Foster and Burkett 2000, 2004; Schneider and McMichael 2010). Where case-implementation has occurred (Clark and York; Clausen and Clark 2005; McClintlock 2010; Wittman 2009; York 2003, it has arguably not attempted to delineate a coherent, programmatic research basis, although some notable attempts have been made by Moore (2003b, 2011). Furthermore, empirical attention has focused overwhelmingly on the dynamics of capitalism, and with little attention to the comparative method; a modest attempt has here been made to advance an empirical contribution, and such a basis for methodological integration. In terms of diversity, such an element has proven decidedly lacking in the limited number of applications to nineteenth century Ireland which have collapsed the internal stratifications of Irish social-ecological structure into a homogenous model of singular dynamic (Fraser 2003, 2006, 2007). Such studies have crucially ignored how the internal differentiation of such societies, in terms of their myriad social-ecological regimes and complex modes of production, structured the distribution of ecological risk, and the experience of distress.

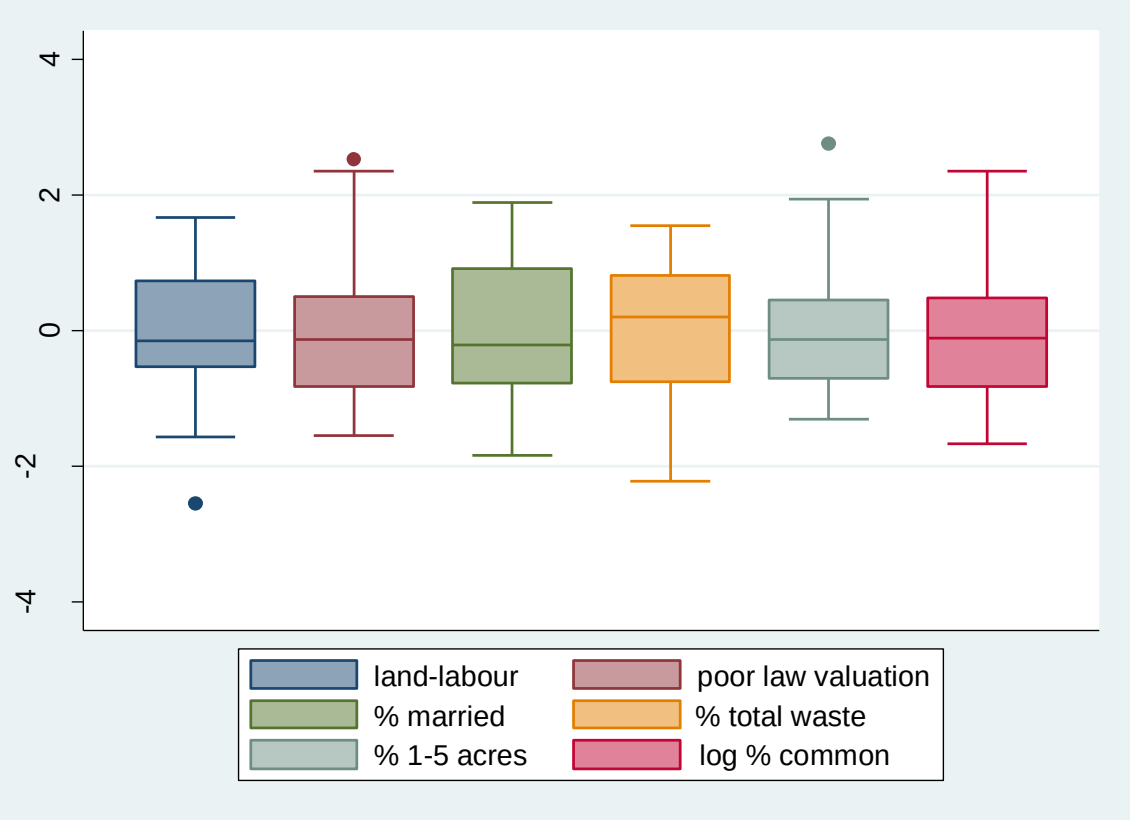
The comparatively concrete concerns of questions 4 and 5 have received sufficient elaboration, and bear little qualification, other than to suggest that future work should seek to further enrich the general template established in this thesis with additional case-specific materials. Unfortunately, the conclusion may be drawn that empirical sources have largely been covered in exhaustive detail, if not in this current work, then certainly in combination with those authors of more extensive surveys of rundale in Ireland (Buchanan 1958; McCabe 1991; McCourt 1947, 1950; Slater 1988). Consequently, the most productive line of inquiry should instead operate at the level of the conceptual, as considerable ambiguity yet abounds concerning structural archetypes of communal settlement, in terms of elements such as their spatial organisation. There is arguably further scope also concerning the 'compartmentalisation' of

communality into regimes beyond those of the social-ecological (i.e. in terms of cultural homogeneity or dissimilarity), which in turn offers a wealth of opportunity for further research.

Regarding question 6; in the context of this historical encounter, the assessment of 'sustainability' is decidedly more straightforward; the rundale system no longer exists, despite its extensive survivals in the archaeology of the modern Irish landscape. Contemporary systems pose something more of a challenge for the analyst; hindsight enables an assessment of ecological constraint, when the conditions of classical experimentalism such as event time-ordering are present, allowing the analyst to isolate critical moments of policy intervention, and to compare structural conditions at significant points revealed by the broad scope of a longitudinal perspective on systemic trajectories. In contemporary contexts, the possibility of applying this methodology is no more diminished by its historical implementation within this thesis. In all research contexts, analysis must attend to historical context, to social structure, panarchical constitution, and internal differentiation in order to approximate the epistemological objective of holistic investigation. A tentative basis for future endeavours has merely been initiated by this work; by identifying such points of compatibility as are here outlined, the informants of complexity offer an avenue with which to reinvigorate the pursuit of systemic models and epistemologies within the social sciences, whilst offering a non-reductive methodology for assessing diversity which eschews essentialism.

Appendix 1 – Cluster analysis output

Boxplot of z-score standardised input variables



Cluster analysis output

Initial Cluster Centers				
	Cluster			
	1	2	3	4
zscore: population density	-2.55204	-.19206	1.18460	1.01252
zscore: poor law valuation per head	2.52063	-1.20268	1.8517	-1.54584
zscore: % females 26-35 married	-.86642	1.24137	-.86642	1.88992
Zscore: % total waste (course pasture) below 800ft above sea level	-2.22270	-.22563	1.04174	.84972
Zscore: % holdings 1-5 acres	-.40549	.76592	-.31538	2.74829
Zscore: log original % land held in common or joint tenancy	-.23244	-.76598	-1.20503	2.34405

Iteration History				
	Change in cluster centers			
Iteration	1	2	3	4
1	2.164	1.523	1.501	1.828
2	.756	.213	.340	.616
3	.205	.174	.000	.492
4	.000	.175	.000	.451
5	.000	.000	.000	.000

Final Cluster Centers				
	Cluster			
	1	2	3	4
zscore: population density	-.92779	-.36225	.79303	1.13052
zscore: poor law valuation per head	.68962	-.50447	1.04749	-1.12032
zscore: % females 26-35 married	-.63480	.38079	-.93591	1.20894
Zscore: % total waste (course pasture) below 800ft above sea level	-1.14187	.22637	.14196	.81131
Zscore: % holdings 1-5 acres	-.45698	.27379	-.65006	.83800
Zscore: log original % land held in common or joint tenancy	.10568	-.06584	-1.03279	1.46913

Number of cases in each cluster	
Cluster	Cases
1	7
2	13
3	7
4	5
Valid	32
Missing	0

Appendix 2 – Input Variable Summary Statistics, poor law union dataset

The following table lists all variables comprising the final study dataset – not all variables were utilised in the models presented in this thesis, although their content and breadth should serve to illustrate the considerations given to model specification, which incorporated many alternative specification. Variables are arranged alphabetically by variable name, and data source citations are provided chronologically in the following list.

Devon Commission. Appendix to minutes of evidence taken before Her Majesty's Commissioners of Inquiry into the state of the law and practice in respect to the occupation of land in Ireland. Part IV. 1845 [672] [673] xxii

Second Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7. 1847 [819] xvii, pp24-26

Third Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7. 1847 [836] xvii, pp30-31

Fourth Report of the Relief Commissioners, constituted under the act 10th Vic., cap. 7. 1847 [859] xvii, pp6-7

Fifth, Sixth and Seventh Reports of the Relief Commissioners, constituted under the Act 10th Vic., cap. 7. 1847-48 [876] xxix, pp7-8; 8-9; 8-9

Returns of Agricultural Produce in Ireland, in the Year 1847. 1847-48 [923] lvii

Returns of Agricultural Produce in Ireland, in the Year 1848. 1849 [1116] xlix, pp14-17

Returns of Agricultural Produce in Ireland, in the Year 1848. Part II. – Stock. 1849 [392] xlix, pp16-1

Returns of Agricultural Produce in Ireland, in the Year 1849. 1850 [1245] li

Variable Name	Description	Unit	Mean	SD	Min	Max
cluster4	Cluster group four (lowest potential social-ecological resilience)	Cluster group membership dummy (0=no, 1=yes)	-	-	0	1
common	Land held in common or joint tenancy (1845)	% all union land	8.004	15.250	0	83.33
common1	Low common	Binary selection dummy (0=union out, 1=union in)	0.068	0.089	0	0.250
common2	Medium-low common	Binary selection dummy (0=union out, 1=union in)	0.476	0.132	0.279	0.719
common3	Medium common	Binary selection dummy (0=union out, 1=union in)	0.981	0.152	0.736	1.189
common4	High common	Binary selection dummy (0=union out, 1=union in)	1.562	0.217	1.300	1.926
commong	Logcommon k-means cluster group	4-category selection dummy	-	-	-	-
corn_chg	Change in relative corn area	% points change (1847-1849)	-6.224	5.214	-20.62	10.53
corn_chg2	Change in corn area	% change in absolute area (1847-1849)	-4.171	11.790	-50.22	30.01
corn47	Corn (1847)	% of all land under crop	62.3	10.216	30	80
corn49	Corn (1849)	% of all land under crop	56.066	9.884	22.81	78.38
crop_chg	Change in relative total crop area	% points change (1847-1849)	1.542	2.267	-3.95	6.74
crop_chg2	Change in crop area	% change in absolute area (1847-1849)	6.403	10.708	-20.36	43.65
crop47	Total union area under crop (1847)	% total union area	28.557	12.290	2.92	59.28
crop49	Total union area under crop (1849)	% total union area	30.1	12.635	2.67	58.61
fifteenthirty_chg	Change in farms 15-30 acres	% change in number of units (1848-1849)	5.881	64.424	-100	630.53

Variable Name	Description	Unit	Mean	SD	Min	Max
fifteenthirty_chg2	Change in relative proportion of farms 15-30 acres	% points change (1848-1849)	1.270	5.846	-18.14	30.68
fifteenthirty48	Farms 15-30 acres (1848)	% all farms	22.954	6.065	10.99	35.08
fifteenthirty49	Farms 15-30 acres (1849)	% all farms	23.164	7.090	0	38.76
fivefifteen_chg	Change in farms 5-15 acres	% change in number of units (1848-1849)	-0.481	69.818	-73.67	692.09
fivefifteen_chg2	Change in relative proportion of farms 5-15 acres	% points change (1848-1849)	-0.543	6.879	-29.33	33.29
fivefifteen48	Farms 5-15 acres (1848)	% all farms	31.737	10.556	9.42	53.74
fivefifteen49	Farms 5-15 acres (1849)	% all farms	29.729	10.563	7.69	52.22
flax_chg	Change in relative flax area	% points change (1847-1849)	-0.032	0.855	-5.49	3.56
flax_chg2	Change in flax area	% change in absolute area (1847-1849)	5.155	193.952	-100	1600
flax47	Flax (1847)	% of all cultivated land	1.1	2.064	0	10
flax49	Flax (1849)	% of all cultivated land	1.105	2.255	0	10.31
landlabour	Land-labour ratio	Area/Population (acres per individual)	2.647	1.186	0.25	7.02
logcommon	Log common (1845)	Log of % land held in common (positive skew redistribution)	0.573	0.534	0	1.926
meadow_chg	Change in relative meadow area	% points change (1847-1849)	-0.930	2.913	-13.59	8.55
meadow_chg2	Change in meadow area	% change in absolute area (1847-1849)	2.055	17.659	-41.24	55.07
meadow47	Meadow (1847)	% of all cultivated land	21.962	10.871	3	57

Variable Name	Description	Unit	Mean	SD	Min	Max
meadow49	Meadow (1849)	% of all cultivated land	21.057	10.760	3.64	53.78
onefifteen_chg	Change in farms 1-15 acres	% change in number of units (1848-1849)	1.662	77.821	-56.99	757.87
onefifteen_chg2	Change in relative proportion of farms less than 1, to 15 acres	% points change (1848-1849)	-0.28	10.037	-19.73	54.26
onefifteen48	Farms 1-15 acres (1848)	% all farms	46.873	13.919	12.81	76.34
onefifteen49	Farms 1-15 acres (1849)	% all farms	44.43	13.837	12.33	75.31
onefive	Holdings 1-5 acres (1845)	% of all holdings	19.240	9.268	4	82
onefive_chg	Change in farms 1-5 acres	% change in number of units (1848-1849)	5.346	96.801	-48.45	915.52
onefive_chg2	Change in relative proportion of farms 1-5 acres	% points change (1848-1849)	0.263	4.338	-6.46	21.31
onefive48	Farms 1-5 acres (1848)	% all farms	15.137	6.617	2.93	32.78
onefive49	Farms 1-5 acres (1849)	% all farms	14.701	6.808	1.85	31.08
overthirty_chg	Change in farms over 30 acres	% change in number of units (1848-1849)	8.567	37.870	-28.69	331.9
overthirty_chg2	Change in relative proportion of farms over 30 acres	% points change (1848-1849)	3.055	7.279	-17.06	38
overthirty48	Farms over 30 acres (1848)	% all farms	25.236	12.533	4.33	68.21
overthirty49	Farms over 30 acres (1849)	% all farms	27.126	13.323	5.57	71.1
plvacre	Poor law valuation per acre (1845)	£ (pounds) per acre	0.871	1.430	0.02	12.82
plvhead	Poor law valuation per head (1845)	£ (pounds) per individual	1.615	0.790	0.36	5.65

Variable Name	Description	Unit	Mean	SD	Min	Max
popdensity	Population density	Population/Area (individuals per acre)	0.489	0.449	0.14	4.02
potato_chg	Change in relative potato area	% points change (1847-1849)	7.900	4.045	-1.96	19.83
potato_chg2	Change in potato area	% change in absolute area (1847-1849)	178.202	108.285	-4.66	565.73
potato47	Potato (1847)	% of all cultivated land	5.985	3.721	1	25
potato49	Potato (1849)	% of all cultivated land	13.853	5.906	2.65	37.96
ration1	Gratuitous rations (1847)	Highest recorded issuing in single reporting period	19643.02	16476.28	389	82776
rationheadz	Gratuitous rations 2 (1847)	Rations issued per head of population (z-standardised)	0	1	-1.44	3.85
rationmaxz	Gratuitous rations 3 (1847)	Highest rations issued in a single date (z-standardised)	0	1	-1.16	3.84
turnip_chg	Change in relative turnip area	% points change (1847-1849)	-0.188	1.846	-3.17	8.7
turnip_chg2	Change in turnip area	% change in absolute area (1847-1849)	9.207	47.002	-48.69	342.4
turnip47	Turnip (1847)	% of all cultivated land	6.854	2.437	2	14
turnip49	Turnip (1849)	% of all cultivated land	6.686	2.349	2.31	13.99
uncult_chg	Change in relative uncultivated area	% points change (1847-1849)	-1.542	2.267	-6.74	3.95
uncult_chg2	Change in uncultivated area	% change in absolute area (1847-1849)	-2.260	3.450	-11.31	6.28
uncult47	Uncultivated (1847)	% of all union land	28.585	12.279	3	59
uncult49	Uncultivated (1849)	% of all union land	69.9	12.635	41.39	97.33
underone_chg	Change in farms less than 1 acre	% change in number of units (1848-1849)	28.177	218.825	-64.29	2321.43

Variable Name	Description	Unit	Mean	SD	Min	Max
underone_chg2	Change in relative proportion of farms less than 1 acre	% points change (1848-1849)	-0.879	5.340	-18.09	21.91
underone48	Farms less than 1 acre (1848)	% all farms	6.456	5.760	0.05	27.78
underone49	Farms less than 1 acre (1849)	% all farms	5.279	4.423	0.18	24.23
underonefive_chg	Change in farms less than 1, to 5 acres	% change in number of units (1848-1849)	9.290	118.875	-46.61	1188.89
underonefive_chg2	Change in relative proportion of farms less than 1, to 5 acres	% points change (1848-1849)	0.833	6.281	-6.78	28.95
underonefive48	Farms less than 1, to 5 acres (1848)	% all farms	20.072	9.586	3.76	47.76
underonefive49	Farms less than 1 to 5 acres (1849)	% all farms	19.980	10.018	2.29	47.98
valu2	Holdings values at £2 or less (1845)	% of all rated holdings	29.910	15.517	8	94
ycorn_chg	Change in corn yield	% change in kilograms per head (1847-1849)	-7.261	23.050	-54.81	76.16
ycorn_chg2	Change in corn yield	% change in kilograms per acre (1847-1849)	-8.095	19.099	-45.39	75.64
ycorn47	Corn yield (1847)	Kilograms per acre	775.369	112.613	476	1135
ycorn49	Corn yield (1849)	Kilograms per acre	701.231	122.875	400	1144
ycornhead47	Corn yield (1847)	Kilogram per head of adjusted population	391.646	171.484	33	1007
ycornhead49	Corn yield (1849)	Kilogram per head of adjusted population	360.754	173.663	29	916
ypotato_chg	Change in potato yield	% change in kilograms per head (1847-1849)	129.815	145.223	-49.7	964.1
ypotato_chg2	Change in potato yield	% change in kilograms per acre (1847-1849)	-23.189	25.511	-82.61	98.86

Variable Name	Description	Unit	Mean	SD	Min	Max
ypotato47	Potato yield (1847)	Kilograms per acre	7406.131	1383.783	2730	11684
ypotato49	Potato yield (1849)	Kilograms per acre	5516.1	1509.846	1429	9055
ypotatohead47	Potato yield (1847)	Kilogram per head of adjusted population	314.862	151.772	31	803
ypotatohead49	Potato yield (1849)	Kilogram per head of adjusted population	622.539	288.776	33	2017
yturnip_chg	Change in turnip yield	% change in kilograms per head (1847-1849)	24.907	77.501	-90.83	468.76
yturnip_chg2	Change in turnip yield	% change in kilograms per acre (1847-1849)	7.534	33.513	-93.42	129.79
yturnip47	Turnip yield (1847)	Kilograms per acre	16691	11095.06	8534	137506
yturnip49	Turnip yield (1849)	Kilograms per acre	16359.39	3712.932	1424	31985
yturnphead47	Turnip yield (1847)	Kilogram per head of adjusted population	918.654	572.351	37	4283
yturnphead49	Turnip yield (1849)	Kilogram per head of adjusted population	936.923	456.485	53	2611

Appendix 3 – Regression diagnostics and plots, chapters 7 and 8

1. Increment in R^2 `[SemiP^2]`
2. Shapiro-Wilk test of residual normality [H_o = residual distribution normal]
3. Ramsey test of omitted variables [H_o = no omitted variable bias]
4. Predicted vs. Score scatterplot
5. Fitted value vs. Residual plot
6. Added variable plots
7. Kernel density plot
8. Residual histogram
9. Standardised normal probability plot (midrange residual normality)
10. Quintile-normal plot (tail residual normality)

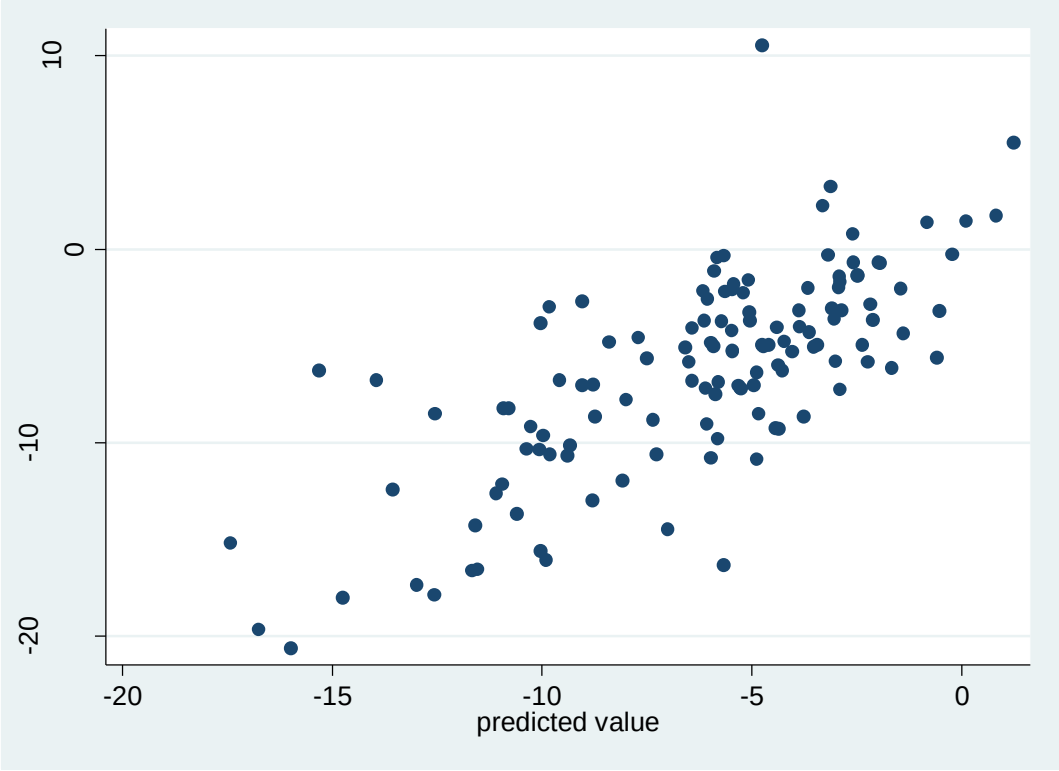
Chapter 7

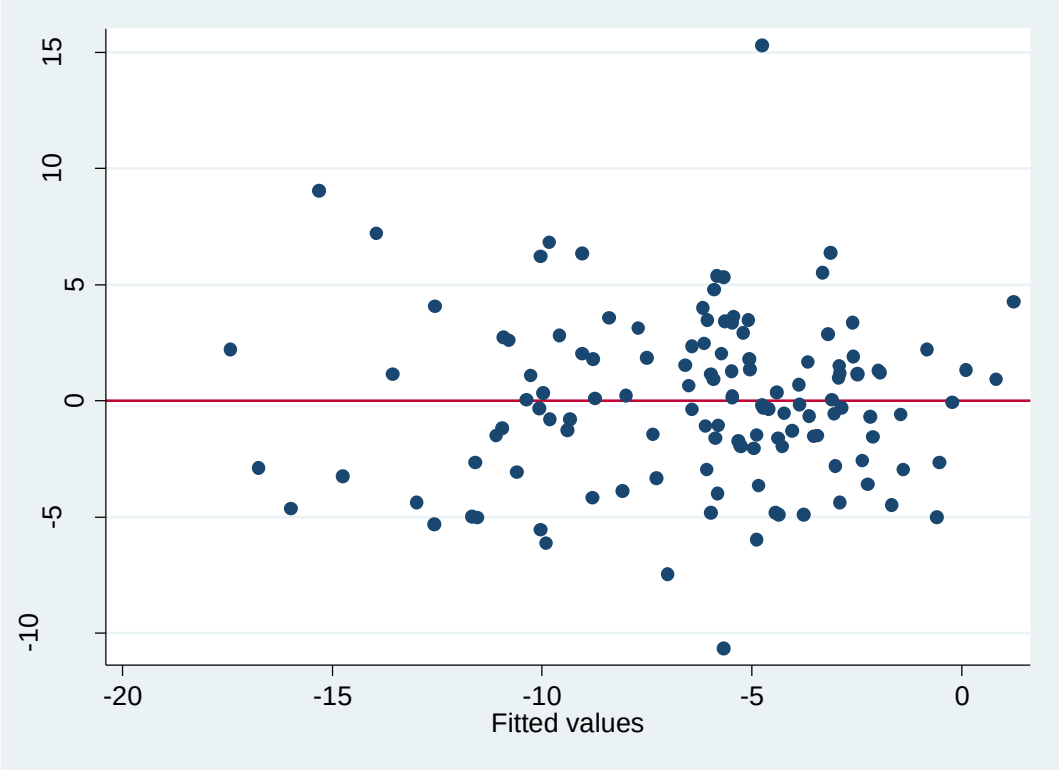
Model 1 [y = corn_chg]

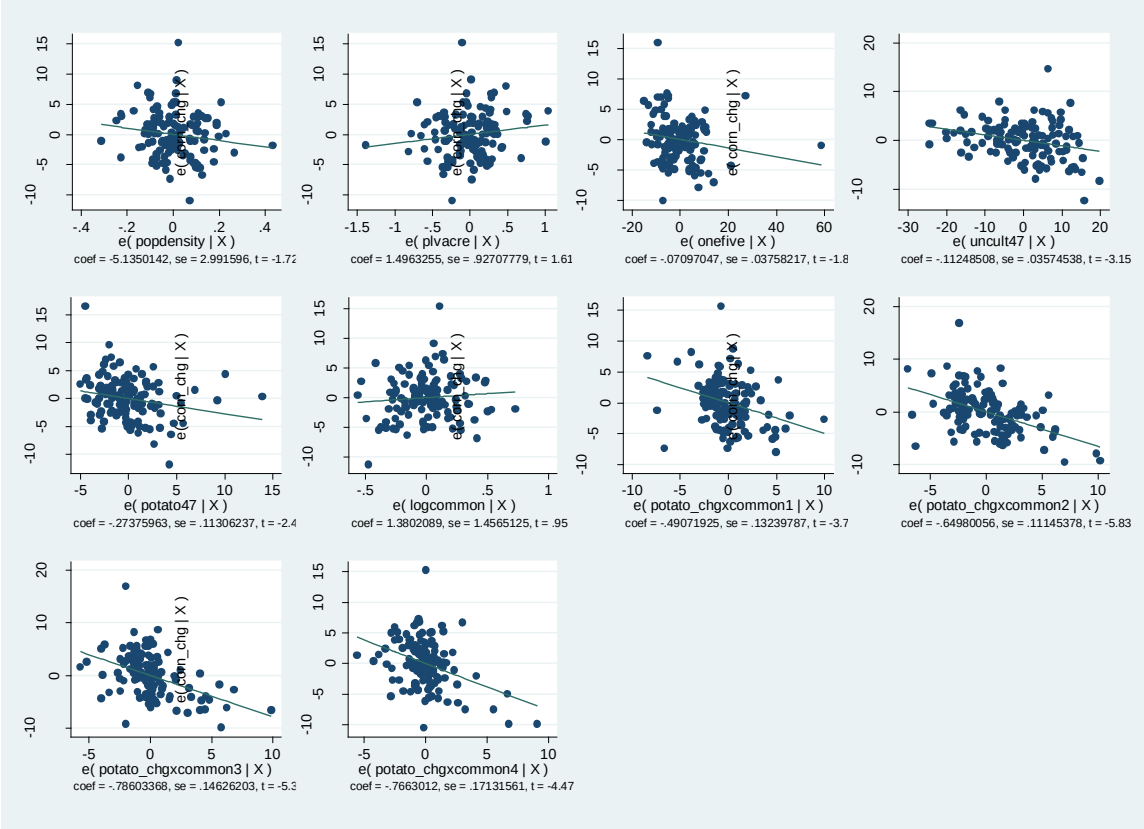
```
Partial and Semipartial correlations of corn_chg with

    Variable |     Partial      SemiP    Partial^2     SemiP^2       Sig.
-------------+------------------------------------------------------------
  popdensity |     -0.1561     -0.1087      0.0244      0.0118       0.089
     plvacre |      0.1470      0.1022      0.0216      0.0104       0.109
     onefive |     -0.1713     -0.1196      0.0293      0.0143       0.061
    uncult47 |     -0.2783     -0.1992      0.0774      0.0397       0.002
    potato47 |     -0.2176     -0.1533      0.0473      0.0235       0.017
   logcommon |      0.0869      0.0600      0.0076      0.0036       0.345
potato_chg~1 |     -0.3229     -0.2347      0.1043      0.0551       0.000
potato_ch~n2 |     -0.4729     -0.3691      0.2236      0.1363       0.000
potato_chg~3 |     -0.4434     -0.3403      0.1966      0.1158       0.000
potato_chg~4 |     -0.3808     -0.2832      0.1450      0.0802       0.000
```

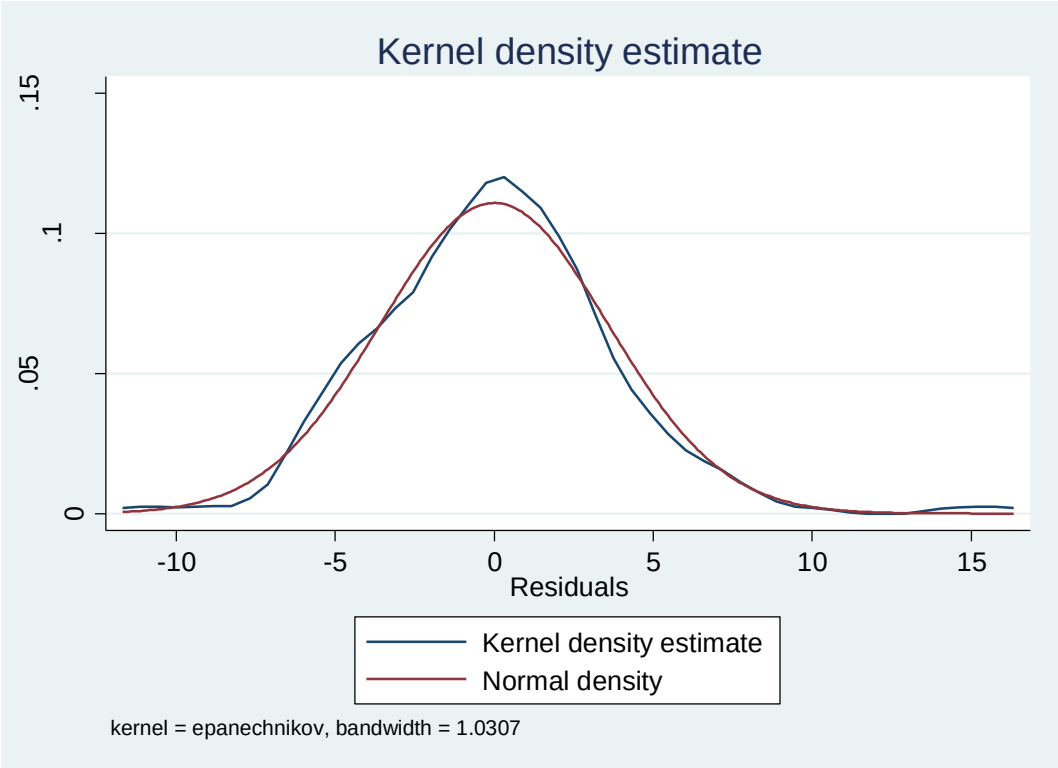
```
                  Shapiro-Wilk W test for normal data

    Variable |    Obs       W           V         z       Prob>z
-------------+-------------------------------------------------
           e |    129    0.97526      2.531     2.088    0.01838
```

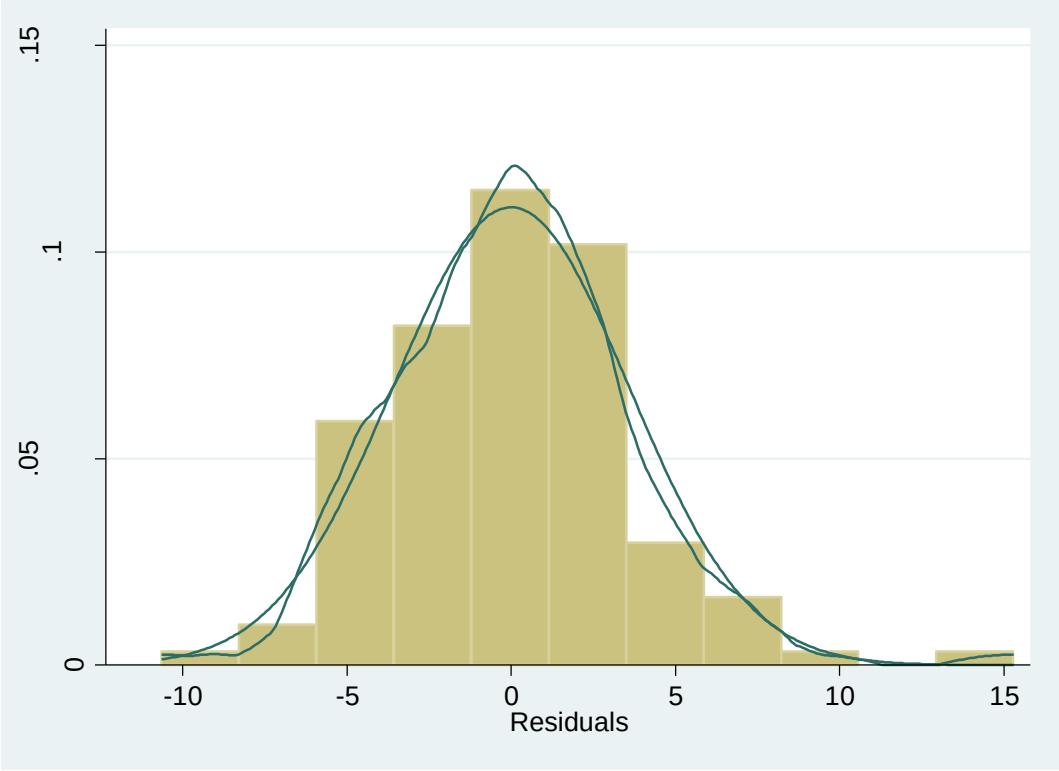
```
Ramsey RESET test using powers of the fitted values of corn_chg
       Ho:  model has no omitted variables
                 F(3, 115) =      0.33
                  Prob > F =      0.8052
```

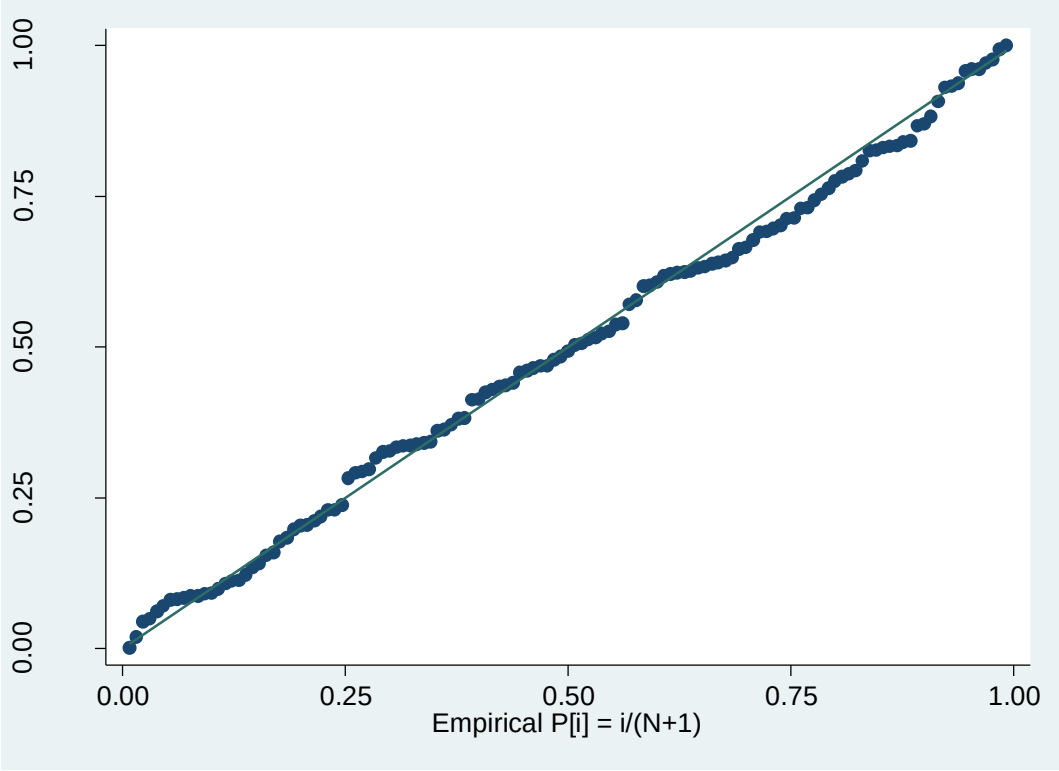

10
0
-10
-20
-20
-15
-10
-5
0
predicted value

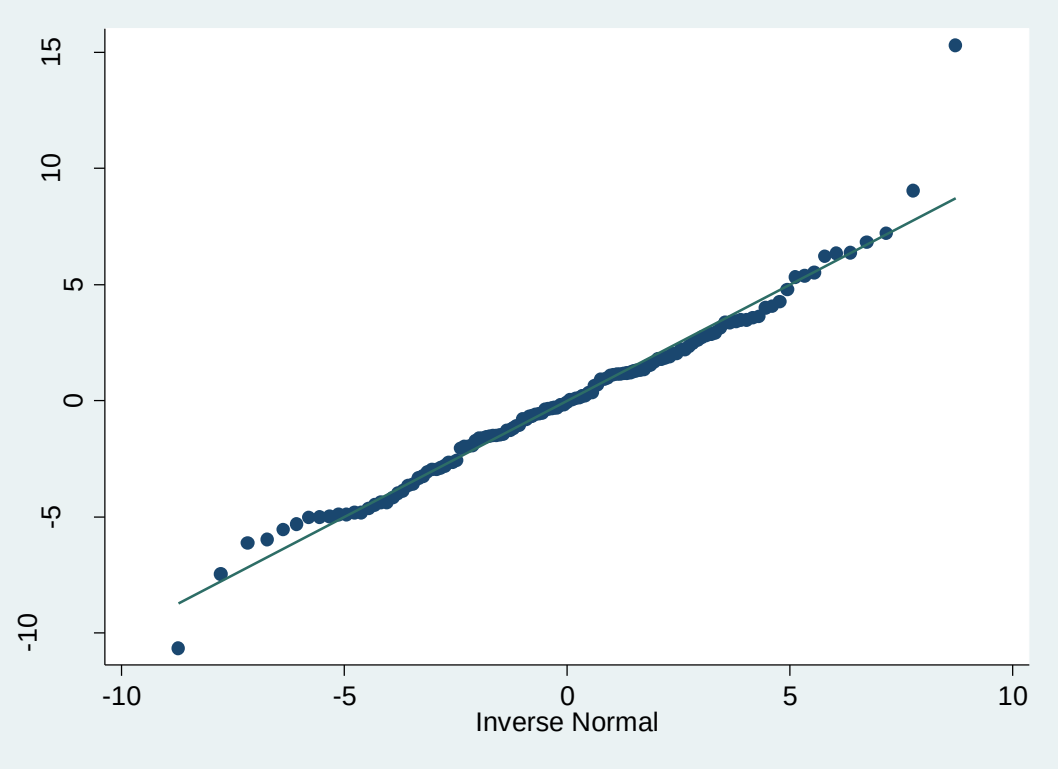

15
10
5
0
-5
-10
-20
-15
-10
-5
0
Fitted values


e(corn_chg | X)
e(popdensity | X)
coef = -5.1350142, se = 2.991596, t = -1.72
e(plvacre | X)
coef = 1.4963255, se = .92707779, t = 1.61
e(onefive | X)
coef = -.07097047, se = .03758217, t = -1.8
e(uncult47 | X)
coef = -.11248508, se = .03574538, t = -3.15
e(potato47 | X)
coef = -.27375963, se = .11306237, t = -2.4
e(logcommon | X)
coef = 1.3802089, se = 1.4565125, t = .95
e(potato_chgxcommon1 | X)
coef = -.49071925, se = .13239787, t = -3.7
e(potato_chgxcommon2 | X)
coef = -.64980056, se = .11145378, t = -5.83
e(potato_chgxcommon3 | X)
coef = -.78603368, se = .14626203, t = -5.3
e(potato_chgxcommon4 | X)
coef = -.7663012, se = .17131561, t = -4.47


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 1.0307


.15
.1
.05
0
-10
-5
0
5
10
15
Residuals


1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)



Model 2 [y = potato49]

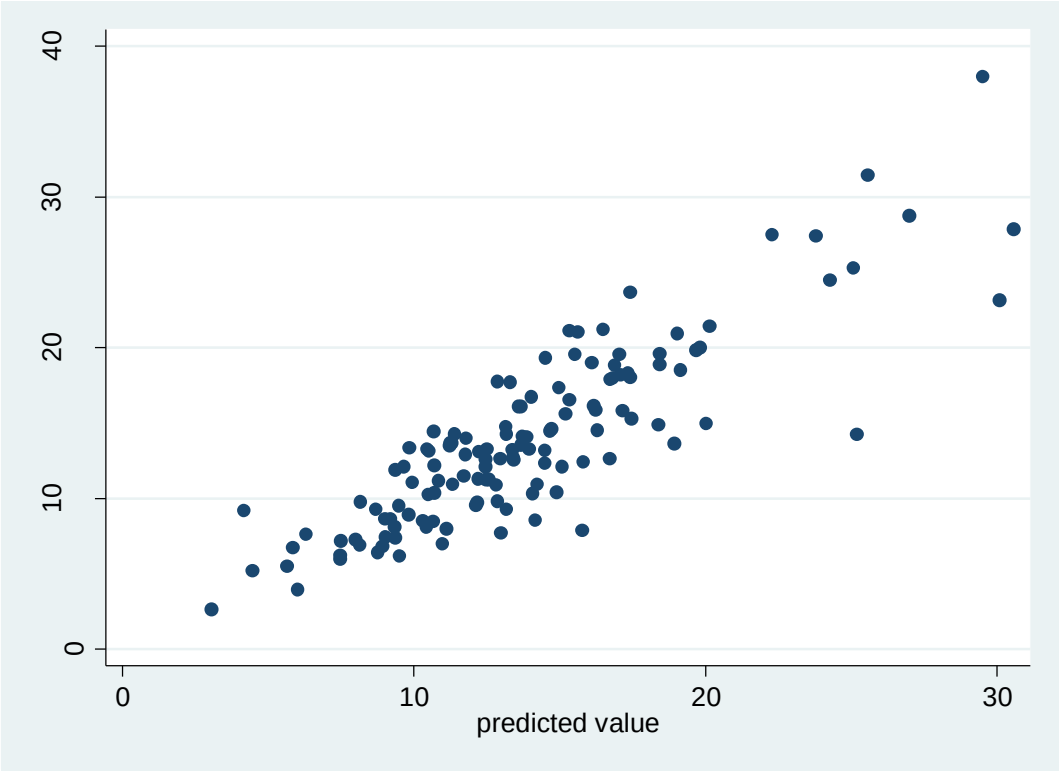
Partial and Semipartial correlations of potato49 with

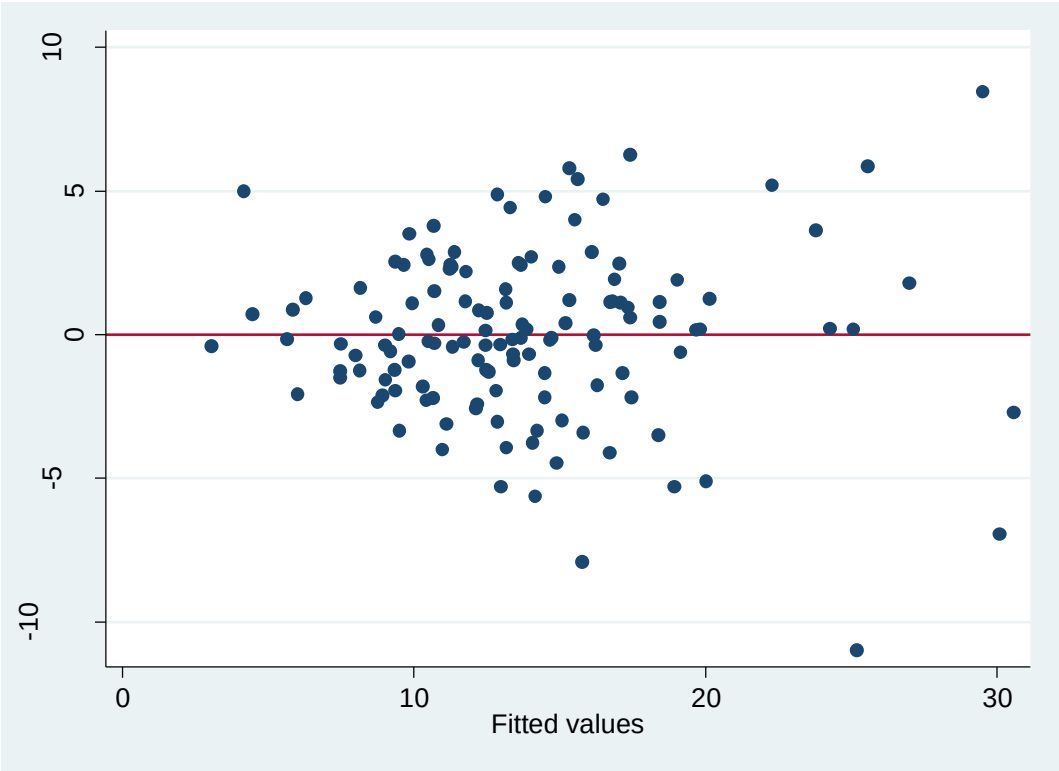
Variable	Partial	SemiP	Partial^2	SemiP^2	Sig.
popdensity	0.1002	0.0504	0.0100	0.0025	0.270
plvacre	-0.1377	-0.0696	0.0190	0.0048	0.129
uncult47	0.1173	0.0592	0.0138	0.0035	0.196
corn_chg	-0.5494	-0.3293	0.3019	0.1085	0.000
potato47	0.6743	0.4573	0.4547	0.2091	0.000
ypotato_chg2	0.1699	0.0863	0.0289	0.0075	0.060
logcommon	0.0138	0.0069	0.0002	0.0000	0.880
underonefi~2	0.2370	0.1222	0.0562	0.0149	0.008

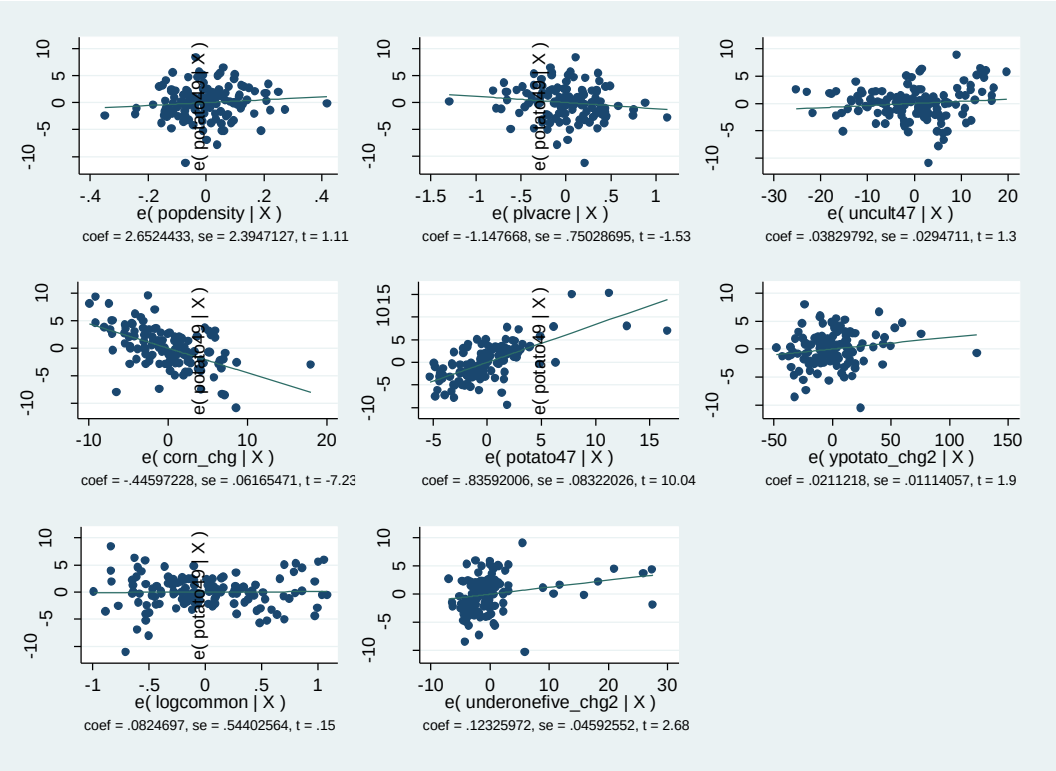
Shapiro-Wilk W test for normal data

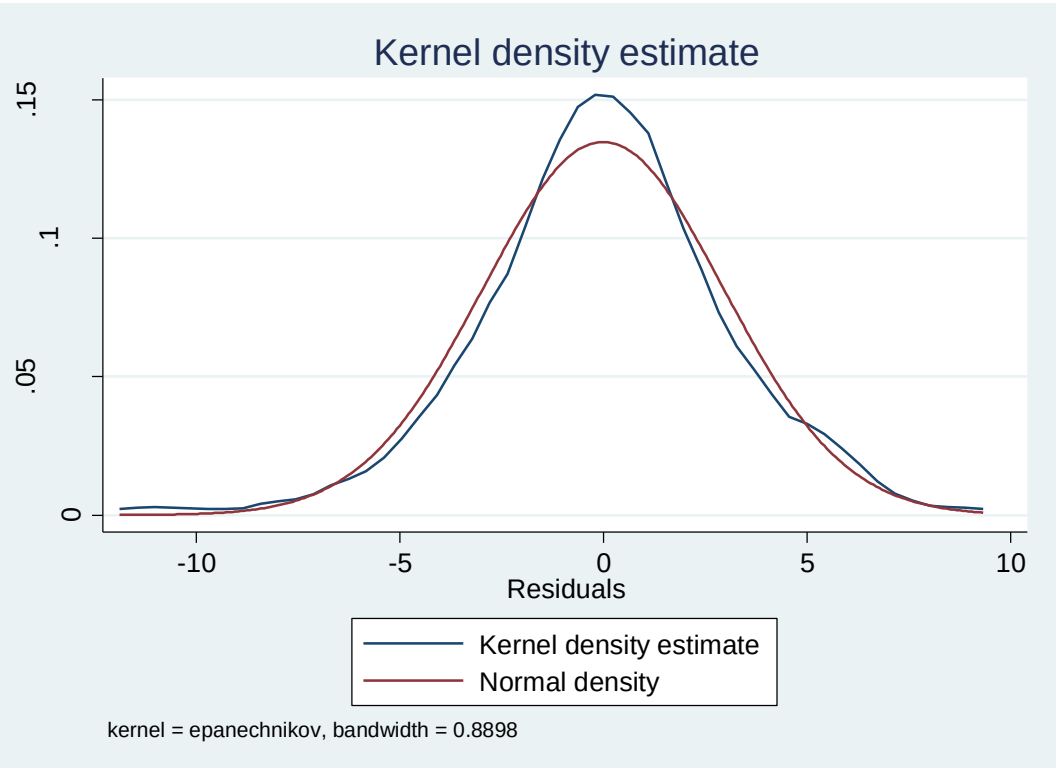
Variable	Obs	W	V	z	Prob>z
e	130	0.98376	1.672	1.157	0.12369

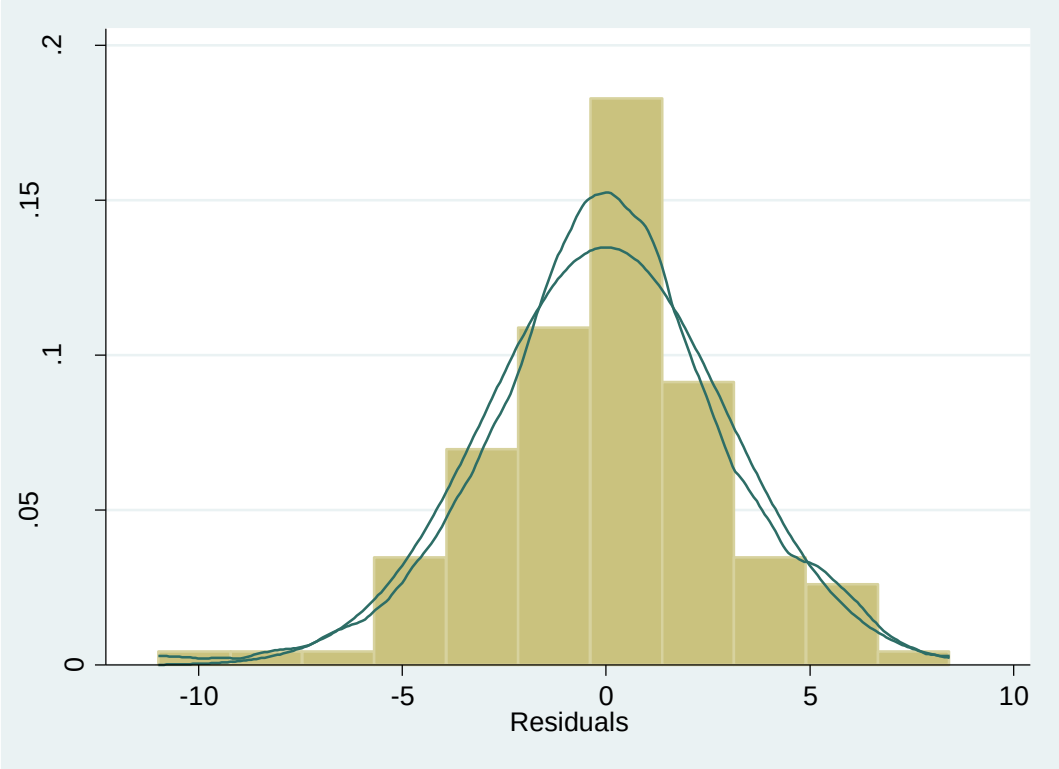
Ramsey RESET test using powers of the fitted values of potato49
Ho: model has no omitted variables
F(3, 118) = 0.36
Prob > F = 0.7790

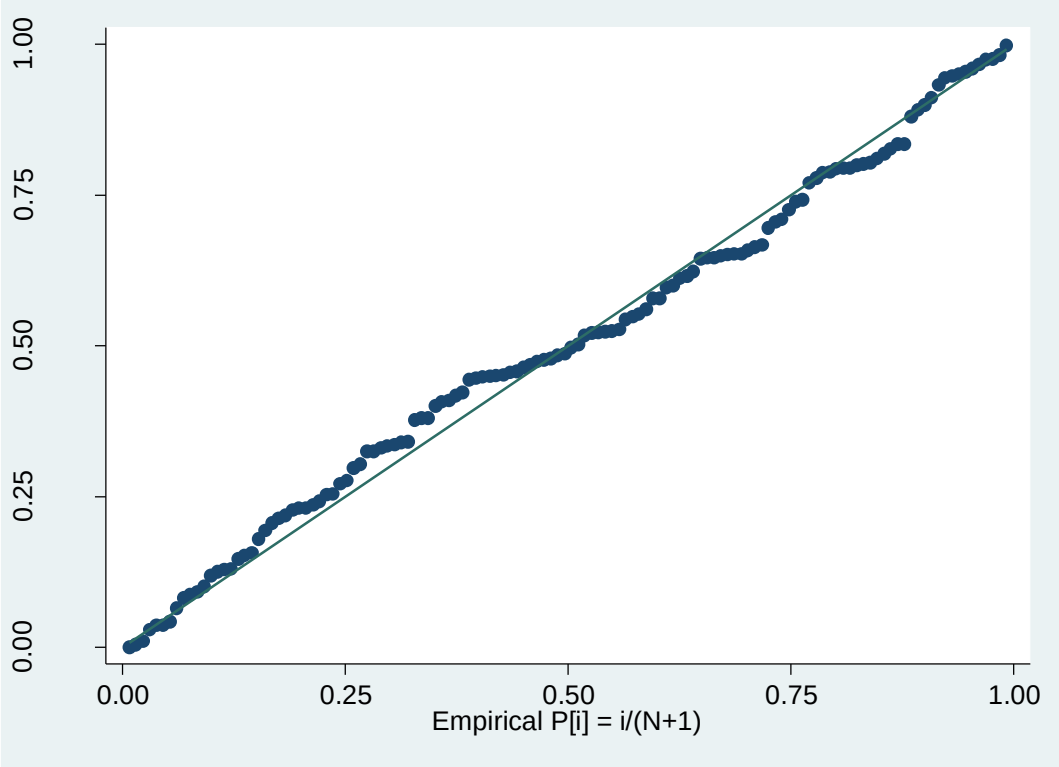

0
10
20
30
40
0
10
20
30
predicted value

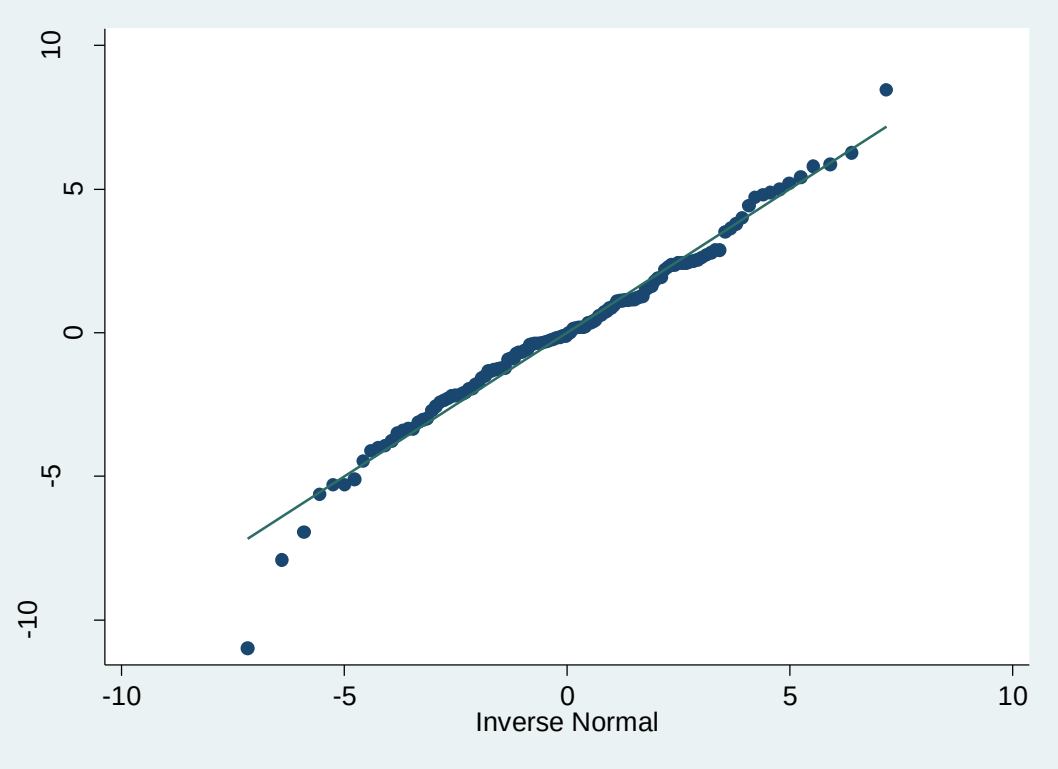

-10
-5
0
5
10
0
10
20
30
Fitted values


e(popdensity | X)
coef = 2.6524433, se = 2.3947127, t = 1.11
e(plvacre | X)
coef = -1.147668, se = .75028695, t = -1.53
e(uncult47 | X)
coef = .03829792, se = .0294711, t = 1.3
e(corn_chg | X)
coef = -.44597228, se = .06165471, t = -7.23
e(potato47 | X)
coef = .83592006, se = .08322026, t = 10.04
e(ypotato_chg2 | X)
coef = .0211218, se = .01114057, t = 1.9
e(logcommon | X)
coef = .0824697, se = .54402564, t = .15
e(underonefive_chg2 | X)
coef = .12325972, se = .04592552, t = 2.68


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 0.8898

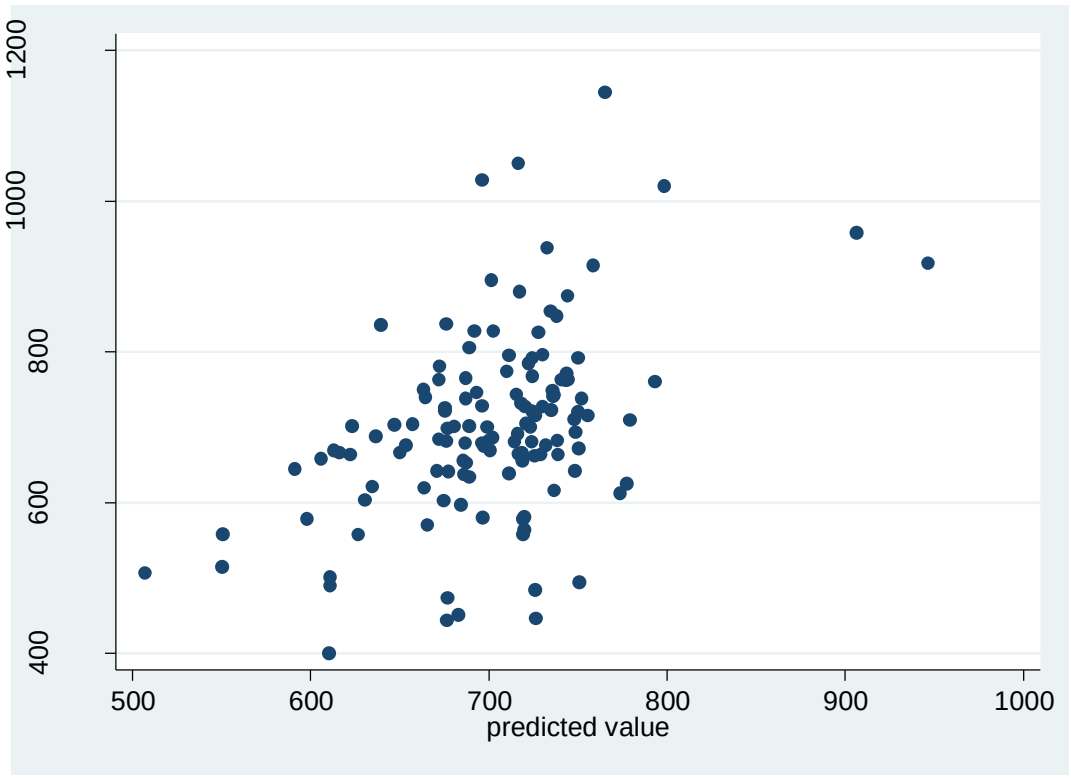

0
.05
.1
.15
.2
-10
-5
0
5
10
Residuals

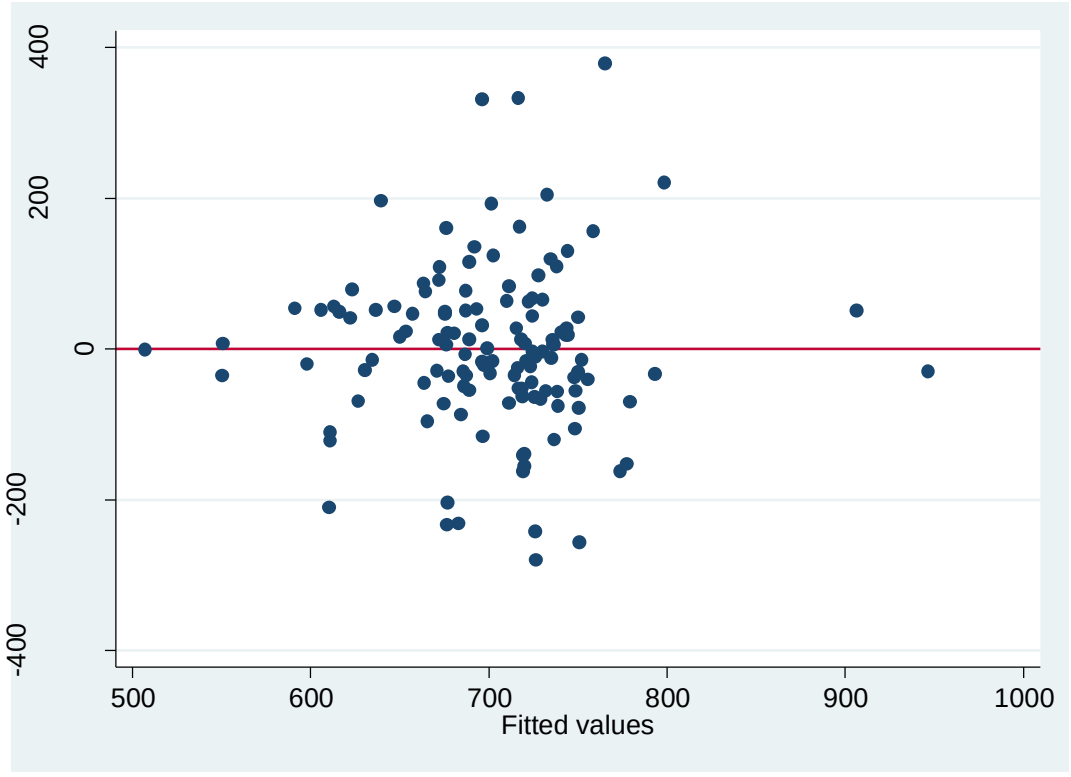

0.00
0.25
0.50
0.75
1.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)

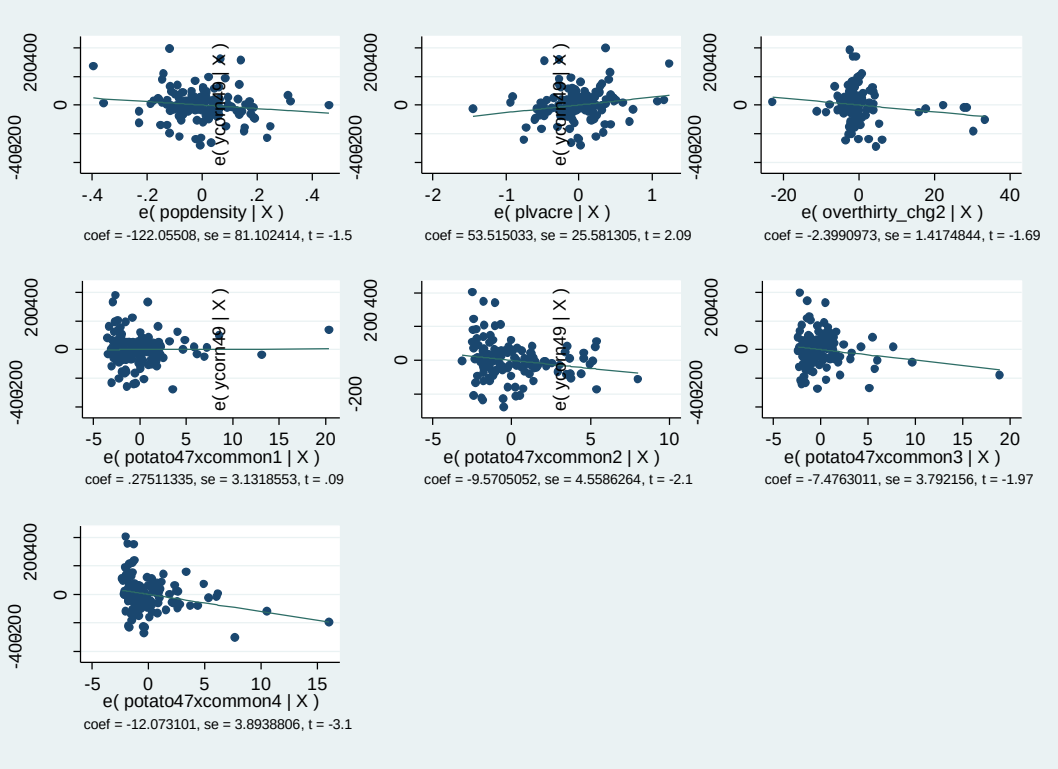


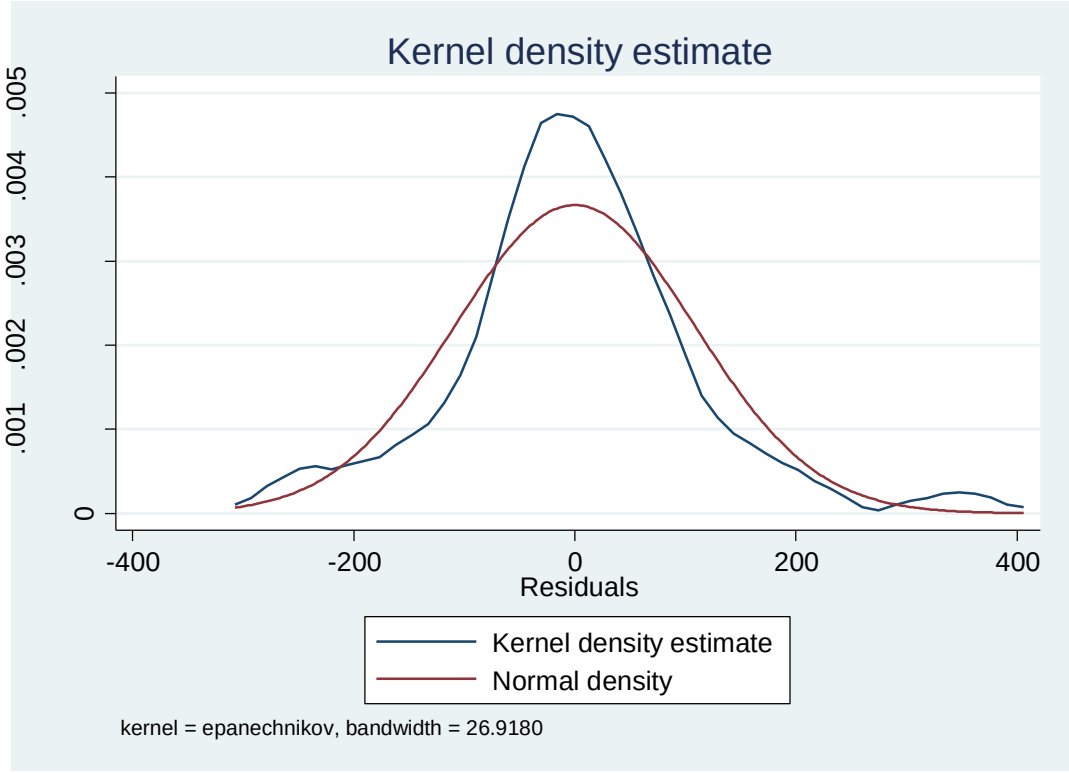
Model 3 [y = ycorn49]

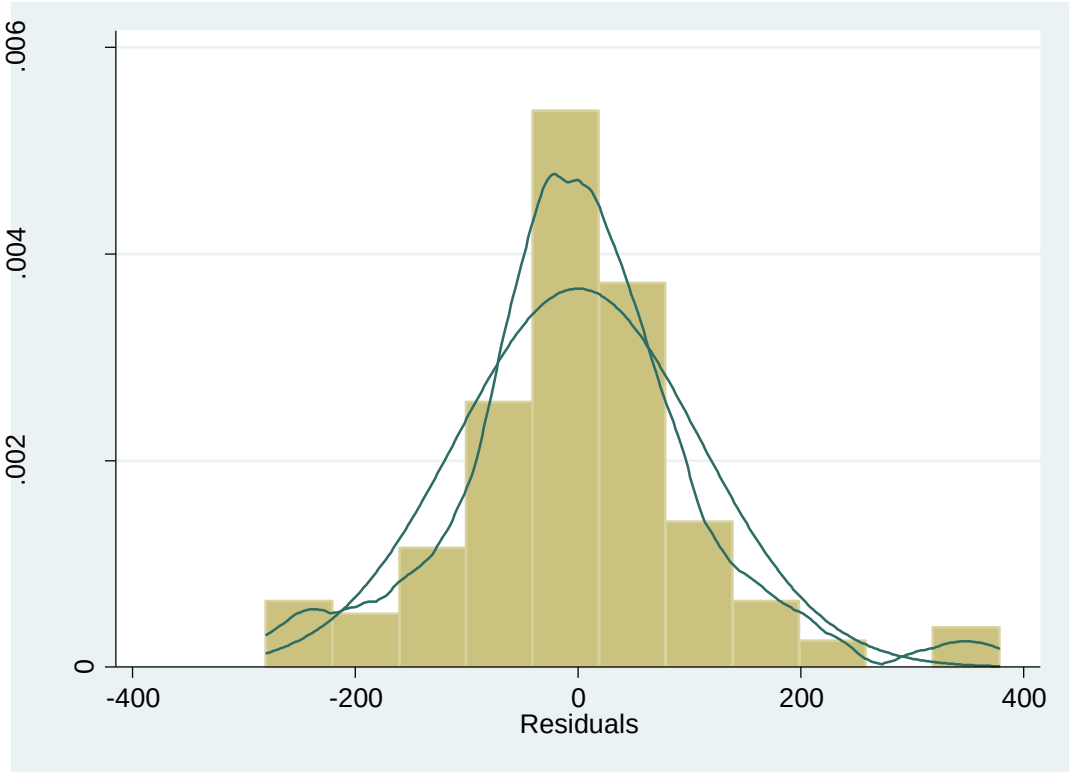
```
Partial and Semipartial correlations of ycorn49 with

    Variable |      Partial      SemiP    Partial^2     SemiP^2        Sig.
-------------+------------------------------------------------------------
  popdensity |     -0.1350     -0.1207      0.0182      0.0146       0.135
     plvacre |      0.1861      0.1678      0.0346      0.0281       0.039
overthirty~2 |     -0.1515     -0.1357      0.0229      0.0184       0.093
potato47xc~1 |      0.0080      0.0070      0.0001      0.0000       0.930
potato47xc~2 |     -0.1867     -0.1684      0.0349      0.0283       0.038
potato47xc~3 |     -0.1757     -0.1581      0.0309      0.0250       0.051
potato47xc~4 |     -0.2703     -0.2487      0.0730      0.0618       0.002


                  Shapiro-Wilk W test for normal data

    Variable |    Obs       W           V         z       Prob>z
-------------+-------------------------------------------------
           e |    130    0.96181      3.933     3.081    0.00103


Ramsey RESET test using powers of the fitted values of ycorn49
       Ho:  model has no omitted variables
                 F(3, 119) =      0.06
                  Prob > F =      0.9816
```

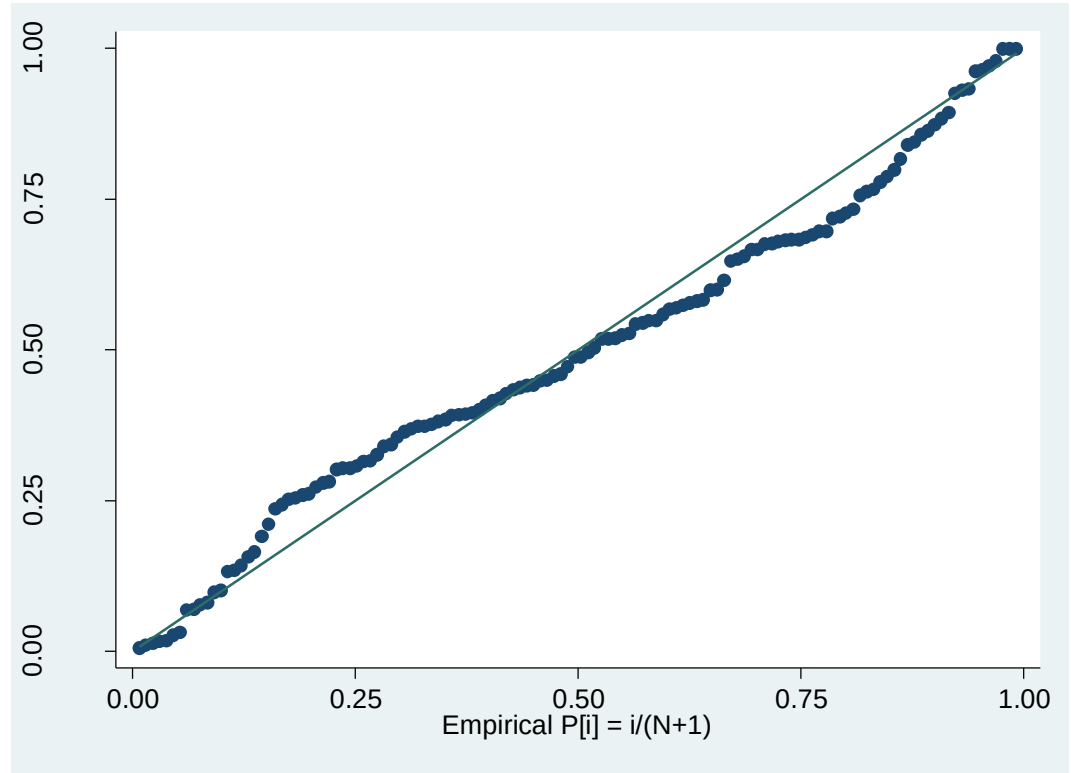

1200
1000
800
600
400
500
600
700
800
900
1000
predicted value

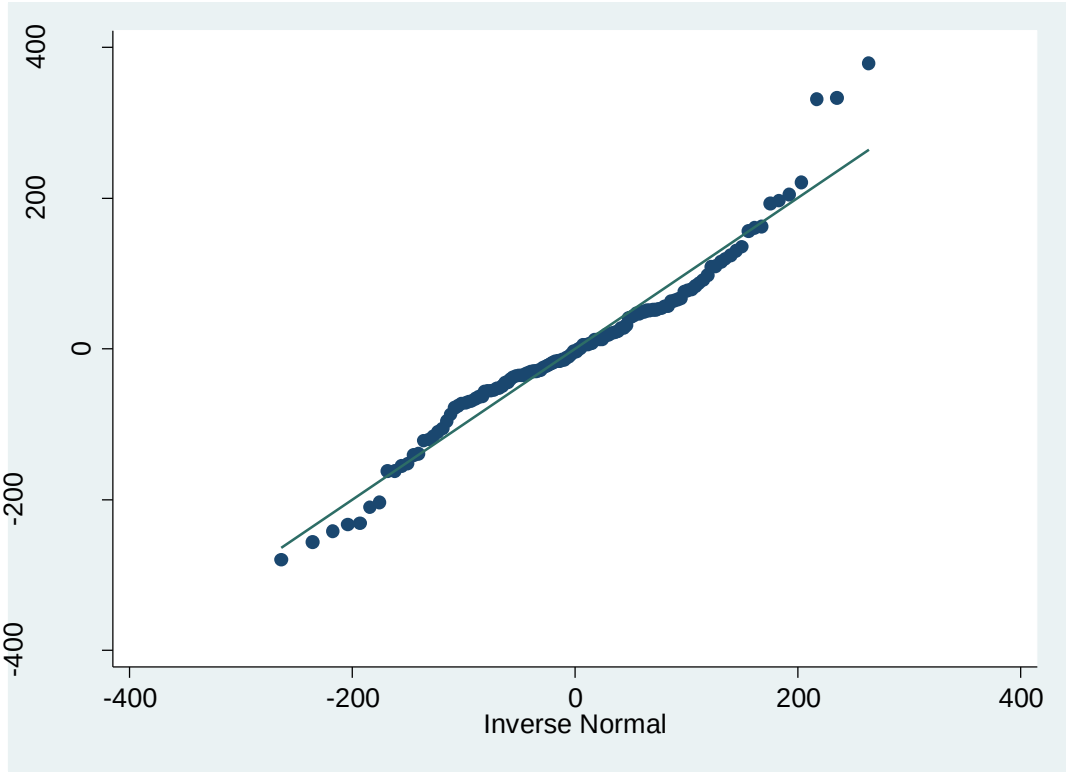

400
200
0
-200
-400
500
600
700
800
900
1000
Fitted values


e(ycorn40 | X)
e(popdensity | X)
coef = -122.05508, se = 81.102414, t = -1.5
e(plvacre | X)
coef = 53.515033, se = 25.581305, t = 2.09
e(overthirty_chg2 | X)
coef = -2.3990973, se = 1.4174844, t = -1.69
e(potato47xcommon1 | X)
coef = .27511335, se = 3.1318553, t = .09
e(potato47xcommon2 | X)
coef = -9.5705052, se = 4.5586264, t = -2.1
e(potato47xcommon3 | X)
coef = -7.4763011, se = 3.792156, t = -1.97
e(potato47xcommon4 | X)
coef = -12.073101, se = 3.8938806, t = -3.1


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 26.9180


.006
.004
.002
0
-400
-200
0
200
400
Residuals


1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)



Model 4 [y = corn_chg2]

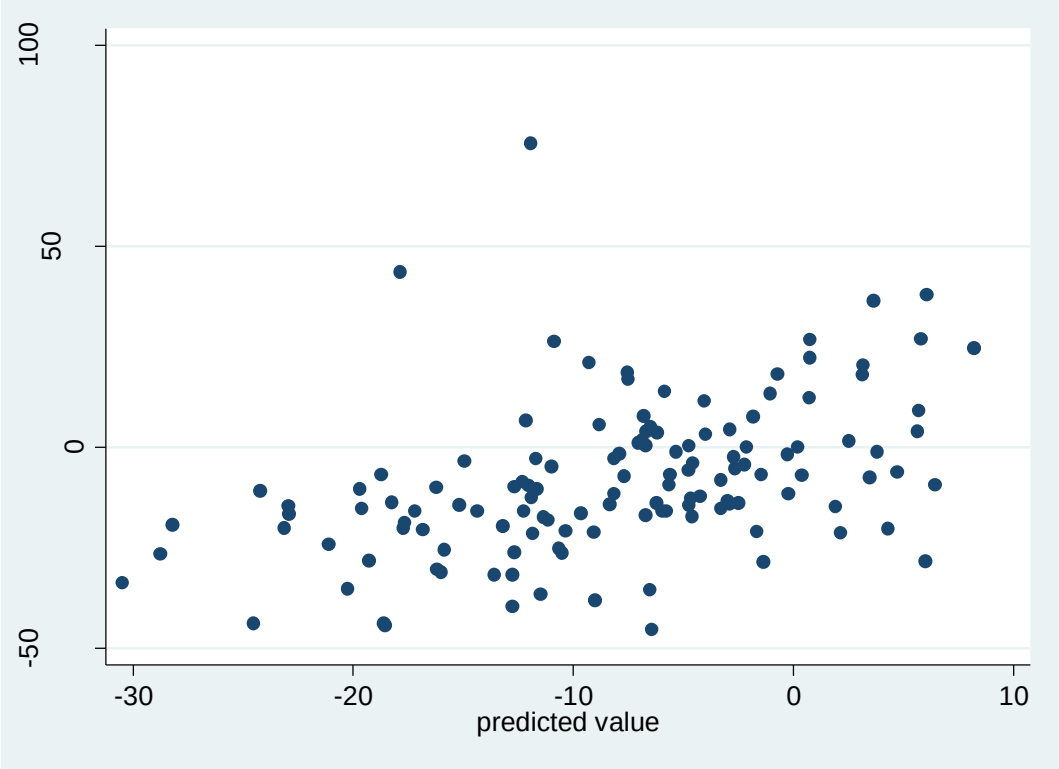
Partial and Semipartial correlations of ycorn_chg2 with

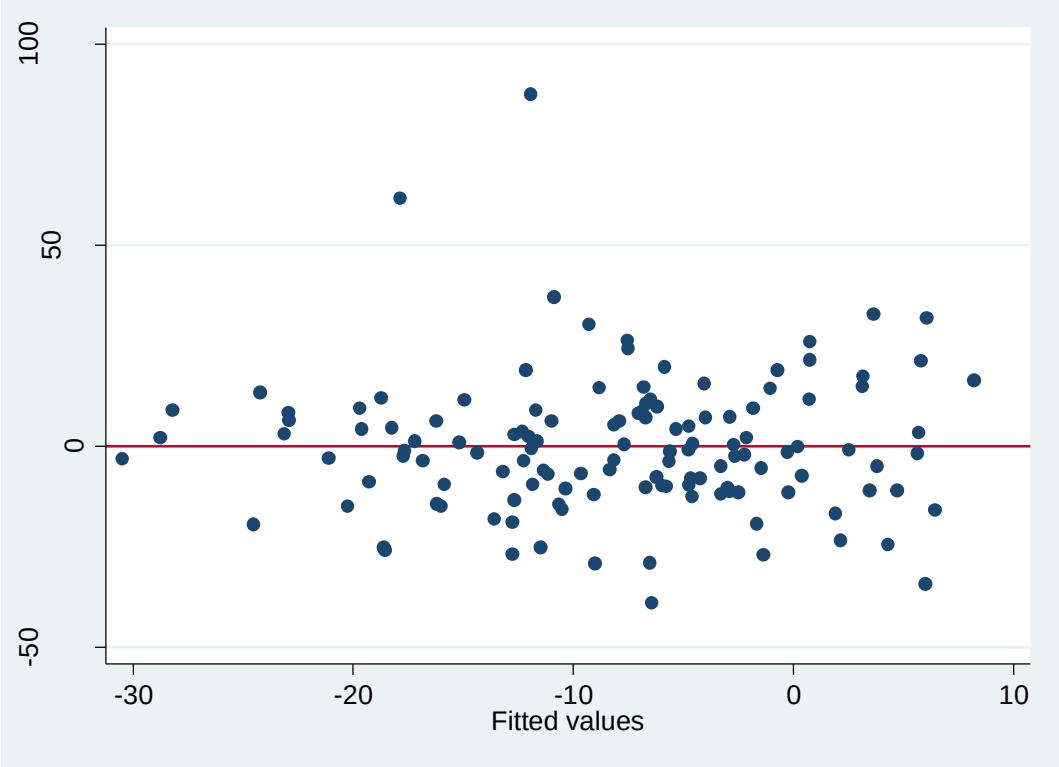
Variable	Partial	SemiP	Partial^2	SemiP^2	Sig.
popdensity	-0.1838	-0.1685	0.0338	0.0284	0.041
uncult47	0.2266	0.2096	0.0513	0.0439	0.011
ypotato49	0.2595	0.2422	0.0674	0.0587	0.004
logcommon	0.0164	0.0148	0.0003	0.0002	0.856
overthirty~2	-0.1718	-0.1572	0.0295	0.0247	0.056
rationheadz	-0.2328	-0.2157	0.0542	0.0465	0.009
cluster4	-0.1193	-0.1083	0.0142	0.0117	0.187

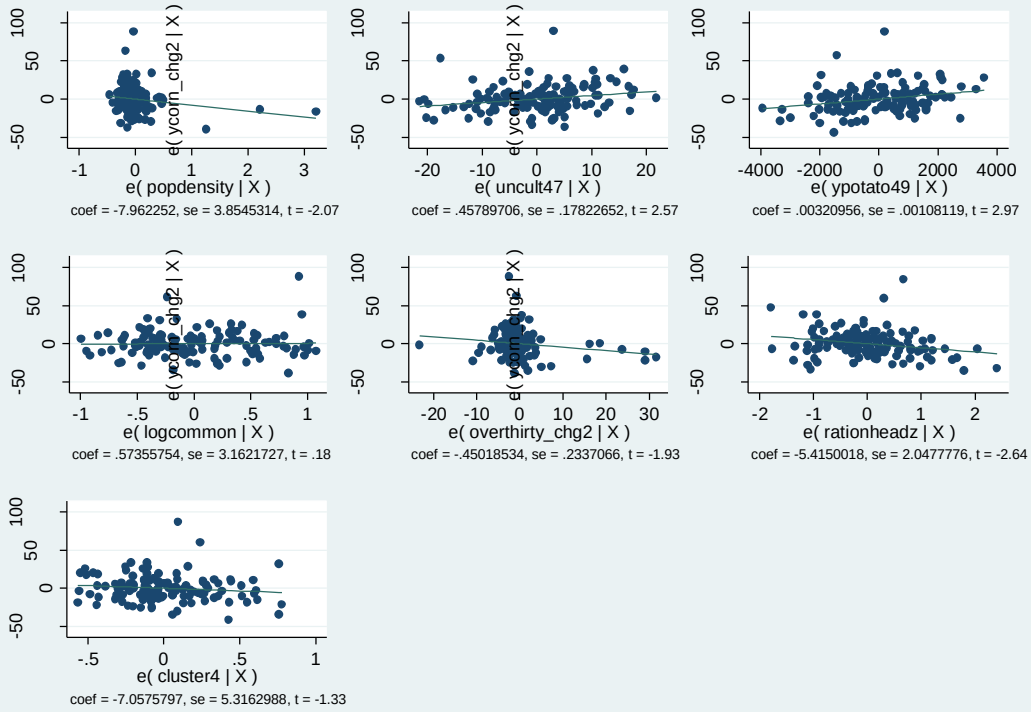
Shapiro-Wilk W test for normal data

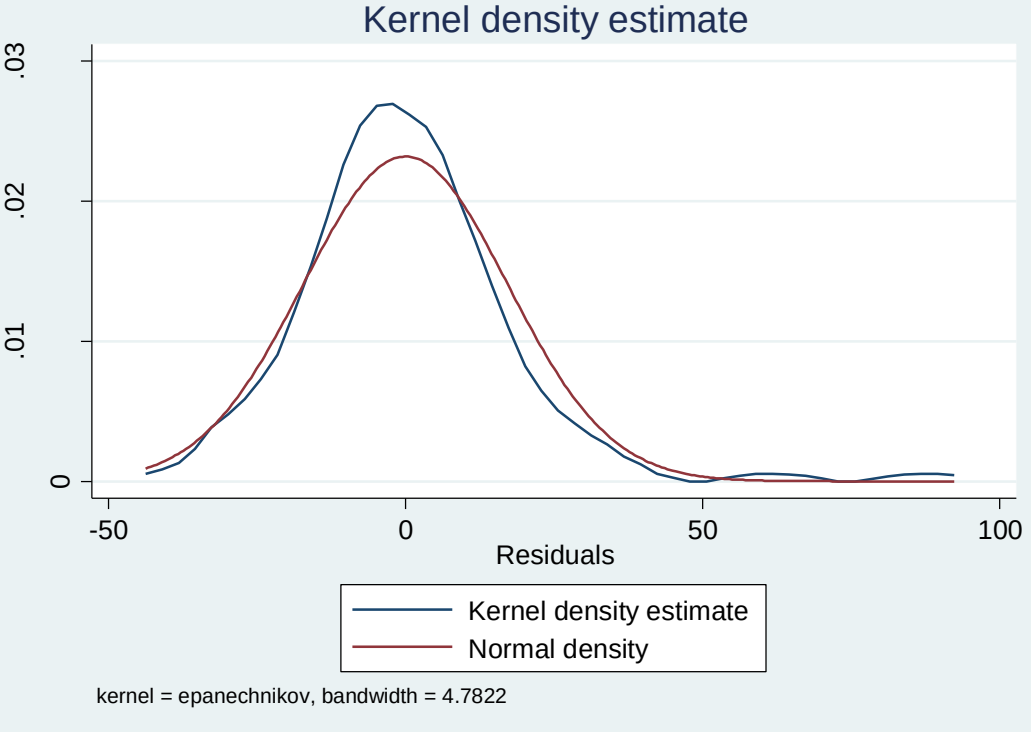
Variable	Obs	W	V	z	Prob>z
e	130	0.92634	7.586	4.559	0.00000

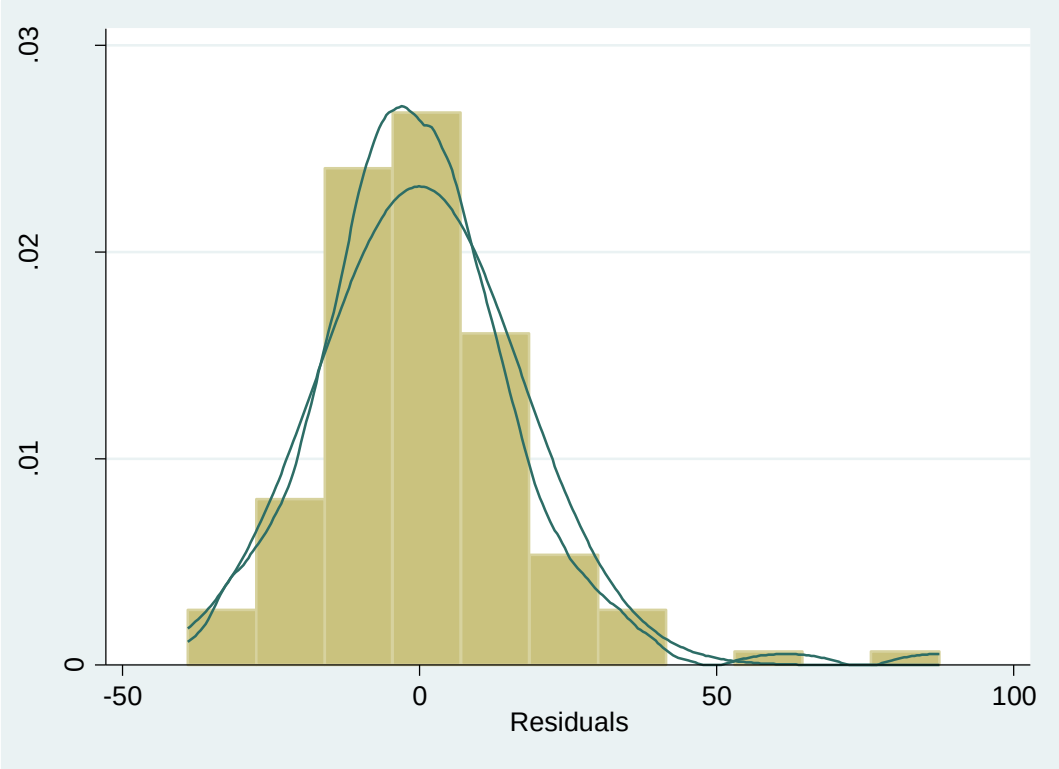
Ramsey RESET test using powers of the fitted values of ycorn_chg2
Ho: model has no omitted variables
F(3, 119) = 0.12
Prob > F = 0.9466

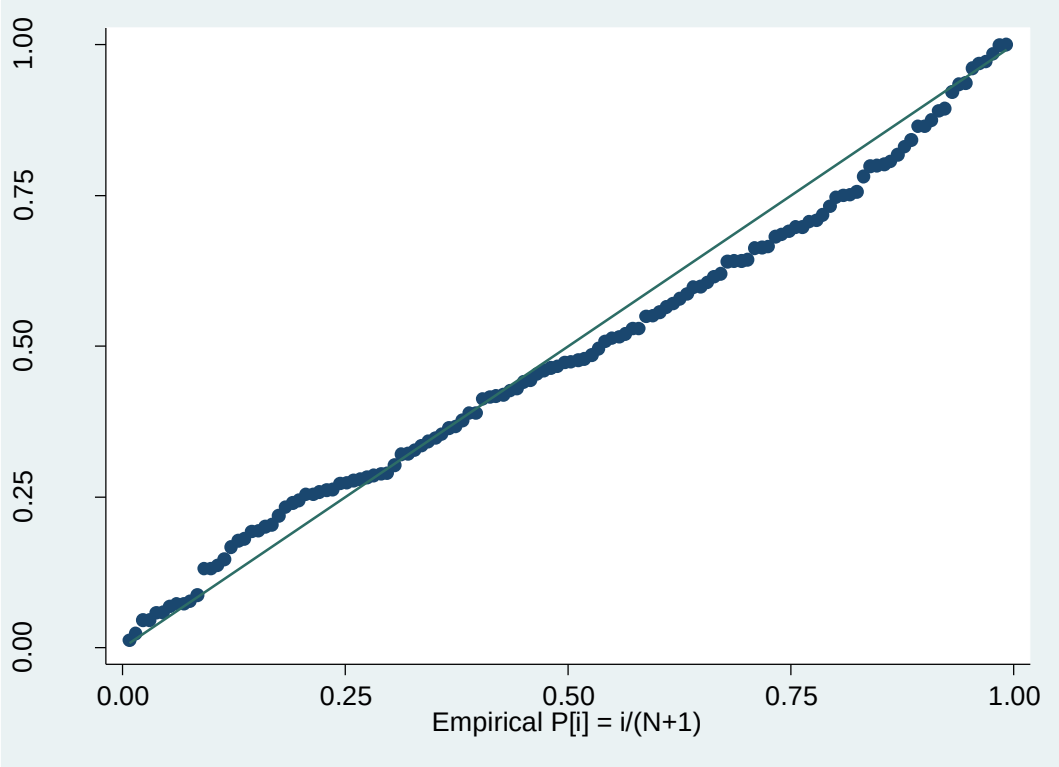

100
50
0
-50
-30
-20
-10
0
10
predicted value

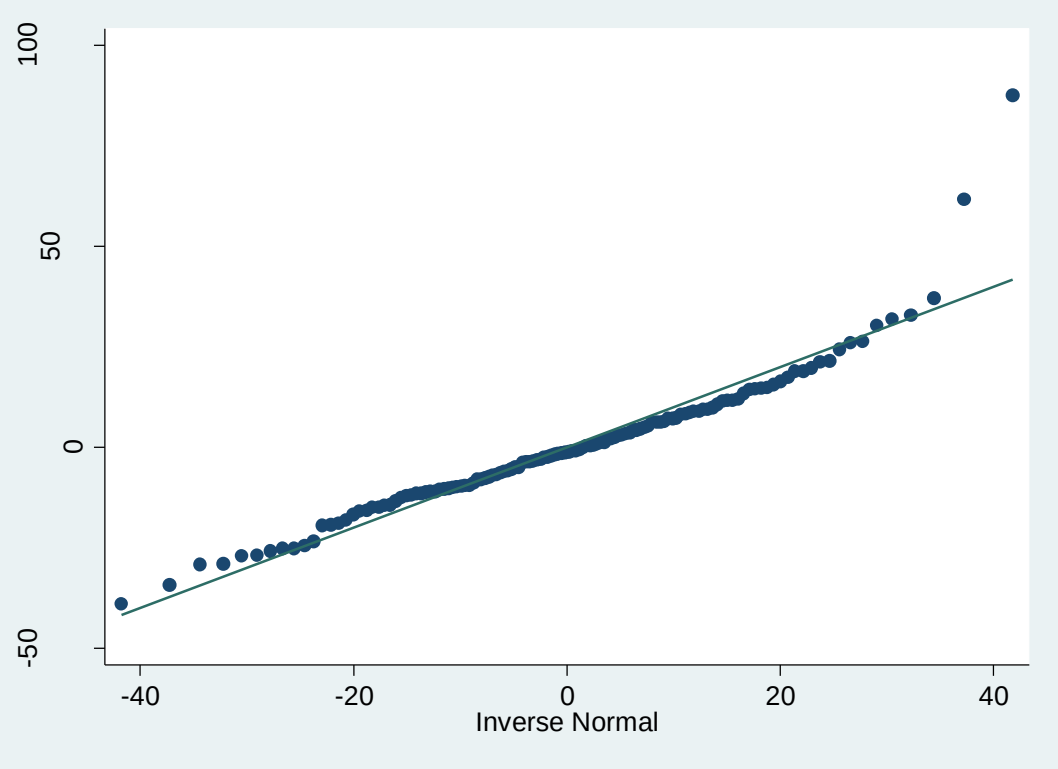

100
50
0
-50
-30
-20
-10
0
10
Fitted values


e(ycom_chg2 | X)
e(popdensity | X)
coef = -7.962252, se = 3.8545314, t = -2.07
e(uncult47 | X)
coef = .45789706, se = .17822652, t = 2.57
e(ypotato49 | X)
coef = .00320956, se = .00108119, t = 2.97
e(logcommon | X)
coef = .57355754, se = 3.1621727, t = .18
e(overthirty_chg2 | X)
coef = -.45018534, se = .2337066, t = -1.93
e(rationheadz | X)
coef = -5.4150018, se = 2.0477776, t = -2.64
e(cluster4 | X)
coef = -7.0575797, se = 5.3162988, t = -1.33


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 4.7822


.03
.02
.01
0
-50
0
50
100
Residuals


1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)



Model 5 [y = rationheadz]

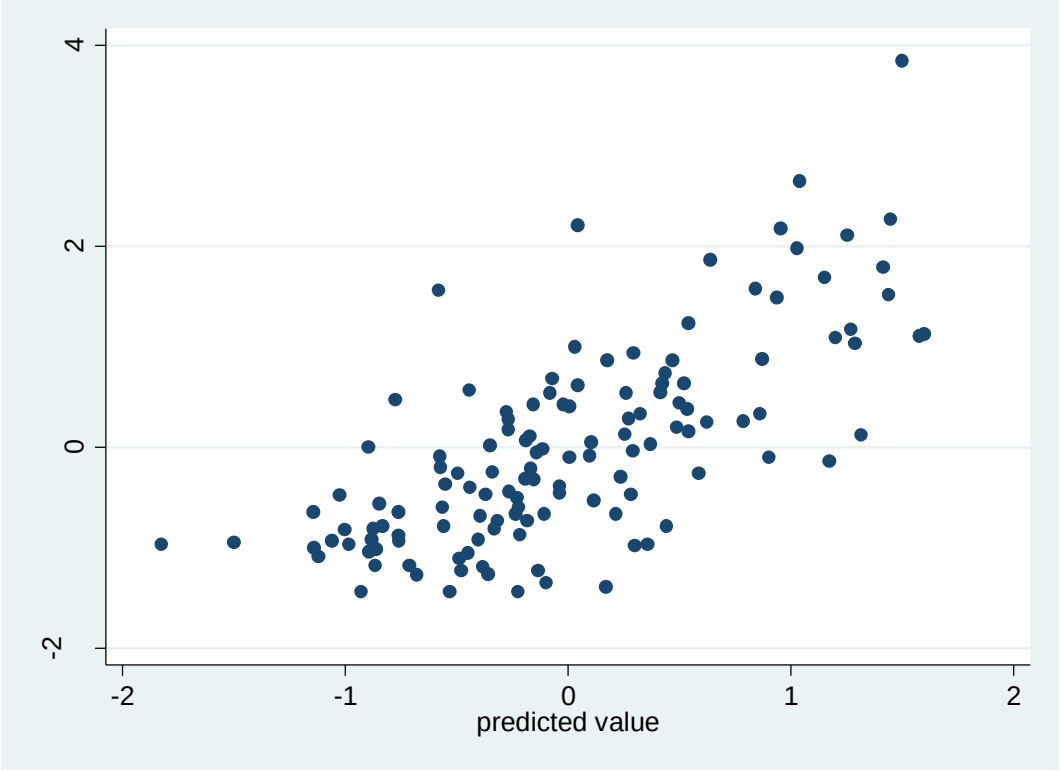
Partial and Semipartial correlations of rationheadz with

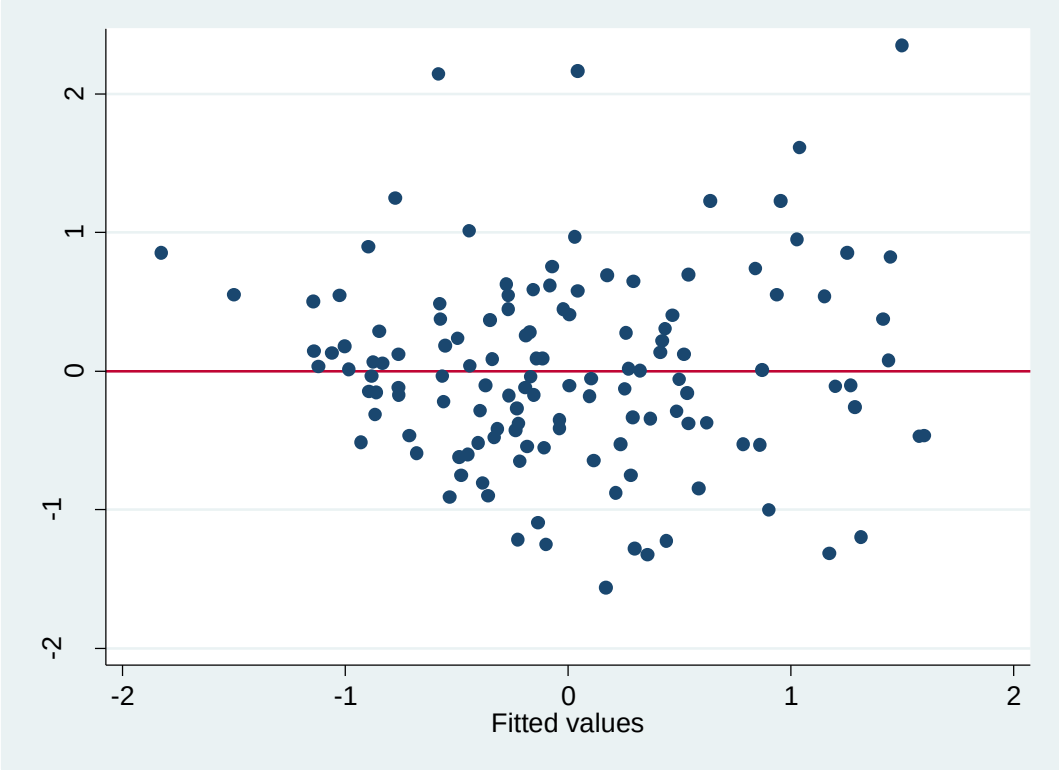
Variable	Partial	SemiP	Partial^2	SemiP^2	Sig.
popdensity	0.2322	0.1668	0.0539	0.0278	0.010
plvacre	-0.2490	-0.1797	0.0620	0.0323	0.006
uncult47	0.4279	0.3309	0.1831	0.1095	0.000
ycorn_chg2	-0.2374	-0.1708	0.0563	0.0292	0.009
crop_chg	-0.2073	-0.1481	0.0430	0.0219	0.023
flax47	-0.3557	-0.2660	0.1265	0.0708	0.000
overthirty~2	0.0521	0.0365	0.0027	0.0013	0.570
_Icommong_2	-0.0613	-0.0430	0.0038	0.0018	0.504
_Icommong_3	-0.0763	-0.0535	0.0058	0.0029	0.406
_Icommong_4	0.2812	0.2048	0.0791	0.0419	0.002

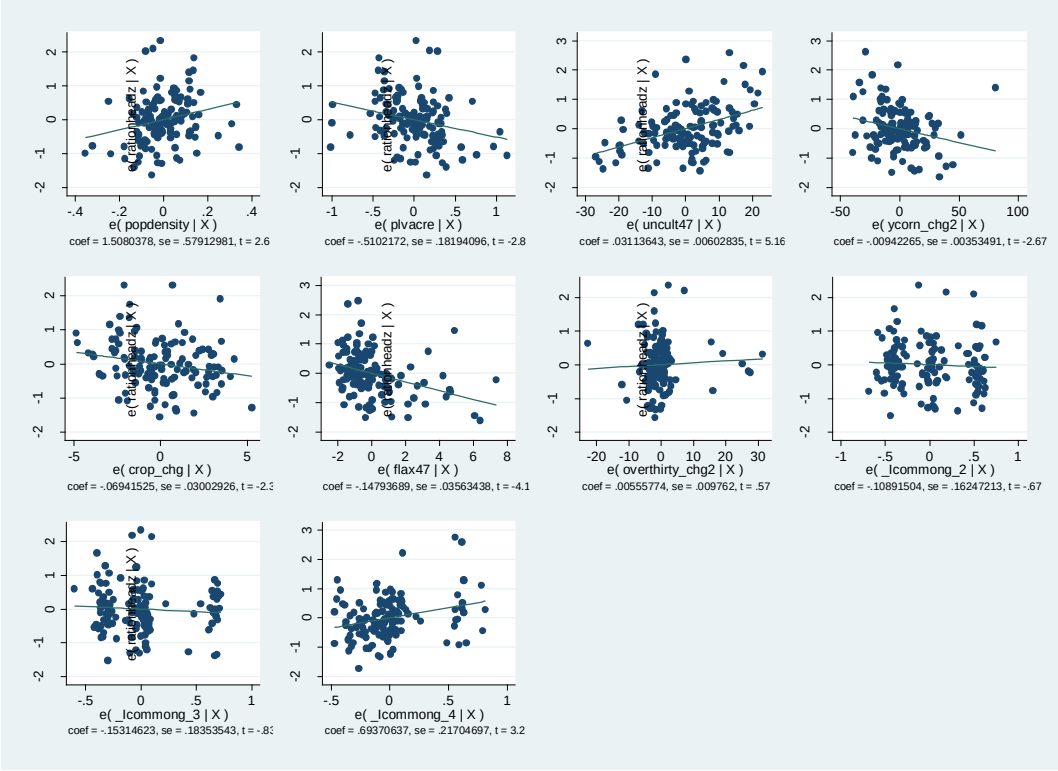
Shapiro-Wilk W test for normal data

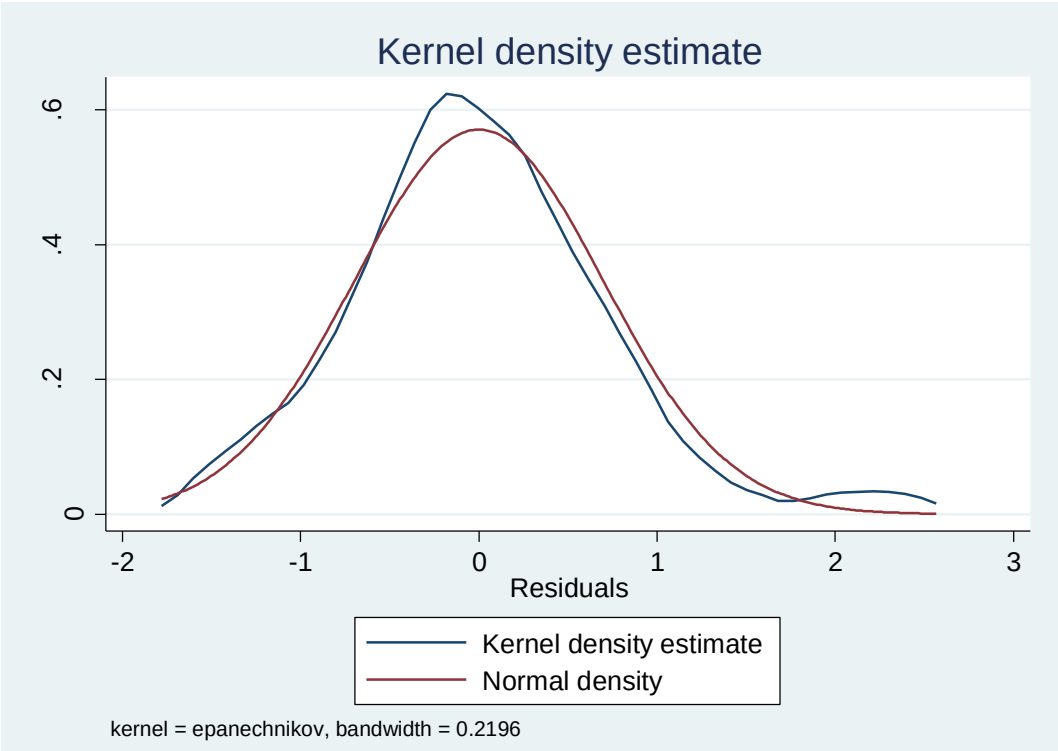
Variable	Obs	W	V	z	Prob>z
e	130	0.97233	2.850	2.356	0.00923

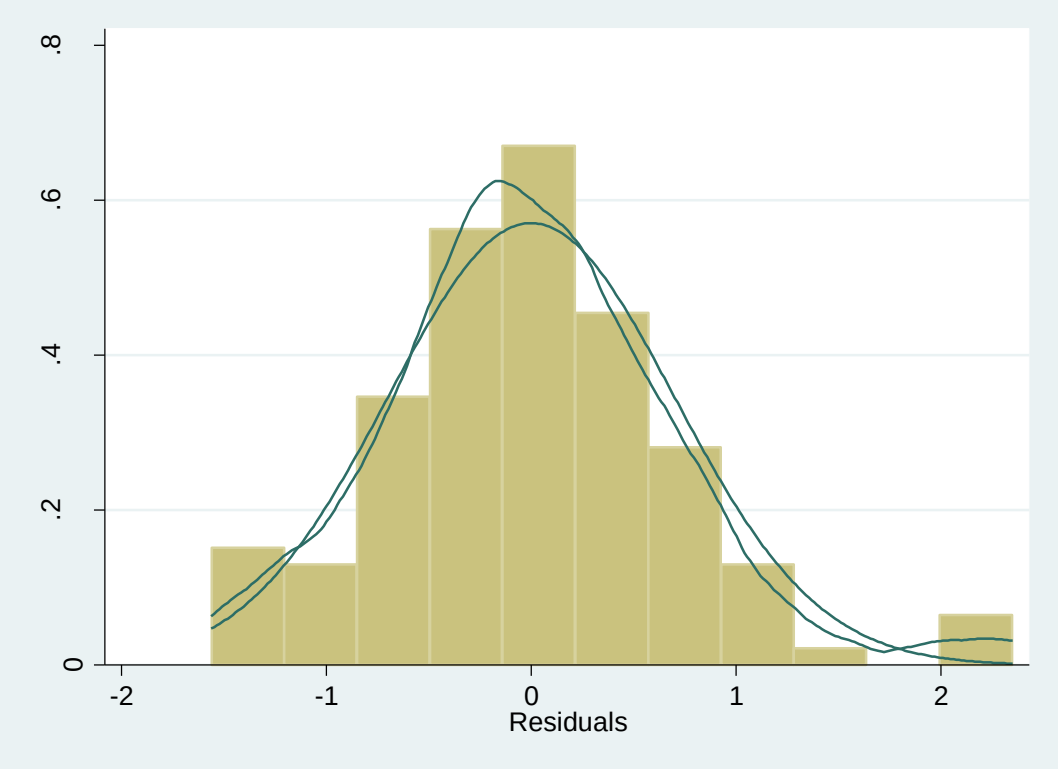
Ramsey RESET test using powers of the fitted values of rationheadz
Ho: model has no omitted variables
F(3, 116) = 3.15
Prob > F = 0.0276

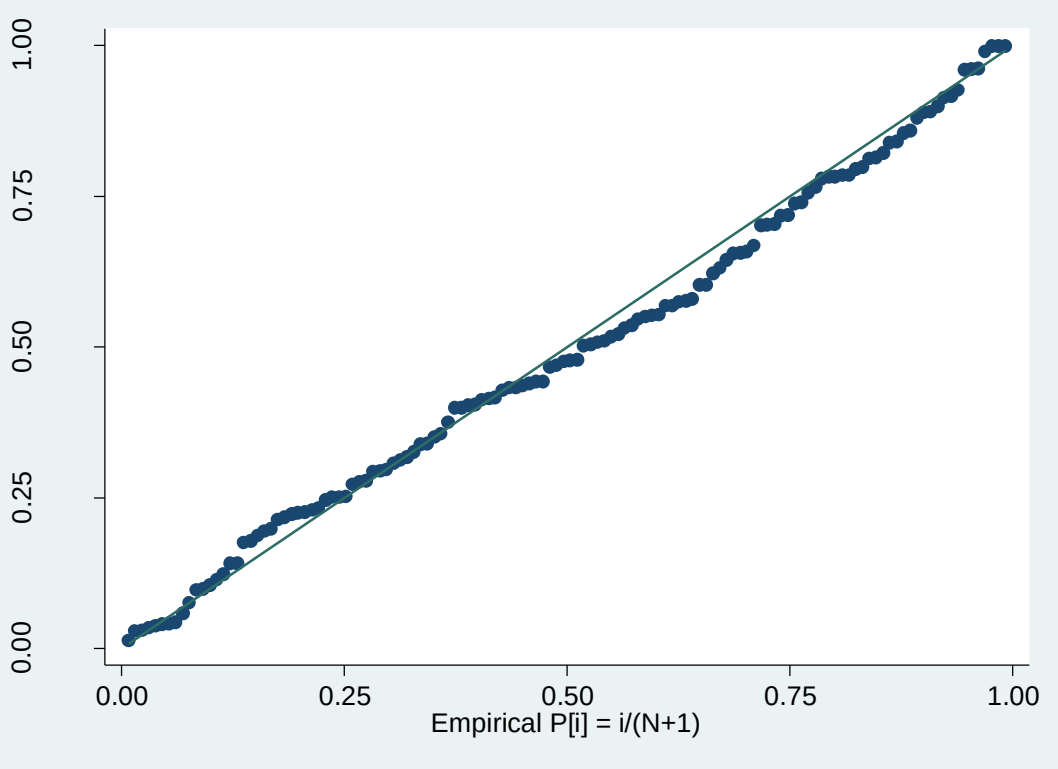

4
2
0
-2
-2
-1
0
1
2
predicted value

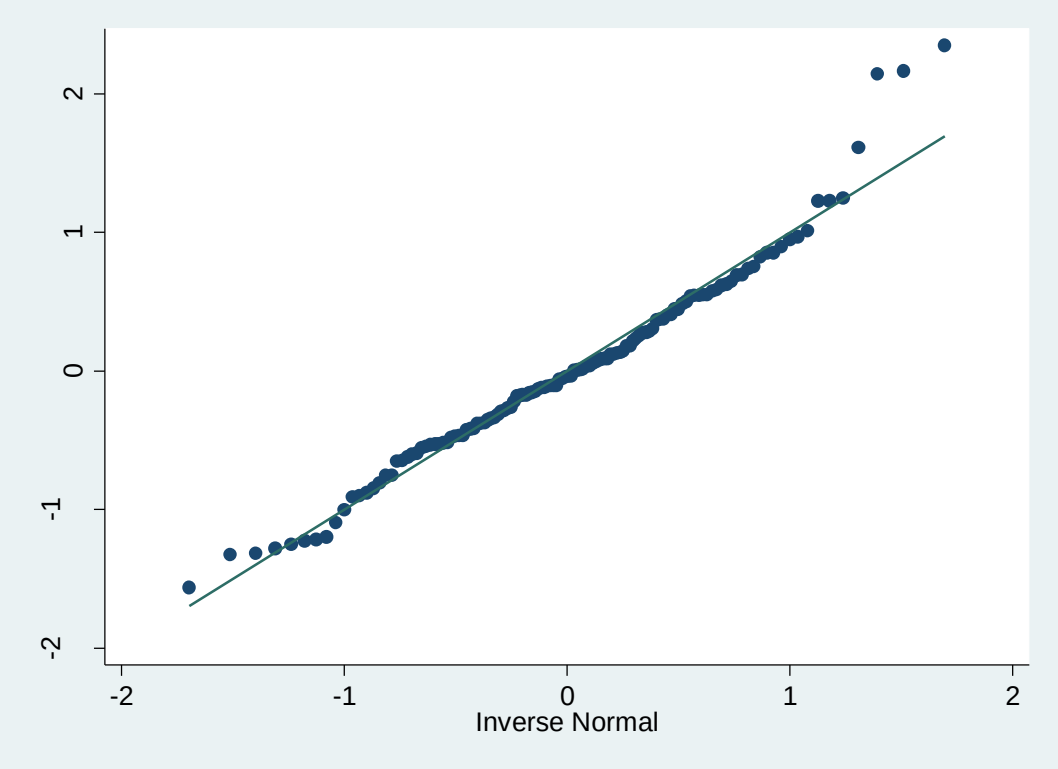

2
1
0
-1
-2
-2
-1
0
1
2
Fitted values


e(popdensity | X)
coef = 1.5080378, se = .57912981, t = 2.6
e(plvacre | X)
coef = -.5102172, se = .18194096, t = -2.8
e(uncult47 | X)
coef = .03113643, se = .00602835, t = 5.16
e(ycorn_chg2 | X)
coef = -.00942265, se = .00353491, t = -2.67
e(crop_chg | X)
coef = -.06941525, se = .03002926, t = -2.3
e(flax47 | X)
coef = -.14793689, se = .03563438, t = -4.1
e(overthirty_chg2 | X)
coef = .00555774, se = .009762, t = .57
e(_lcommong_2 | X)
coef = -.10891504, se = .16247213, t = -.67
e(_lcommong_3 | X)
coef = -.15314623, se = .18353543, t = -.83
e(_lcommong_4 | X)
coef = .69370637, se = .21704697, t = 3.2


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 0.2196


0
.2
.4
.6
.8
-2
-1
0
1
2
Residuals


0.00
0.25
0.50
0.75
1.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)



Model 6 [y = rationheadz]

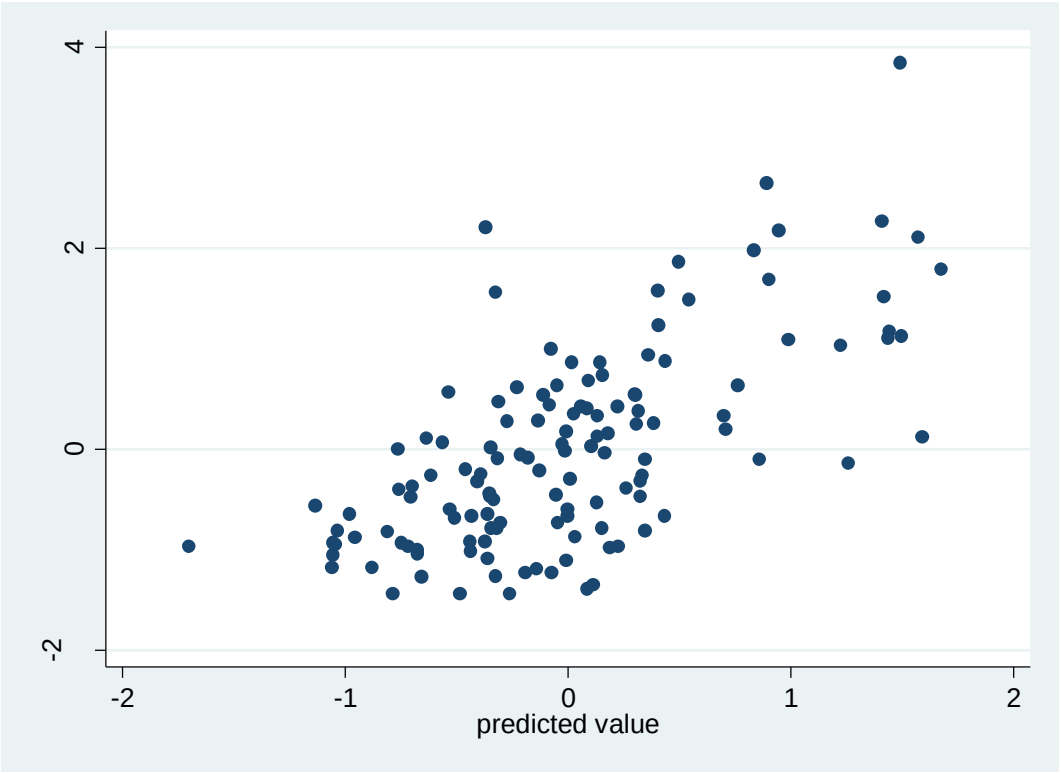
Partial and Semipartial correlations of rationheadz with

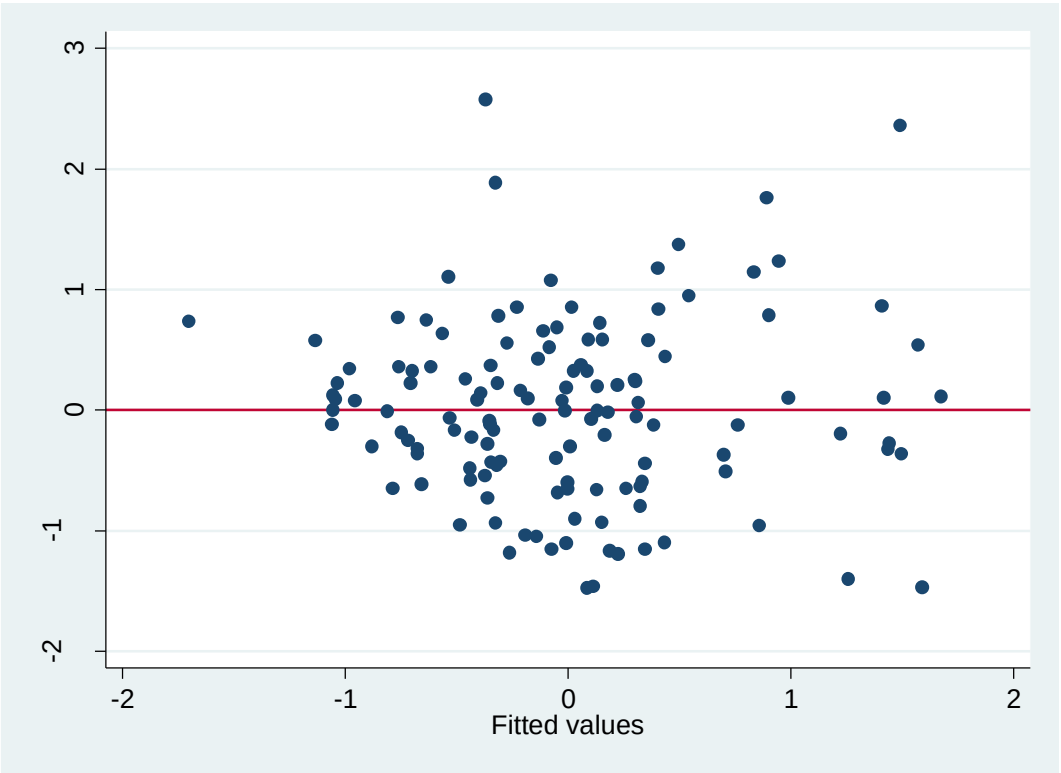
Variable	Partial	SemiP	Partial^2	SemiP^2	Sig.
popdensity	0.0918	0.0691	0.0084	0.0048	0.315
plvacre	-0.0979	-0.0738	0.0096	0.0054	0.283
uncult47	0.4536	0.3816	0.2058	0.1456	0.000
corn47	0.1029	0.0776	0.0106	0.0060	0.259
ycorn_chg2	-0.2133	-0.1637	0.0455	0.0268	0.018
logcommon~47	-0.2777	-0.2167	0.0771	0.0470	0.002
_Icommong_2	-0.0130	-0.0098	0.0002	0.0001	0.887
_Icommong_3	0.0073	0.0054	0.0001	0.0000	0.937
_Icommong_4	0.3216	0.2547	0.1034	0.0648	0.000

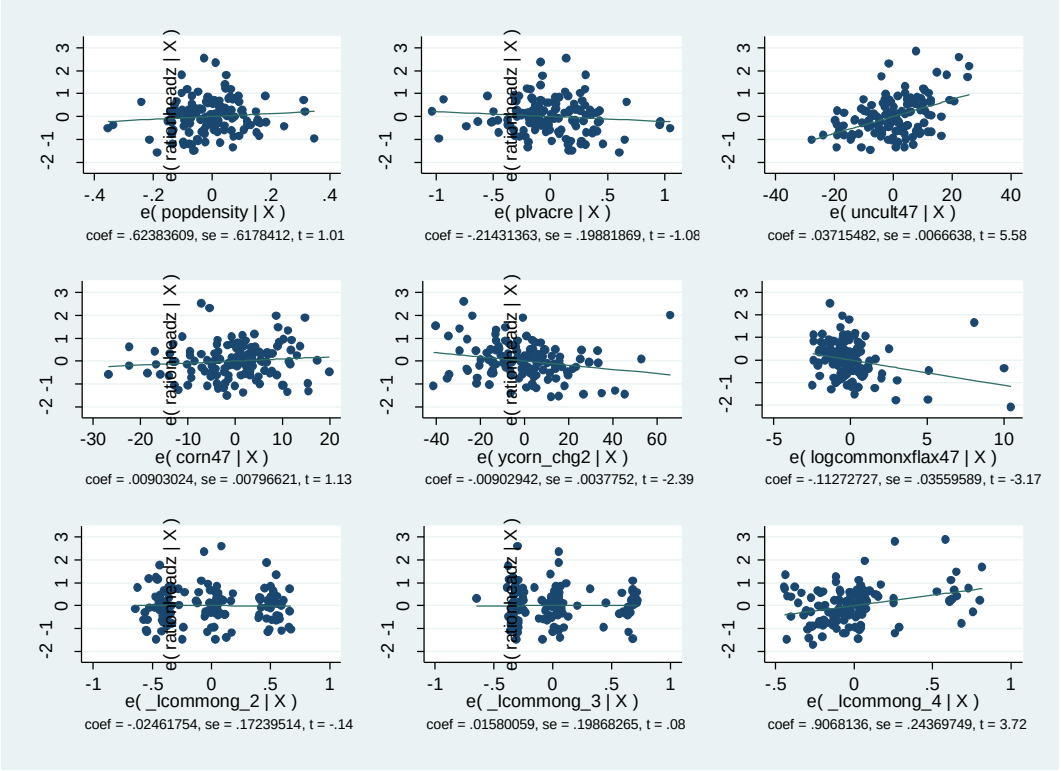
Shapiro-Wilk W test for normal data

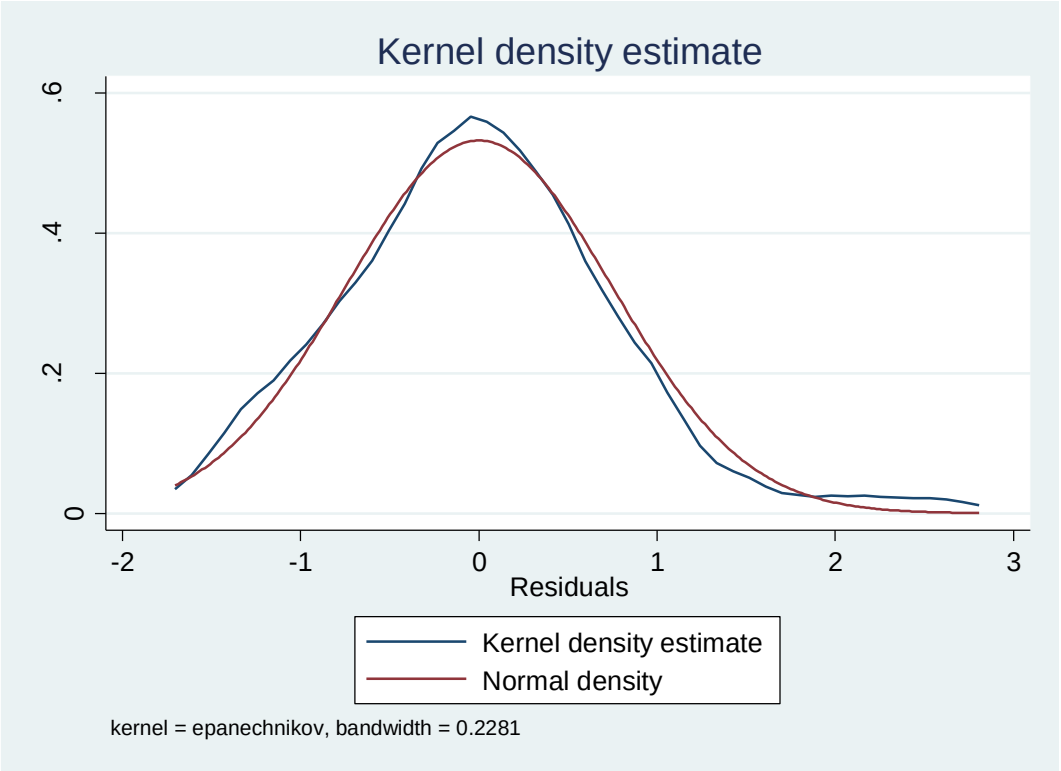
Variable	Obs	W	V	z	Prob>z
e	130	0.97722	2.346	1.919	0.02749

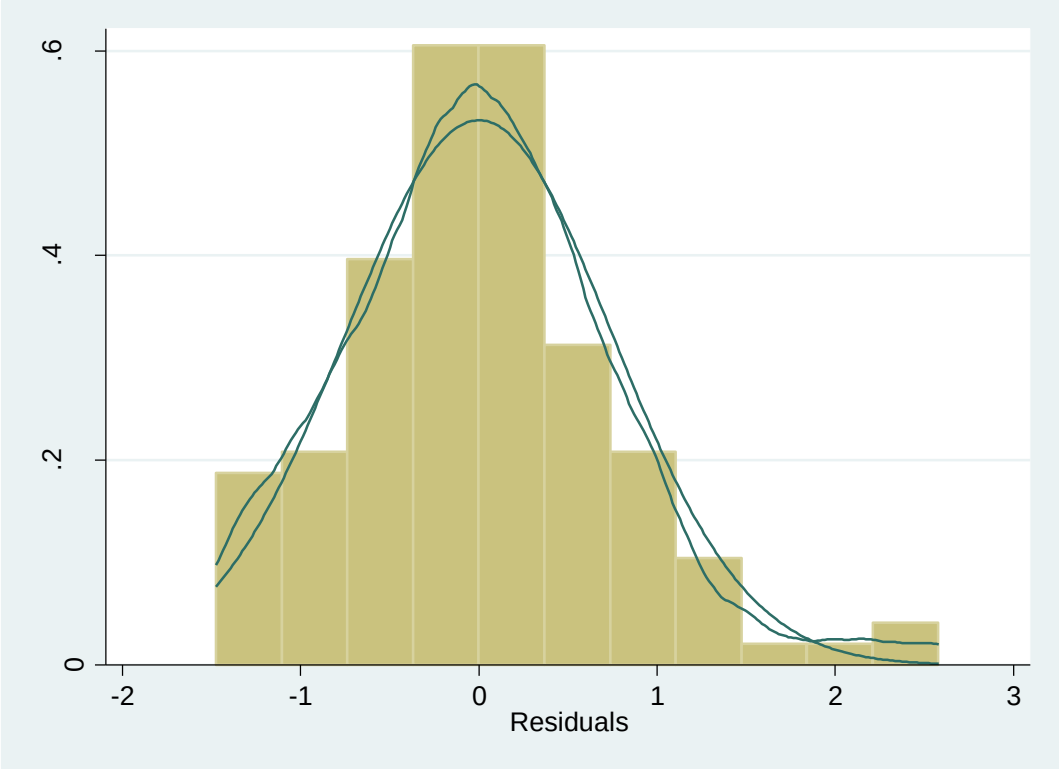
Ramsey RESET test using powers of the fitted values of rationheadz
Ho: model has no omitted variables
F(3, 117) = 1.56
Prob > F = 0.2018

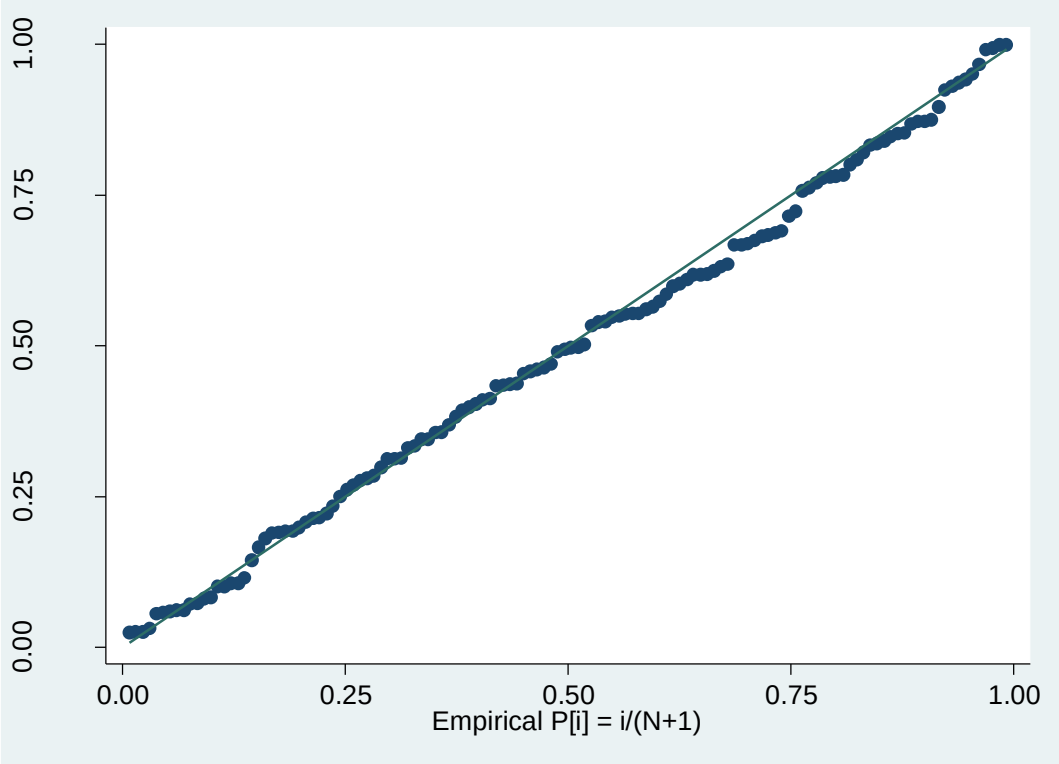

4
2
0
-2
-2
-1
0
1
2
predicted value

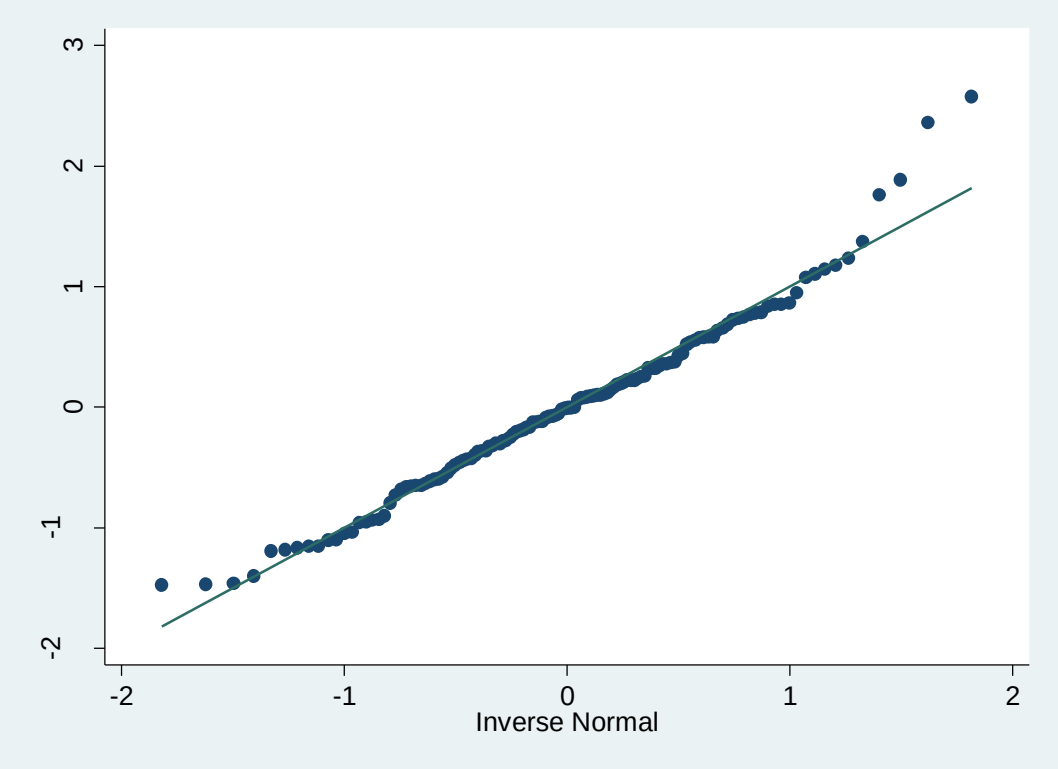

3
2
1
0
-1
-2
-2
-1
0
1
2
Fitted values


e(rationheadz | X)
e(popdensity | X)
coef = .62383609, se = .6178412, t = 1.01
e(plvacre | X)
coef = -.21431363, se = .19881869, t = -1.08
e(uncult47 | X)
coef = .03715482, se = .0066638, t = 5.58
e(corn47 | X)
coef = .00903024, se = .00796621, t = 1.13
e(ycorn_chg2 | X)
coef = -.00902942, se = .0037752, t = -2.39
e(logcommonxflax47 | X)
coef = -.11272727, se = .03559589, t = -3.17
e(_lcommong_2 | X)
coef = -.02461754, se = .17239514, t = -.14
e(_lcommong_3 | X)
coef = .01580059, se = .19868265, t = .08
e(_lcommong_4 | X)
coef = .9068136, se = .24369749, t = 3.72


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 0.2281


.6
.4
.2
0
-2
-1
0
1
2
3
Residuals


1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)



Chapter 8

Model 1 [y = logcommon]

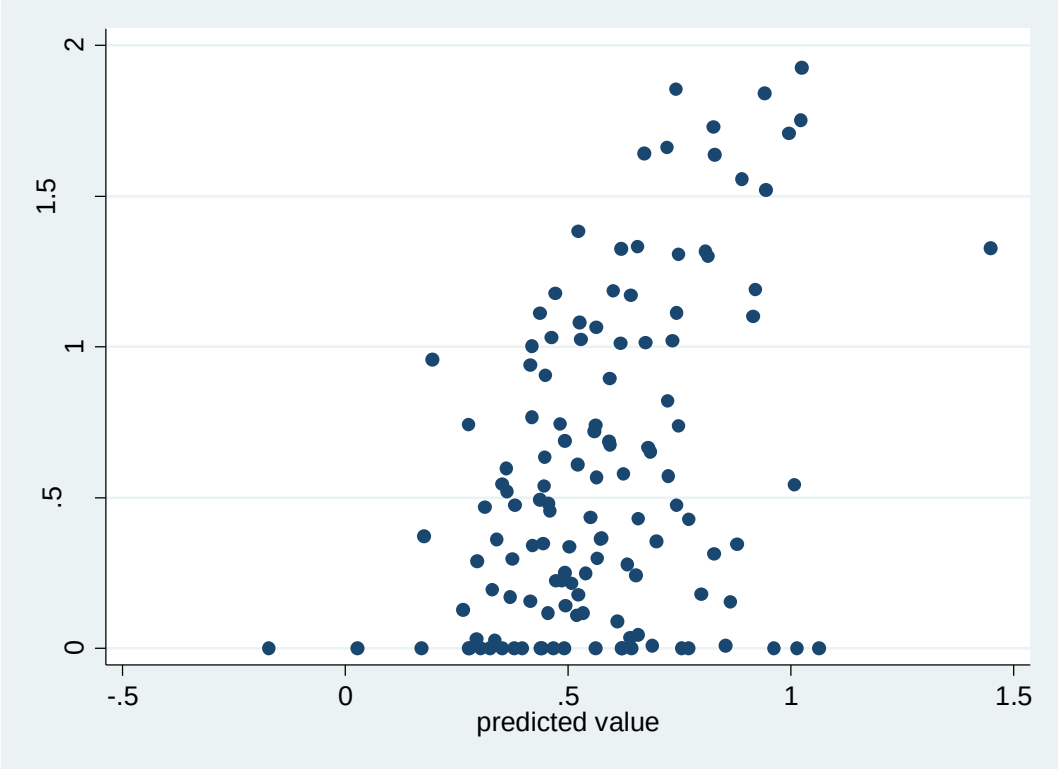
Partial and Semipartial correlations of logcommon with

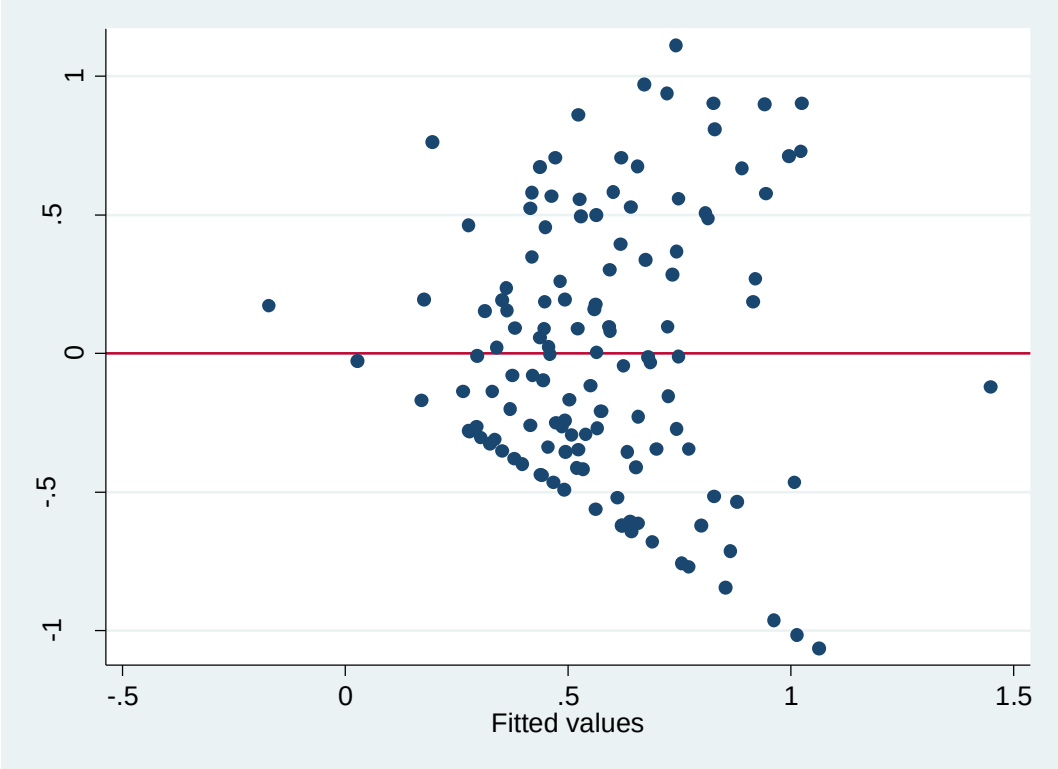
Variable	Partial	SemiP	Partial^2	SemiP^2	Sig.
plvacre	0.0962	0.0871	0.0092	0.0076	0.288
flax47	0.2029	0.1868	0.0412	0.0349	0.024
onefive	-0.1675	-0.1531	0.0280	0.0234	0.063
ycorn49	-0.0939	-0.0850	0.0088	0.0072	0.300
potato49	0.0620	0.0560	0.0038	0.0031	0.494
rationheadz	0.3376	0.3233	0.1140	0.1045	0.000

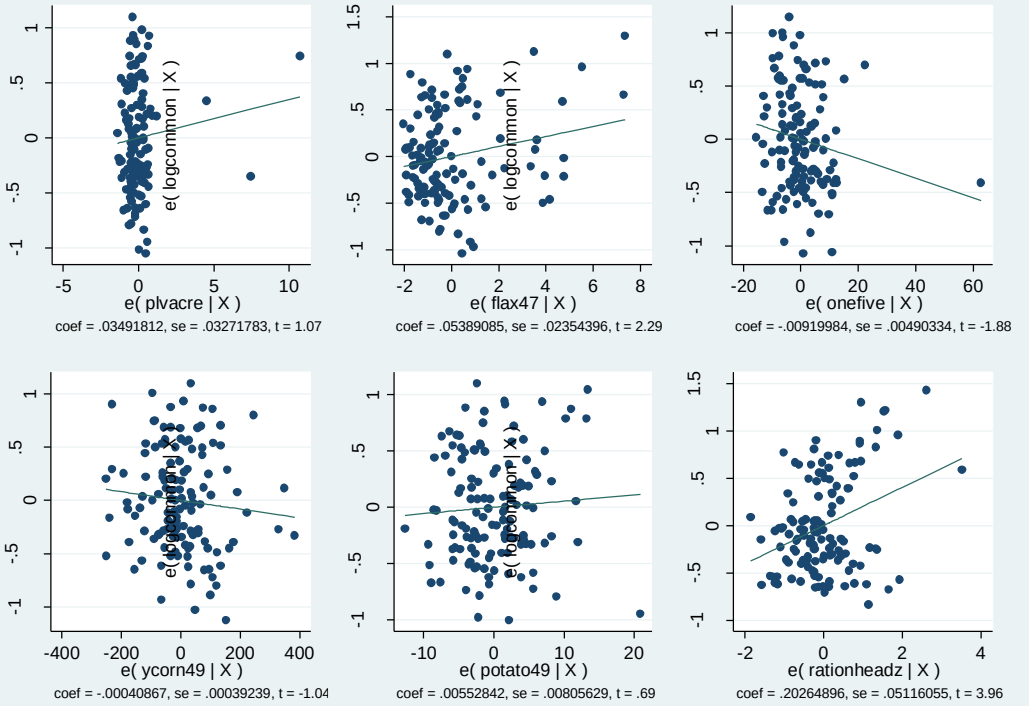
Ramsey RESET test using powers of the fitted values of logcommon
Ho: model has no omitted variables
F(3, 119) = 0.18
Prob > F = 0.9125

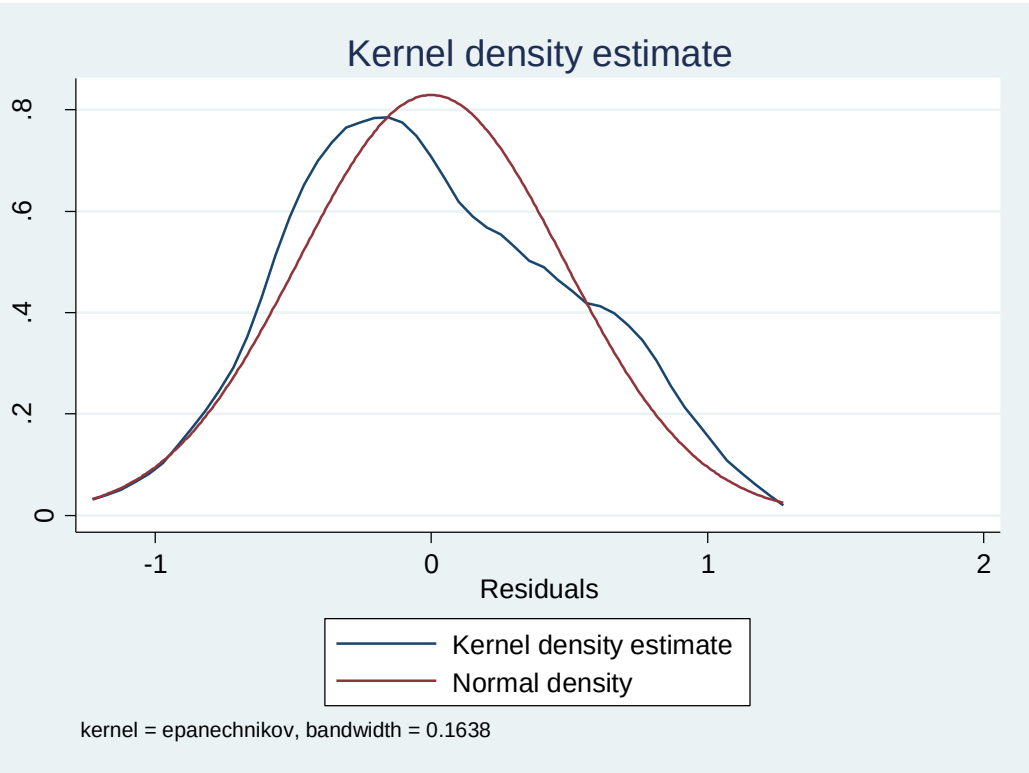
Shapiro-Wilk W test for normal data

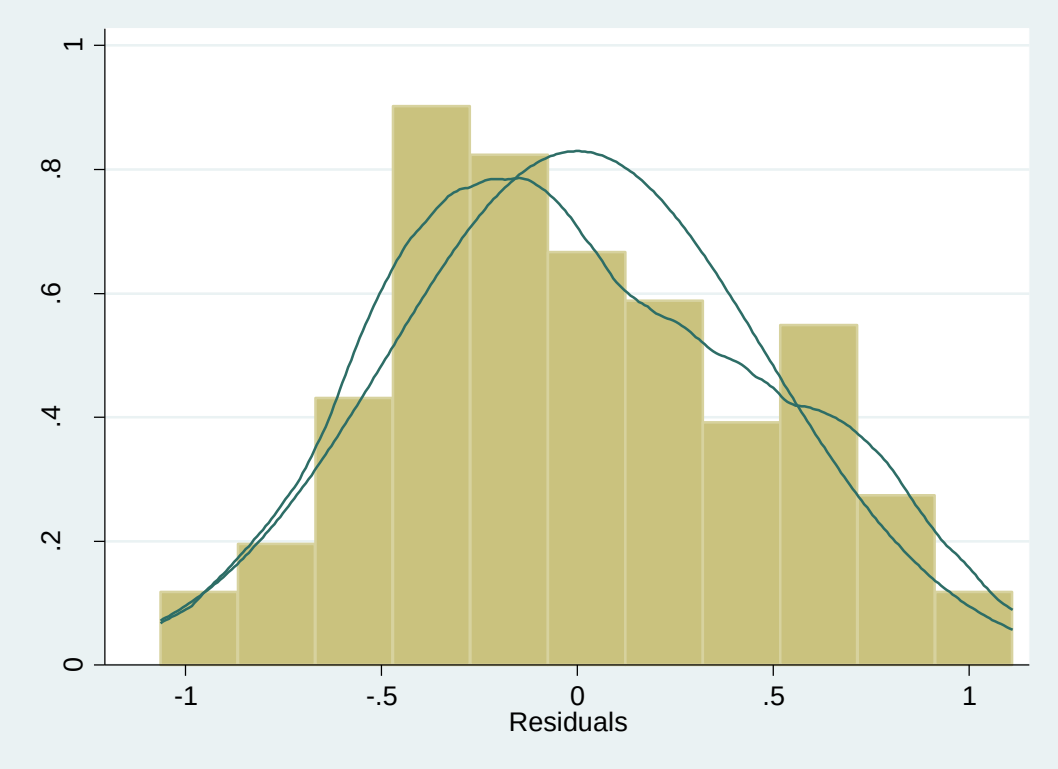
Variable	Obs	W	V	z	Prob>z
e	129	0.98198	1.844	1.376	0.08440

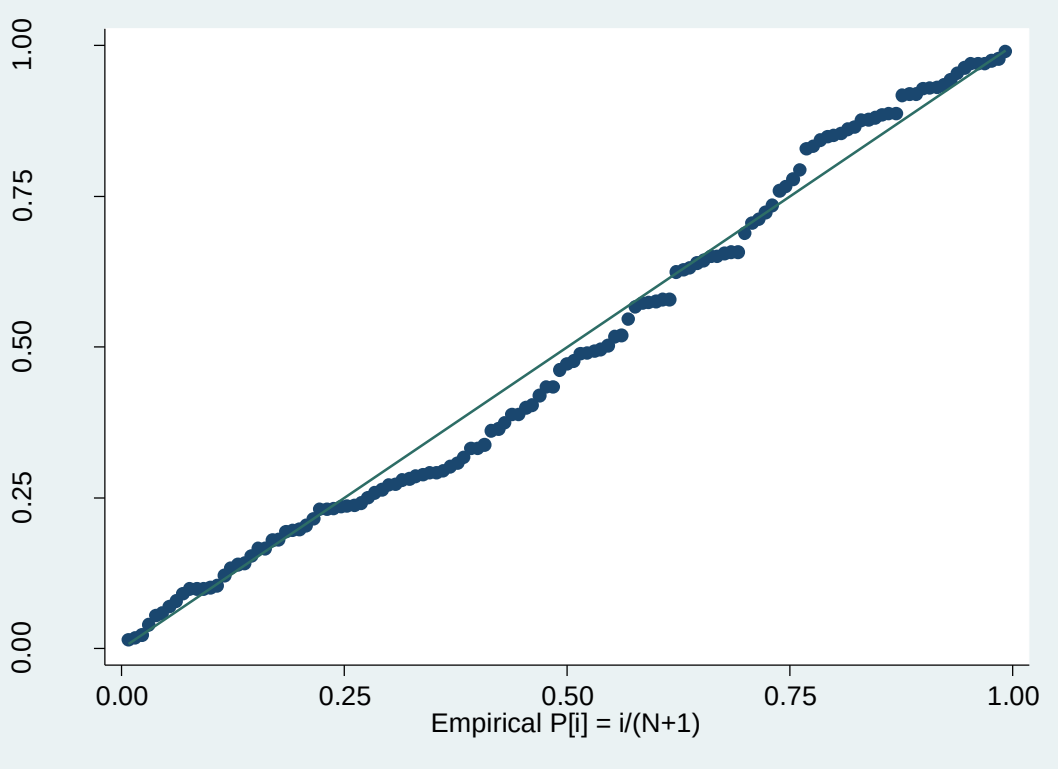

2
1.5
1
.5
0
-.5
0
.5
1
1.5
predicted value

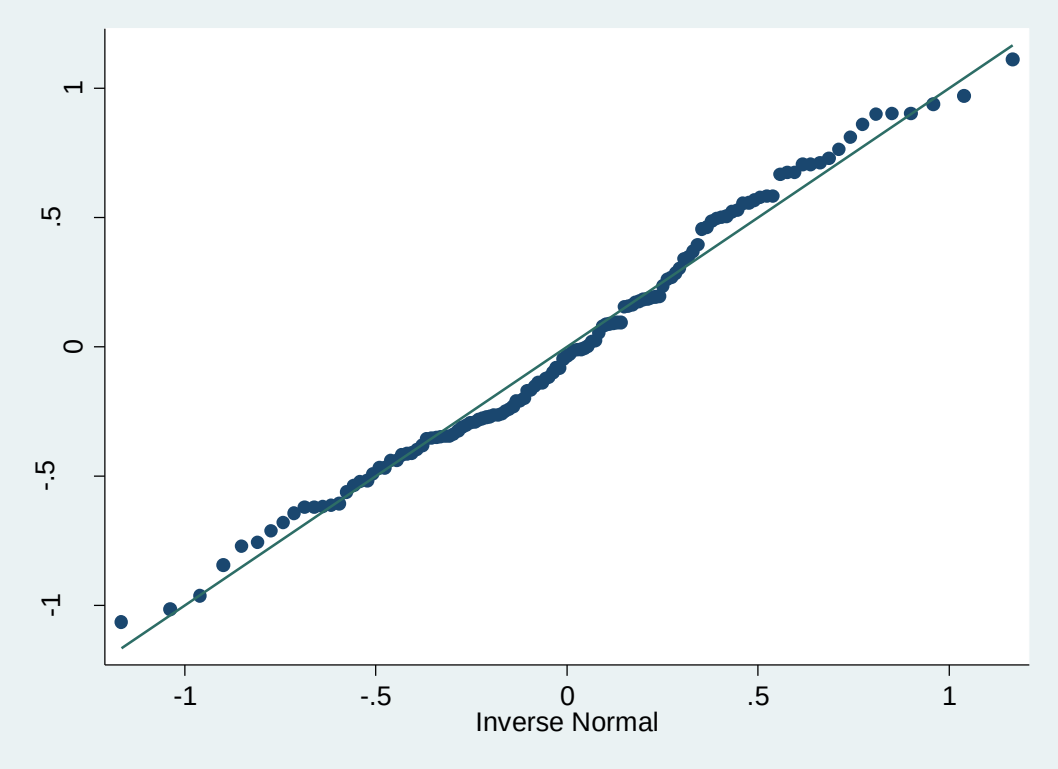

1
.5
0
-.5
-1
-.5
0
.5
1
1.5
Fitted values


e(logcommon | X)
e(plvacre | X)
coef = .03491812, se = .03271783, t = 1.07
e(flax47 | X)
coef = .05389085, se = .02354396, t = 2.29
e(onefive | X)
coef = -.00919984, se = .00490334, t = -1.88
e(ycorn49 | X)
coef = -.00040867, se = .00039239, t = -1.04
e(potato49 | X)
coef = .00552842, se = .00805629, t = .69
e(rationheadz | X)
coef = .20264896, se = .05116055, t = 3.96


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 0.1638


0
.2
.4
.6
.8
1
-1
-.5
0
.5
1
Residuals


0.00
0.25
0.50
0.75
1.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)



Model 2 [y = logcommon]

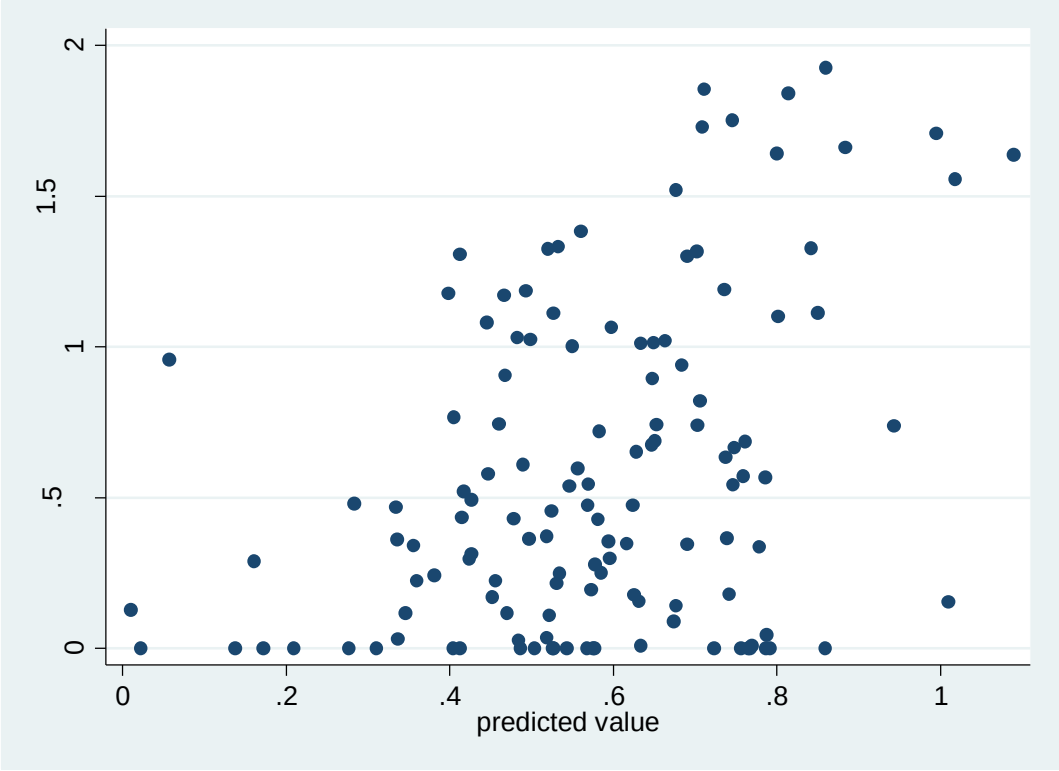
Partial and Semipartial correlations of logcommon with

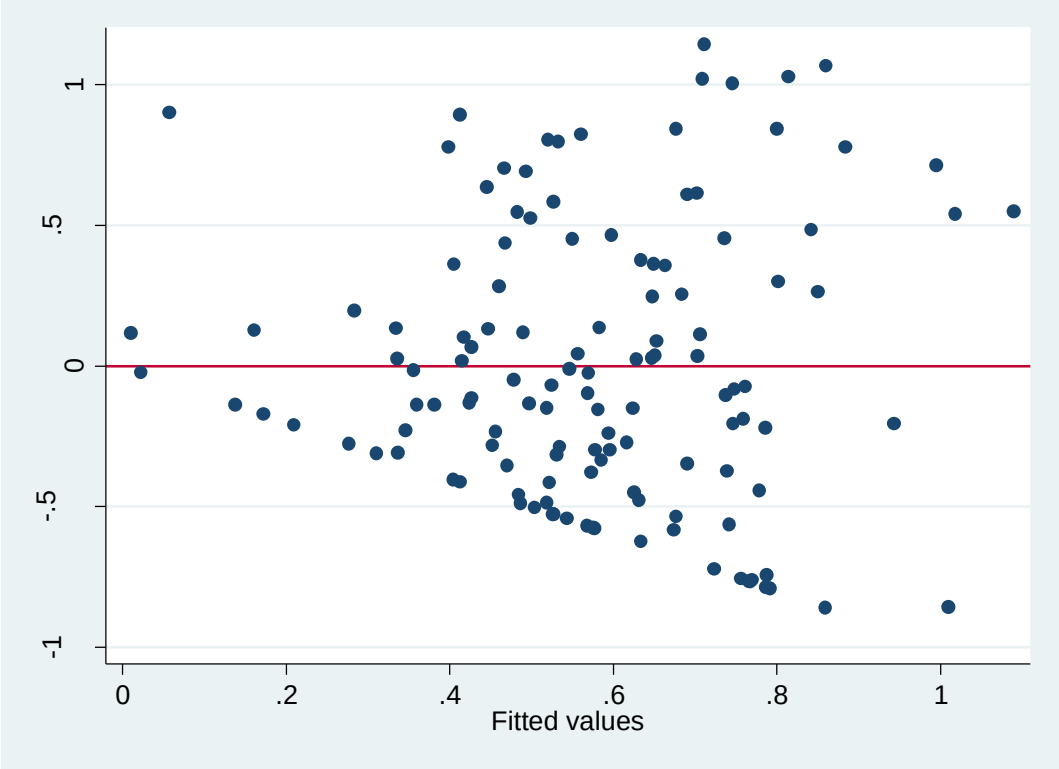
Variable	Partial	SemiP	Partial^2	SemiP^2	Sig.
plvacre	0.1134	0.1060	0.0129	0.0112	0.210
uncult47	0.2436	0.2333	0.0593	0.0544	0.006
flax47	0.1309	0.1227	0.0171	0.0151	0.147
onefive	-0.0539	-0.0501	0.0029	0.0025	0.552
ycorn49	-0.1566	-0.1473	0.0245	0.0217	0.082
potato49	0.0140	0.0130	0.0002	0.0002	0.878

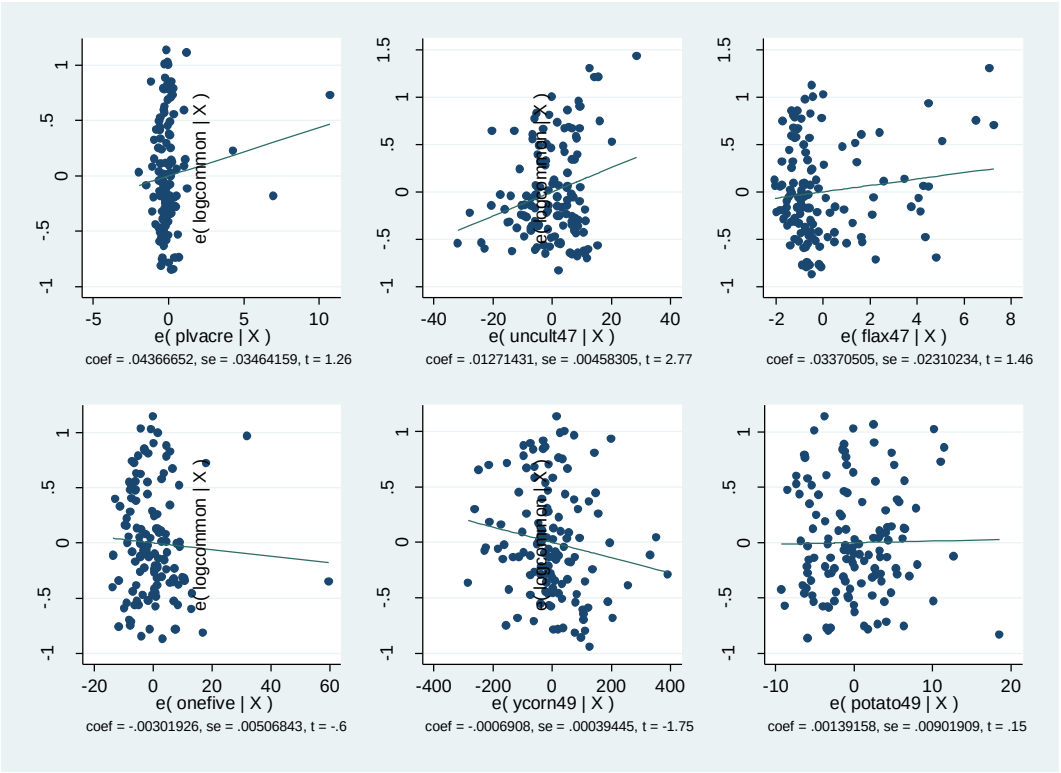
Ramsey RESET test using powers of the fitted values of logcommon
Ho: model has no omitted variables
F(3, 119) = 0.79
Prob > F = 0.5021

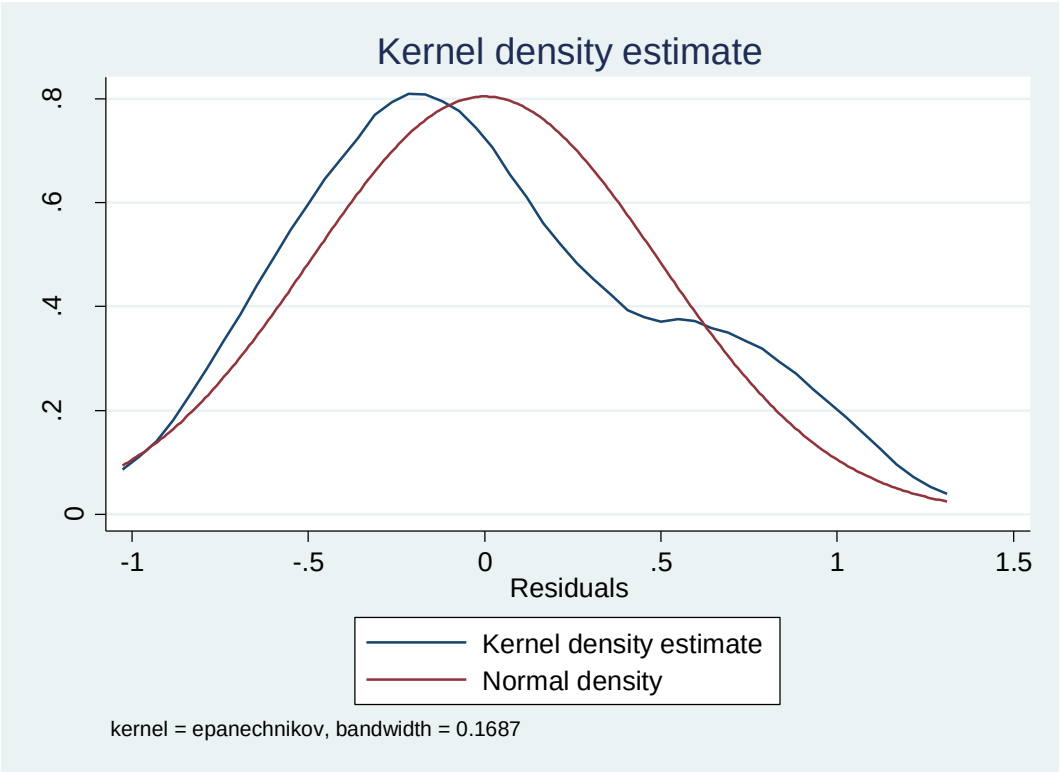
Shapiro-Wilk W test for normal data

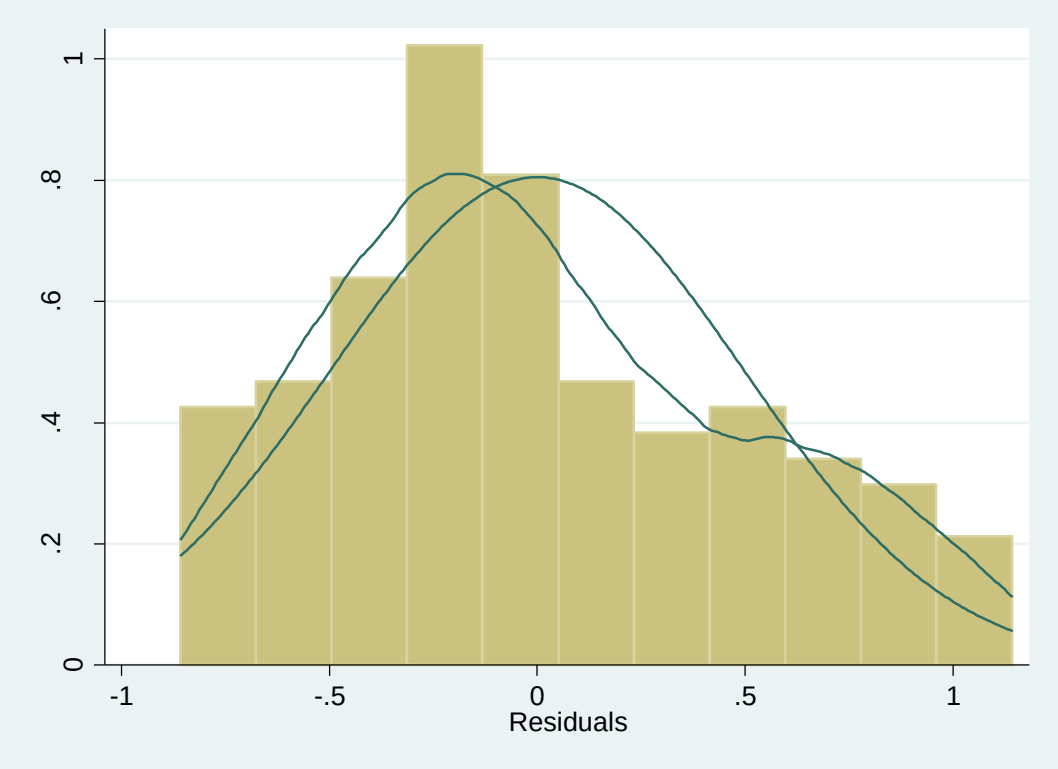
Variable	Obs	W	V	z	Prob>z
e	129	0.96597	3.481	2.805	0.00251

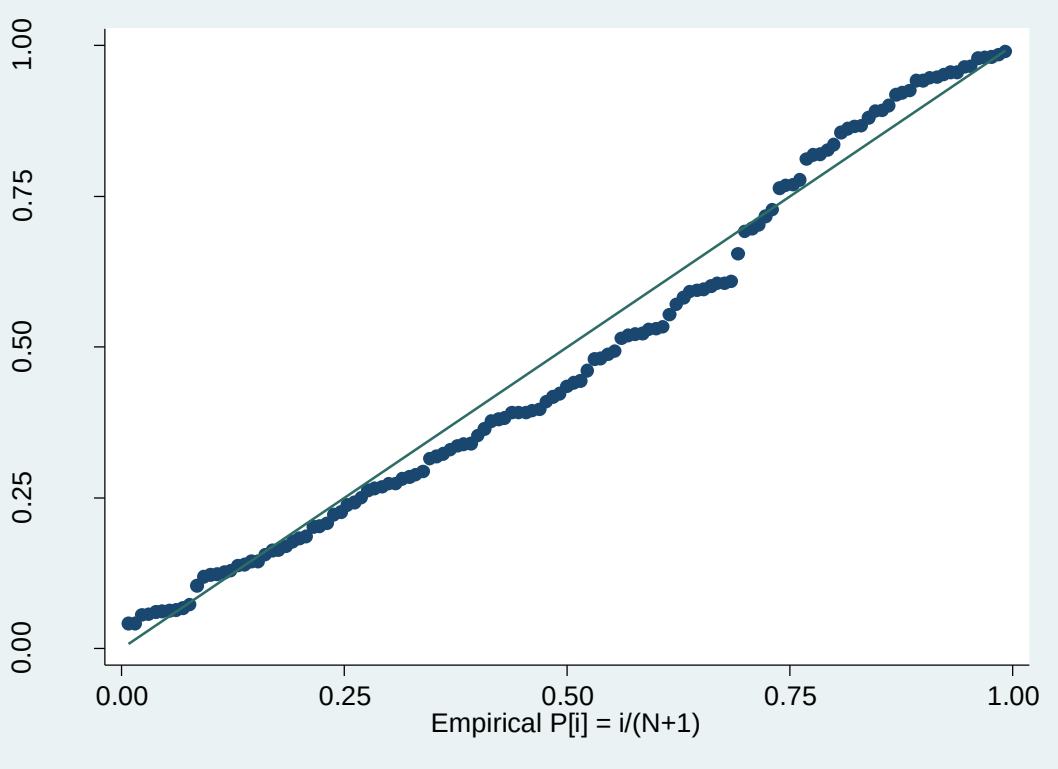

2
1.5
1
.5
0
0
.2
.4
.6
.8
1
predicted value

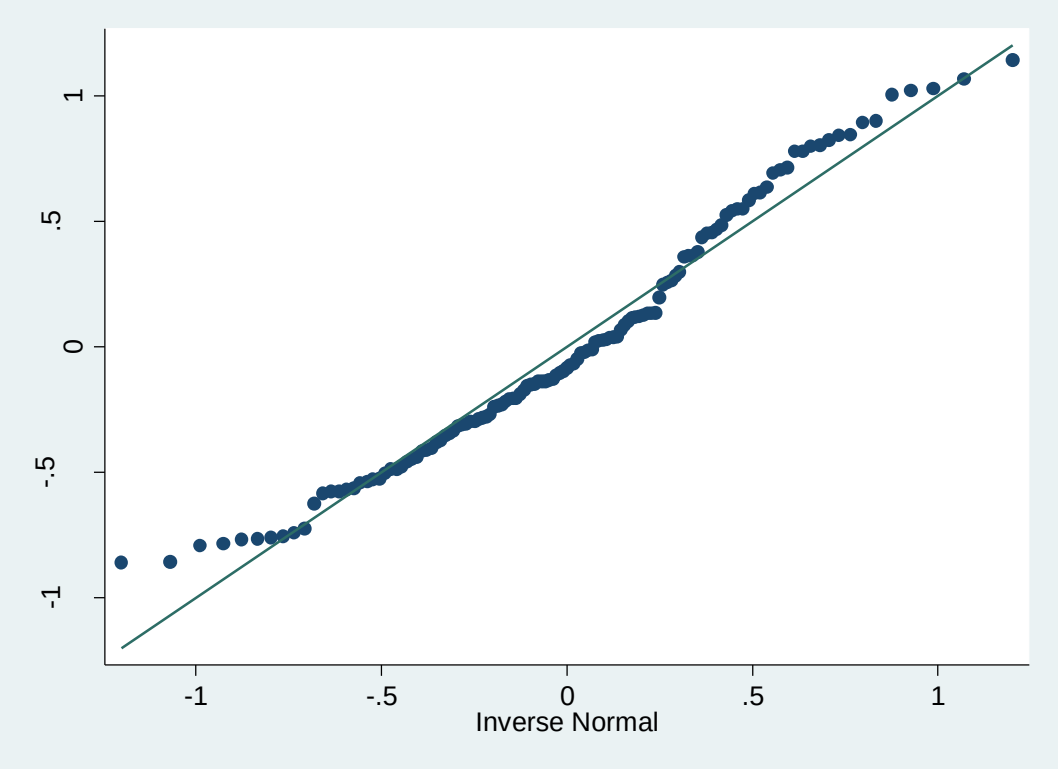

1
.5
0
-.5
-1
0
.2
.4
.6
.8
1
Fitted values


e(logcommon | X)
e(plvacre | X)
coef = .04366652, se = .03464159, t = 1.26
e(uncult47 | X)
coef = .01271431, se = .00458305, t = 2.77
e(flax47 | X)
coef = .03370505, se = .02310234, t = 1.46
e(onefive | X)
coef = -.00301926, se = .00506843, t = -.6
e(ycorn49 | X)
coef = -.0006908, se = .00039445, t = -1.75
e(potato49 | X)
coef = .00139158, se = .00901909, t = .15


Kernel density estimate
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 0.1687


0
.2
.4
.6
.8
1
-1
-.5
0
.5
1
Residuals


0.00
0.25
0.50
0.75
1.00
0.00
0.25
0.50
0.75
1.00
Empirical P[i] = i/(N+1)


-1
-.5
0
.5
1
-1
-.5
0
.5
1
Inverse Normal

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