VISUALISING INEQUALITY: MODELLING DISPARITIES IN HEALTH OUTCOMES

BY

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A thesis

submitted to the Victoria University of Wellington

in fulfilment of the requirements for the degree of

Master of Arts

Victoria University of Wellington

2011

Abstract

The thesis begins to integrate some contemporary theorising in sociology, frameworks for explaining social disparities in population health, disciplines from System Dynamics modelling, and, D.D. Heckathorn's model of 'The Dynamics and Dilemmas of Collective Action'. Wilkinson and Marmot are recognised as leading participants in public discussion of population health disparities. The priorities they advocate are reflected in public statements of intent such as the statutory objective of New Zealand District Health Boards 'to reduce, with a view to eliminating, health outcome disparities between various population groups . . .' Sen's advocacy for impartial governance when allocating freedom-based capabilities is considered as a core strategy for reducing disparities and promoting justice. The main question addressed is whether sociological theory can contribute to understanding the dynamics implied by Sen's 'idea of justice'. The conclusion is that the work of Runciman, Coleman, Turner, Lenski, Jasso and Heckathorn can be used to analyse the influence of corporate actors and sectoral strategies, which Wilkinson and Pickett referred to as 'the elephant in the . . . room' in discussions about determinants and the social gradient of health.

Acknowledgements

My thanks to David Pearson and Bob Cavana who supervised this thesis.

David provided a stable, tolerant and well informed reference point as I began to develop a response to material that was previously unknown to me. I greatly appreciate his willingness to participate in this project and the depth of support he provided.

Bob introduced me to System Dynamics as a modelling method and a community of interest. He was a tutor as well as a supervisor, generous with his guidance and willing to accommodate some idiosyncratic learning objectives.

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INTRODUCTION

Three influences shaped the proposal for this thesis: Wilkinson's (1996; 2000; 2003; 2005) analysis of health and inequality, the rigour and range of Coleman's (1990; Clark 1996) contribution to social theory, and an introduction to System Dynamics modelling (Maani and Cavana 2000). The initial question was: 'is it possible to simulate societal dynamics that "reduce, with a view to eliminating, health outcome disparities between various population groups within New Zealand . . . in consultation with the groups concerned . . ."?' (2000:22(1)(f)). The thesis outlines the line of enquiry that followed from that question.

Chapter 1 reviews sociological theory that applies a consistent conceptual framework to the selection and adaptation of social practices and to the much longer process of human evolution. The cryptic link between the two processes is Bottero's phrase 'hierarchy makes you sick' (Bottero 2004:186).

The second chapter reviews a liberal response to the issue from the World Health Organisation (WHO) (CSDH 2008) with reference to governance and Sen's commentary on 'The Idea of Justice' (Sen 2009). There is then an initial attempt to organise a response to Sen's strategy by drawing on the work of Jasso and Coleman.

Chapter 3 comments on concept modelling as it has been discussed in the System Dynamics community and identifies some examples. The most relevant model identified which integrated the conceptual framework and modelling strategy was Heckathorn's (1996; 1998) model of 'The Dynamics and Dilemmas of Collective Action'. The following chapter presents some of the dynamics of that model.

Chapter 5 takes some initial steps towards integrating Jasso's model of macro social structure and the model of collective action. The conclusion is consistent with Giddens' advice that 'game-theoretical models can be very useful in empirical research, in respect of suggesting both problems to be investigated and how research results might be interpreted' (Giddens 1984:313). The thesis reports some preliminary work undertaken with those aims in mind.

CHAPTER 1: THEORETICAL FRAMEWORK

Introduction

This chapter identifies the set of sociologists drawn on in the thesis. That section is followed by a summary of Lane's suggestion that System Dynamics modelling of societal dynamics would benefit from closer attention to Giddens' contribution to social theory. Aspects of Giddens' conceptual framework are elaborated by referring to other sociologists, particularly Runciman, Lenski, Coleman and Turner. Then evolutionary aspects of that theorising are related to recent discussion of the health gradient led by Marmot, Wilkinson and Pickett. The conclusion of the chapter is that Wilkinson and Pickett have correctly identified 'corporate power', or more broadly the roles of corporate actors, as the 'elephant in the room' in discussions of the social gradient of health (Wilkinson and Pickett 2009:242).

Relevant Theorists

The framework (Jasso 2002b:318; 2002a:45; 2004:403) used to guide the selection of sociological theories included the following criteria: (a) conceptual clarity, (b) an explicit dynamic which includes direct reference to power, (c) work of established, contemporary sociologists, (d) a generic approach with strong historical references, (e) a conceptual framework compatible with those used by leading public health researchers, and (f) compliance with the formal principles of 'general theoretical sociology' (Fararo 1989). The theoretical contributions of W.G. Runciman, J.S. Coleman[1], J.H. Turner, G.E. Lenski, G. Jasso and D.D. Heckathorn met the criteria.

Two sociologists had particular influence on the decision to use System Dynamics modelling. Tristram's approving reference to Hanneman as a rigorous social theorist (Tristram 1990:172) was the initial prompt. Hanneman is the leading advocate for testing the logic of social theory using System Dynamics (Hanneman 1988). The other decisive influence was Lane who had made several contributions to the System Dynamics community advocating stronger links between current social theory and System

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[1] Fararo suggests that Coleman is an exemplary systematic theorist who rates very highly on criteria such as clarity and parsimony.

Dynamics modelling (Lane 2001a; 2001b; Lane and Husemann 2008) . Lane's proposal is taken up in the next section.

This combination of influences means that what follows is exploratory and speculative. It is recognised that many sociologists do not support either the theoretical or modelling approaches, and there are unresolved differences among those who promote evolutionary frameworks with few published exchanges among the main protagonists cited in the thesis[2]. In addition there are strong arguments that assert evolutionary explanations are used to explain too much, are not applicable to social change, and are commonly deployed for ideological reasons. The observation that evolutionary explanations are overused has added relevance to this project because the research strategy was confirmed during 2009, the 150th anniversary of the publication of *The Origin of Species* (Darwin 1859) when Darwin's influence was widely recognised and discussed (e.g. Lewontin 2009). Although these arguments have merit, the 'selectionist paradigm' was selected because the literature search did not reveal another conceptual framework with a better fit with the criteria listed above.

A Generic Template

Lane and Husemanns' outline of core elements for System Dynamics models of societal systems is the starting point for this attempt to integrate sociological theories and modelling practices. The sociological aspects of the template are discussed in this and the following chapter. The modelling is covered in Chapters 3 and 4.

Lane drew attention to the lack of explicit societal dynamics in the mainstream of System Dynamics modelling. He suggested social models should be based on a consistent, integrative approach to the dynamics of human agency and social structure (Lane 2001a; Lane 2001b; Lane and Schwaninger 2008) and emphasised the value of Gidden's 'structuration theory' (Lane 2001b:297). In an article co-authored with Husemann he proposed the scheme summarised in Figure 1.

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[2]   There are exchanges involving others, for example, the reviews of Sanderson's theory edited by Niedenzu, Meleghy and Meyer (2008).

Figure 1: Feedback implied by an integrative approach
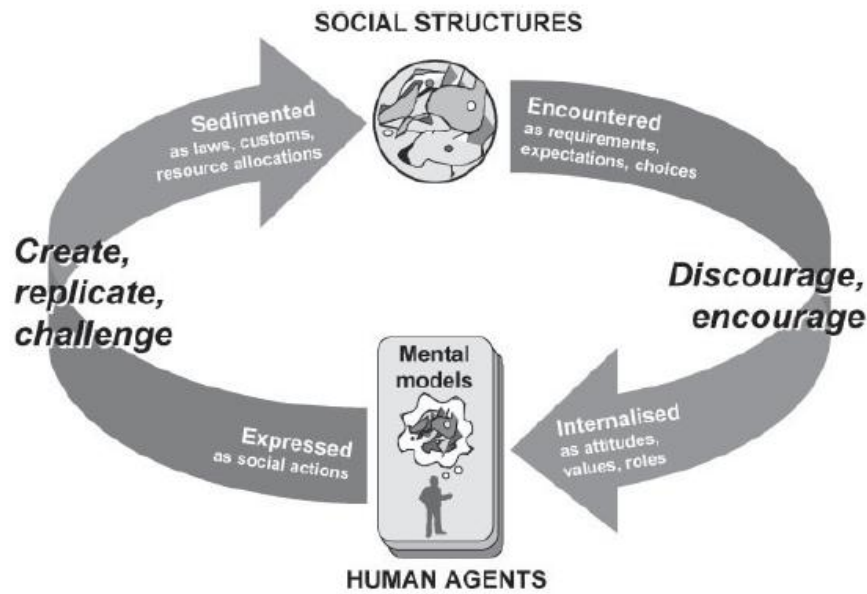
(Lane and Husemann 2008:55)[3]

Lane and Husemanns' scheme was adopted with particular emphasis on the concepts of replication and structuration as a synthesis of micro and macro interaction. Replication is used here in an evolutionary sense which includes reproduction with variation in an environment of selection pressures. In social settings the pressures that 'encourage' or 'discourage' are sanctions. The main point of difference is that the discussion that follows does not put the emphasis on 'human agents' as shown in Figure 1. The focus in the thesis is on interactions as social practices, and the definition of 'social' is limited to modes of production, coercion and persuasion. From that point of view 'agency' is enacted by persons assuming institutionalised roles. The shift in emphasis is discussed in later sections. The next section addresses Giddens' reservations about evolutionary social theories and models.

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3   For a similar scheme using the additional concept of 'attractor', see Woog, Cavana, Roberts and Packham (2006 Figure 3). This thesis includes two concepts from the framework in Woog et. al., namely power and emergent strategies. The concept of attractor has not been addressed explicitly here. For sociological discussions of the concept, see Sallach (2000) and Mackenzie (2005).

Giddens' Synthesis and Critique

Giddens' social theory is primarily synthesis and critique; in this case his critique of Parsons and Marx are particularly relevant. Giddens described his work in *The Constitution of Society* as an 'extended reflection upon a celebrated and oft-quoted sentence written by Marx that "Men [let us immediately say human beings] make history, but not in circumstances of their own choosing".' (Giddens 1984:xxi)[4] Given those two elements – action and circumstances – Giddens suggests that the appropriate way to analyse the constitution of social systems, especially societies, is to distinguish *structures* ('rules and resources, or sets of transformation relations', also referred to as organising principles, institutions and interpretive schemes) and *systems* ('reproduced relations . . . organized as regular social practices' – both routine and motivated). He refers to the conditions governing the continuity of structures and reproduction of social systems as *structuration* (Giddens 1984:25).[5]

Giddens also distinguishes between *social* and *system* integration. 'Social integration . . . means systemness on the level of face-to-face interaction. System integration refers to connections with those who are physically absent in time or space.' (Giddens 1984:28) Crossley (2011:129) suggests Giddens does very little with the concept of system. That criticism is addressed here by limiting discussion of 'social systems' to situations where there are innumerable chains of direct interaction among actors in institutionalised roles, regardless of whether the interactions are face to face,. The main (macro) system characteristic of interest is the relative frequencies of types of (micro) interaction, the average payoff for each type of interaction or strategy, and the relative strength and cost

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[4]   Giddens also provided a substantial footnote that quoted Marx in the original German and notes that the passage is polemical. Marx goes on to say '. . . the tradition of the dead generations weighs like a nightmare on the minds of the living. And, just when they appear to be engaged in the revolutionary transformation of themselves and their material surroundings, in the creation of something which does not yet exist, precisely in such epochs of revolutionary crisis they timidly conjure up the spirits of the past to help them . . .' (Marx 2010:146). This tendency is relevant to the modelling assumptions described in Chapter 3.

[5]   This is similar to the distinction between structure and behaviour in System Dynamics modelling which is introduced in Chapter 3.

of sanctions. The extent to which a society is integrating or disintegrating is an open question.

As Lane suggests, Giddens provides a useful set of propositions about social structure and dynamics in social systems (Giddens 1984:185-193). Giddens discussed 'Change, Evolution and Power' (Giddens 1984:227ff) in a vigorous critique of evolutionism and Parsons in particular. He emphatically opposed the use of evolutionary concepts to explain historical processes. He objected to, among other things: teleological explanations that account for societal forms in terms of progression towards a predetermined state or goal; referring to adaptation as a continuous process rather than a result (the converse of extinction); assuming there are predetermined developmental stages, including drawing parallels between societal development and the human life cycle; and, the search for general causal laws or strong generalisations about the causes of societal transitions[6].

Others[7] make similar points and all the points are accepted. However that does not vitiate the uses of evolutionary concepts provided the limitations are noted. For these purposes an evolutionary approach implies the application of principles can be used to explain but not predict social trajectories. For example, explaining the differentiation of social roles, practices and institutions (Sanderson 2007:235-46). The position taken here is that differentiation is a logical consequence of replication with variation in the absence of selection pressures which eliminate variants. Differentiation is not necessarily the cause of social change, although such a process might be associated with social disintegration in the absence of effective integrating institutions. Evolutionary analysis can reveal progression in terms of change through time and in some cases identify essential prior conditions, but is not inherently committed to an assumption that change is 'progress'.

Finally, Giddens allows a place for modelling, but with strong reservations. He suggests that 'there is no doubt that game-theoretical models can be very useful in empirical research, in respect of suggesting both problems to be investigated and how research results might be interpreted'. (Giddens 1984:313) However, he regards it as very unlikely

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[6]   Wright (1983:29) identifies an evolutionary impetus in Giddens' concepts of 'distanciation' and 'power'.

[7]   Sanderson provides a comprehensive review of recent objections to the concept of social evolution, with particular reference to those raised by Giddens (Sanderson 2007:263-76).

that sociologists will limit their interest to closed systems in which all significant causes of change are endogenous (cf. Richardson 2011), or to processes where all other things can be considered equal. More fundamentally, Giddens asserts that social time is not measurable as chronological time and the duration and sequencing of episodes of interest may vary greatly in each particular case. That is the reason why the unit of time in the model is 'iteration'[8] which has a direct bearing on how the charts in Chapter 4 are to be read – empirical comparisons will not have the regular 'chronological' time steps of the model. This short review is intended to acknowledge that the concept of social evolution is fraught, and it also provide a basis for assessing the theoretical strategy proposed by Runciman (1998; 2009b) particularly the 'selectionist paradigm' (Runciman 1998; Chattoe 2002) which is introduced in the next section[9].

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[8]   Iteration has two meanings in the thesis. It refers to the time step in the model, as in this instance. Iteration is also a feature of the modelling process and that is how the term is used in Chapters 4 and5.

[9]   In this thesis Runciman's contribution has been left to speak for itself. This extended footnote is the only reference to the wide range of responses to his work, and others' assessments of its strengths and weaknesses. Sanderson notes Runciman's contribution, but only briefly, in a comprehensive review of 'evolutionism' in social theory. He describes it as a 'sociologically interesting variant' (Sanderson 2007:258) and adds: 'I would judge Runciman's natural selectionist theory to be the best of the lot, but there is a problem with it apart from his overemphasis on the role of the interests of powerful groups in creating the main selection pressures. Runciman's analyses are theoretically interesting and often persuasive, but in most instances he provides no actual evidence to support his claims'. (Sanderson 2007:259-60) For this project, the emphasis on powerful groups is appropriate and a step towards defining what constitutes 'actual evidence'. For a more argumentative response, see Sanderson's (2008:219-21) review of 'The Two Transitions In The Evolution of Human Sociality' (Runciman 2008:172-181). Turner's review of *A Treatise on Social Theory* (Volume 2) *Substantive Social Theory* notes some strengths but concludes 'The book is also strikingly provincial . . . (and) . . .will have virtually no impact on theoretical sociology, even on that branch of theoretical sociology interested in selection processes as a central mechanism of human social organization' (Turner 1992) Turner's observation that Runciman is constrained by cultural insularity seems to be true generally within the field as a whole. Some English reviewers reach conclusions closer to mine. Carling begins his review with the assessment: 'W.G. Runciman's *Treatise on Social Theory* is one of the finest works in its field published over the last fifty years.' (Carling 2004:71) Similarly Anderson considered the *Treatise* the most original of all the large projects in sociology undertaken in

Social Dynamics

Interacting strategies

Following Giddens and the predominant methodology adopted in the Systems Dynamics community (Sterman 2000:965), Figure 1 emphasises the mental models of individuals. However, it is more useful, as Crossley noted, to focus the analysis of social[10] systems on interactions that reproduce relevant relations (Crossley 2011:129). A single human agent is not a social unit and adaptation is a characteristic of populations not individuals, hence the frequency of types of interaction provides a more satisfactory basis for describing social change. Runciman makes the following point about the replication of social practices:

> 'In the application of selectionist theory, as a leading evolutionary game theorist has aptly put it, "it is the strategies that come to the fore; the individuals that implement them on various occasions recede from view" (Skyrms 1996:10).' (Runciman 2009b:30)

Coleman came to a similar conclusion, which in some ways is more interesting because of his strong commitment to rational action theory and methodological individualism (Coleman 1990:5). After extensive work on a linear model of rational action which

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English in the 1970's and 1980's.' (Anderson 1992a:220) He noted the subtlety with which Runciman explored a very wide range of examples but then observed 'curiously, however, the central mechanism of social selection is by comparison somewhat underspecified: competition more invoked as a principle than traced through as a process, the alternative practices actually outrivaled often remain elusive.' (Anderson 1992a:224) (See also (Anderson 1992b:162-5)) Anderson's last point is very important. McLennan suggests that the *Treatise on Social Theory* has 'sustained depth and rigour . . . something which possibly accounts for its strange neglect within sociological journals' (McLennan 1995:94) .

[10]   Parsons made the '*inter*action' of actors the 'fundamental starting point [for] the concept of social systems of action'. (Gerhardt 2005:286)

included an assumption that social structure can be derived from an analysis of the purposive action of actors[11] Coleman concluded:

> 'In a double-contingency situation[12], where the very definition of what constitutes rationality is population-contingent, the notion of rationality is of questionable value as either a prescription for a course of action or a description of the course of action that individuals take. . . . In such a circumstance the idea that strategies can evolve through a process of selective survival is a highly appealing one. Evolutionary processes may not lead to an optimal strategy in a given population, but they will result in strategies that do well in that population. Because the strategies of all in the population are changing through the same evolutionary processes, the adaptive process constitutes a reasonable way to track the social environment. . . . For these reasons the development of theories of evolution of strategies appears particularly promising for double-contingency situations in social systems.' (Coleman 1990:931)

Both Runciman and Coleman commend the contribution of Maynard Smith to analysing evolutionary dynamics in populations (Maynard Smith 1974; Maynard Smith 1982)[13]. The Heckathorn model introduced in Chapter 3 extends the modelling strategy used by Maynard Smith and applies it directly to sociological problems[14]. The model has

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[11]   Coleman is often cited as a prominent exponent of methodological individualism (e.g. Crossley 2011:9). However he regarded his Linear Model as equally applicable to actors or types of actor, i.e. roles occupied by natural persons or corporate actors.

[12]   That is, when the optimum action for each actor depends on the action of others and vice versa, and the effects of the interdependencies implicate a population of actors. Under these conditions purposive behaviour of individuals is so contingent on the actions of many others that the most direct approach is to analyse the contingencies.

[13]   The strategy can also aspire to high aesthetic standards (Maynard Smith 2002)

[14]   The work of others who have reached similar conclusions is not reviewed here. An important example is Gintis' suggestion that the Hawk-Dove-Bourgeois model 'can be widely generalized. Indeed, there are excellent grounds for considering the correlated equilibrium, rather than the Nash equilibrium, the fundamental equilibrium in game theory, and for identifying correlated equilibria with social norms (Gintis 2009a)' (Gintis 2009b:154; and also Bowles and Gintis 2011:89) For an earlier example of work of a similar nature see Ullman-Margalit (1977)

characteristics of structuration in which 'macro' features (selection pressures) and 'micro' action (replication) are integral aspects of the same process.

To take Runciman's reference to Maynard Smith a step further:

> 'In the real world, simple pairwise contests between animals who always behave the same way are much less likely than contests in which there is a wider choice of possible strategies, the contestants sometimes follow one and sometimes another, and the payoff in fitness to the individual contestant depends not on the strategies of successive individual opponents but on some average property of the population as whole. . . . in the context of comparative sociology, the interest of the strategies of 'Hawk' and 'Dove' is that they can equally well be observed in the behaviour of human beings contesting territory, and in such cases the resulting behaviour-pattern can be either acquired or imposed rather than evoked.' (Runciman 2009b:53)

In previous work Runciman suggested a similar generic two-by-two typology of social strategies[15] in which social practices contribute either to strategies of Cooperation or Dominance (Runciman 1989:3). This implies that when the strategies form a payoff matrix of an evolutionary game there are three types of interaction: (a) Cooperation-Cooperation, a consensus, (b) Dominance-Cooperation, an asymmetric interaction of control and compliance, and (c) Dominance-Dominance, a conflict (see Table 1).

Table 1: Matrix of Dominance and Cooperation

	Cooperation	**Dominance**
Cooperation	Consensus	Compliance
Dominance	Control	Conflict

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[15]   Runciman and Sen (1965) jointly provide an example of this modelling strategy.

Hierarchical relations are found on the diagonal formed by control-compliance. The two homogeneous interactions are on the other diagonal[16]. This forms the basis of the payoff matrix to which Runciman and Coleman referred. Heckathorn used a variation of the two-by-two payoff matrix as the core of his model. The scheme provides for two fundamental societal strategies, three types of interaction or social practice, and four sites at which there are payoffs or selection pressures. The rest of this section discusses the concepts of 'social practice' and 'selection pressure'.

Social practices

Runciman provides a useful working definition of *social* interaction. He perceives a common logic in biological, cultural and social dynamics, namely 'heritable variation and competitive selection affecting phenotype'. He identifies three levels of selection: natural selection of *evoked* behaviour, where the response to the environment is direct and instinctive; cultural selection of *acquired* behaviour where the response is imitated[17] or learned; and social selection of *imposed* behaviour associated with a social role underwritten by institutional inducements and sanctions (Runciman 2009b:8). Each mode of selection has a distinctive type of replicator – the entity that is selected – which has the potential for heritable variation, and a carrier that interacts with influences in the environment (Runciman 1999:11-12; 2009a:9)[18]. The templates for replication in each mode are, respectively, genes which can mutate and recombine and are carried in bodies, 'memes' which can be reinterpreted and are carried in minds, and, practices which can be renegotiated and are carried in roles (Runciman 1998; Runciman 2009a).

Runciman's scheme is reproduced in Figure 2 below as an Influence Diagram. The diagram suggests that biological and then cultural factors create parameters for social practices, and that subsequently social practices can modify those parameters.

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[16]   This is similar to Lin's characterisation of social capital as vertical or horizontal (Lin 2001).

[17]   Throughout this discussion there is a basic assumption that human biology includes an innate capacity to *imitate* and *compare* which is strongly influenced by the *learning* environment, with particular attention to emotional responses (Jasso 2006; Turner 2007).

[18]   For a more descriptive account, see Beinhocker (2006)

Figure 2: Three Evolutionary Processes

natural selection   cultural selection   social selection
(genes)   (memes)   (practices)
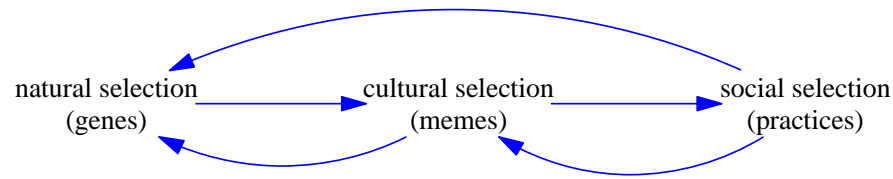
(Based on Runciman 2009b:224) [19]

The references to 'genes' and 'memes' are regarded as indicative and do not define the full scope of the influences involved. For example, the relative influences of genetic inheritance and epigenesis on foetal development and consequent prospects through the life cycle are complex and fundamental to interpretations of health inequalities (e.g. Gluckman and Hanson 2006). Likewise the concept of 'memes' is a placeholder while work continues defining forms of cultural evolution (e.g. Nowak 2006:Chapter 13). This discussion is focused on '*social* disparities', meaning the extent to which stratified health in a population can be attributed to social selection. Inequalities and health disparities attributable to biological or cultural factors are not discussed in the thesis. This means there is not a comprehensive relationship to statistics of health outcomes but it does allow for a more straightforward discussion of social gradients and stratification.

Social practices are 'units of reciprocal action' governed by rules which are prescriptive for the parties to the relationship and define the respective roles (Runciman 1999:11-2). Runciman suggests that social enquiry should seek to explain dynamics bounded by three vectors or dimensions of power that are institutionalised as modes of production, coercion and persuasion (Runciman 2009b:140). It is the use of power in sets of role-relations that defines practices as 'social'.

The theory allows for any amount of variation in role performance attributable to the ingenuity or objectives of an actor. The main issues are the effects of responses on the replication of the interaction, the rate at which a practice is replicated in the relevant

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[19]   The concept outlined in Figure 2 is as Runciman summarised it. Because this discussion uses modelling conventions of System Dynamics the diagram was amended to remove double-headed arrows.

population, and consequently the relative frequencies of each type of interaction[20]. In that sense power is institutionalised capacity to influence the relative payoff of the various types of interaction[21]. Examples of social practices include: the recruitment of 'free labour'[22] for regular employment by ongoing enterprises (Runciman 1995:33; 2009b:140); reinvestment of profits and fair dealing with strangers by owners of small businesses (Runciman 2005:292)[23]; and the allocation of and tenure in venal offices[24] (Runciman 2002:17-21; 2009b:185-7).

Selection pressure

This theoretical strategy turns on successfully defining and identifying the pressures selecting practices[25]. Turner and Maryanski (2008:155) and Lenski (2005:76 & 113) have proposed comprehensive schemes of forces and pressures to account for societal evolution[26]. This discussion and modelling exercise is limited to social stratification and does not extend to the more fundamental questions of system and societal viability. For these purposes the approaches of Turner, Coleman and Runciman are aligned insofar as Turner noted that Coleman's concept of a 'power-weight consensus' is a form of selection pressure created by competing normative regimes constituted as organised responses to externalities of interactions (Turner 2003:15). Normative pressures are

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[20]   Beinhocker addresses the measurement problems associated with this approach. He suggests that 'One way around (the measurement) problem is to note that in biology, the notion of frequency is really an abstraction of a more fundamental measure. Instead of asking what percentage of organisms contains a gene, we could equivalently ask what percentage of the species' total biomass contains the gene. . . . This percentage-of-resources view is also more consistent with our substrate-neutral approach to evolution.' (Beinhocker 2006:291)

[21]   Two succinct summaries of the approach are Runciman (2008:172-181) and Carling (2004).

[22]   'Free' in a formal contractual sense, not an evaluation of personal freedom.

[23]   This scenario is interpreted as cultural selection in another reference (Runciman 2009b:137-139). In this discussion 'Puritan' could denote exclusively cultural features but 'Capitalist' always implicates social roles.

[24]   That is, social roles that are purchased and confer delegated authority; examples are found in military and political bureaucracies.

[25]   See also comments in footnote 9.

[26]   Turner and Maryanksi (2008:155) provide a more comprehensive set of pressures which is not as directly applicable to the issue of disparity.

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exerted as sanctions. The effectiveness of the sanctions is contingent on the relative power inherent in institutionalised roles that form the modes of production, coercion and persuasion (e.g. Runciman 1997).

Figure 3 summarises the main elements taken from Runciman and Coleman. The figure points to a model that is located within a normative regime, in the cases that follow a single jurisdiction. The main question to be addressed is the mix of strategies of dominance and cooperation embodied by actors enacting institutionalised roles. The relative frequency of each strategy is influenced by the distribution of power used to determine the payoff of each type of interaction or social practice and the yield of each strategy. Power is embedded in the structure of the payoffs or in the capacity to change the payoffs and thereby realign the normative regime, drawing on aspects of social structure that Coleman has described as social capital (Coleman 1990:300ff).

In Coleman's conception, social capital augments the rights of individuals to control their resources by creating a collective matrix of control that increases the relative power of those with shared interests and relationships. Social capital in that sense includes information about the social system, prevailing norms including recognised rights, authority and associated obligations, and control of relevant resources particularly levels of organisation and sanctioning capacity[27].

Runciman's theoretical strategy has not, it seems, been developed by others. There has been some critique. For example, it is difficult to identify the *competing* practices in Runciman's examples, such as those cited previously. Without explicit competition and selection cases become descriptive historical vignettes, referred to by Runciman as 'just-so stories'.

There are fundamental unresolved issues among those who see value in the approach. For example, Carling (2004:87), a well informed commentator, argues that Runciman's logic requires him to define roles, not practices, as the unit of selection. That criticism seems to

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[27]   David and Bill Robinson (Robinson and Robinson 2002) initiated a critique of Coleman, and more particularly Putnam's publications. Bill Robinson suggested that a phases diagram was required to advance the discussion. Heckathorn's state-space (Figure 14) was the best example that was found.

be misplaced. The interpretation here is that pressure is applied to a role as a carrier of action that is an essential element in an interaction, but it is the practice or interaction that is replicated or not.

Figure 3: A basic process of social selection

Normative regime	Dominance	Cooperation
Selection pressure - power, sanctions		
Variants - relative fitness	Roles - dominant	Roles - cooperative
Interactions	Social practices	
Interests - organised and institutionalised	Effects - payoffs and externalities	
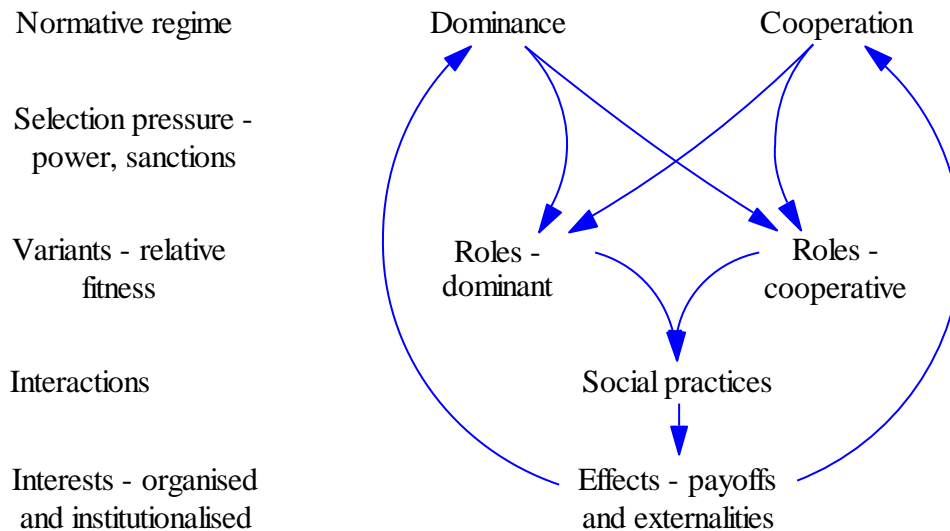
A Historical Trajectory

Two aspects of a normative regime

The rest of the chapter discusses implications of the relatively recent evolution of human societies as a context for humans who, as a species, evolved in a different social environment over the preceding 1.8 million years (Turner and Maryanski 2008:20). This part addresses two aspects of recent societal evolution influenced by the loops in Figure 3, one related to rights of natural persons and the other to rights assigned to abstract corporate actors. These dimensions have been introduced to distinguish two long term trends, one of increasing formal equality of persons – the source of claims that health disparities are unjustified – and the other of enduring hierarchical stratification – the source of health disparities within populations.

The historical trajectories of interest relate to the capacity of societies to, on one hand, provide freedom for natural persons, and on the other, mobilise corporate capability. Ideological regimes interpret 'freedom from' and 'freedom to' quite differently. A typology of ideologies is introduced in Chapter 3. Corporate capability can also be

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evaluated in many ways but for these purposes the question is the extent and effect of hierarchical organisation. An outline of the proposition is in Figure 4:

Figure 4: A historical trajectory

Freedom of natural persons → Impartiality

Capabilities

Corporate forms institutionalised → Hierarchy
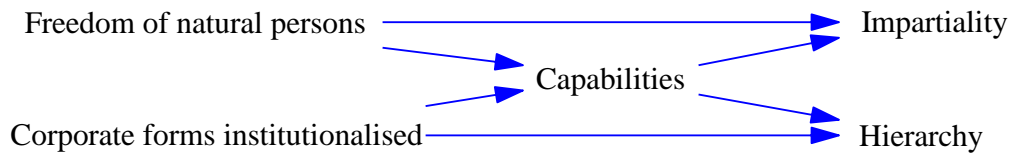
Three broad influences on this trajectory are discussed in this section. The first part addresses conditions that sustain claims to individual rights with references to norms of impartiality and interaction among equals. These claims have been effective within limits, for example the constraints associated with social distance (e.g. Black 2002) and formal provisos on the scope of legitimate claims to impartial treatment (e.g. Gert 1995). The constraints created by the dominance institutionalised in corporate actors are addressed in the second part. The following section outlines biological responses to hierarchical social structures and provides a logical link to the concept of a health gradient created by social structure.

Norms of Social Equality

Lenski (Lenski 1966:437) and Turner (Turner and Maryanski 2008:225, 239 & 295) concluded that industrialisation reversed a trend towards growing inequality. Callinicos (2000) and Turner (1986) have traced a similar trend of increasing equality of citizens. Sen observed 'that every normative theory of social justice that has received support and advocacy in recent times seems to demand equality of *something*[28] – something that is regarded as particularly important in that theory.' (Sen 2009:291) Sen's ideological synthesis concludes that contemporary demands for equality have as a generic feature a claim for impartial public processes for distributing freedom-based capabilities based on decisions that explicitly recognise all reasonable arguments (Sen 2009:293-4 & Chapter 5). Sen's argument is central to Chapter 2. The rest of this chapter is context for considering his concept of social equality.

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[28]   See also Sen's discussion of the question 'Inequality of What?' (Sen 1992)

Wilkinson and Marmot commented on the plausibility of social equality in their discussions of the health gradient. Early in the published discussion Wilkinson concluded that: 'If it is possible for some people to have death rates as low as those in upper social classes, then it should be possible to achieve equally low death rates in all groups' (Wilkinson 1996:59). Marmot doubts this: 'All societies will have social rankings; ergo all societies will have health gradients. . . . I ask myself if I can envisage a society where all are equal. My answer is not in real life. Hence, health gradients are inevitable.' (Marmot 2004:25) However, later he suggests: 'There is no reason why the health of today's lowest social group should not, tomorrow, be as good as the health of today's highest group.' (Marmot 2004:255) Marmot's examples provide partial support for that statement by comparing life expectancy in England and Wales in the 1970's and 1990's. Marmot makes three observations that are important for this discussion. Firstly, significant change can occur in basic indicators of health over a period of two decades. Secondly, the health status of Class IV (the second to lowest category) in the later period exceeded that of Class I in the earlier period. Thirdly, the health gradient increased because relative gains were greatest in the higher social classes. (Marmot 2004:26).

Lenski has produced a high level scenario which provides historical support for Marmot's reference to change over time and Sen's attention to freedom-based capabilities. Lenski's definition of freedom is similar to Sen's freedom-based capabilities. The definition includes concepts of legitimate authority, and freedom from 'repressive social controls' and 'an exhausting struggle to produce the necessities of life'. 'The fewer the viable choices, the less freedom there is – and it matters little whether the constraints are imposed by nature or by other people' (Nolan and Lenski 2011:325). Lenski summarised his estimate of the upper limits of freedom through the history of human societies in Figure 5. The figure depicts a situation in which Agrarian elites experienced over four times the freedom of the average member of society compared to the final estimate for the average member of an Industrial society with a substantially greater degree of freedom and a third of the freedom of a member of the elite. Similarly, after reviewing the evolution of and fit between the biologically based propensities of humans and the structure of societies Turner and Maryanski (2008:315) concluded that 'political democracy accompanied by dynamic markets offering choices about where to live and work are far more compatible with human nature . . . than any other societal formations since hunting and gathering'. Those conclusions could be used by a body such as the

WHO Commission on Social Determinants of Health (CSDH 2008) to argue that average well-being will continue to increase using existing institutional arrangements.

Figure 5 was constructed on the basis that, at the end of the period, claims for freedom are expressed as universal human, civil, political and economic rights loosely integrated with prevailing modes of production and coercion. These conditions require the production of an economic surplus derived from a combination of the following factors:

$$Economic\ Surplus = \frac{(Resources)(Technology)(Capital)}{Population\ Size} + e \text{ (Lenski 2005:80).}$$

Economic surplus in this equation is a general concept of production in excess of what is required for subsistence.

Three points are made about the trends and interpretation of Figure 5. First, the description of freedom refers to a particular mix of strategies; other definitions of freedom are also applicable. Five ideal-typical regimes are identified in Table 5 and all of them have the potential to sustain some form of freedom. Second, there can be fundamental changes in the selection pressures on the means and mode of production, coercion and persuasion. As an example, Nolan and Lenski (2011:146) regard agrarian societies as 'one of the rare instances in sociocultural evolution in which major technological advances generate negative feedback'[29]. The systematic exploitation of the productive population to sustain military activity led to unsustainable costs of conflict and impoverishment. The composition of elites changed as relatively unproductive, high cost, militarised, agrarian social systems[30] came into competition with mercantile technology and institutions. This trend was continued in nation-states that adopted capitalist industrial

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[29]   The figure shows upper limits. It does not refer to other societal limits such as those that can be illustrated by reference to totalitarian regimes of the Twentieth Century. Nolan and Lenski recognise other societal trajectories, for example, instances of 'democide' in authoritarian centralised states (Nolan and Lenski 2011:322). Civil wars, colonisation, and transportation are also absent from this account.

[30]   For a model of cycles in agrarian societies, see Turchin (2003; 2006; 2009). Turchin (Turchin and Nefedov 2009) (Turchin 2003; Turchin 2006), reviewing Goldstone, provides a useful examination of the pressures and consequent oscillations associated with agrarian societies. Turner and Maryanski have summarised this sequence of societal formations in causal loop diagrams (Turner and Maryanski 2008:173, 209, 212, 224, & 226).

modes of production and democratic modes of coercion and persuasion (also Giddens 1981:182-91, 197). Lenski emphasises the importance of technological prerequisites for societal change. He makes less of the prior or concurrent institutional development required, for example the emergence of city states and trading networks in the evolution of mercantile capitalism.

Figure 5: Upper limits of freedom in societies during the Holocene epoch[31]

Elites

The average members of societies

| Hunting and gathering societies | Horticultural societies | Agrarian societies | Industrial societies |
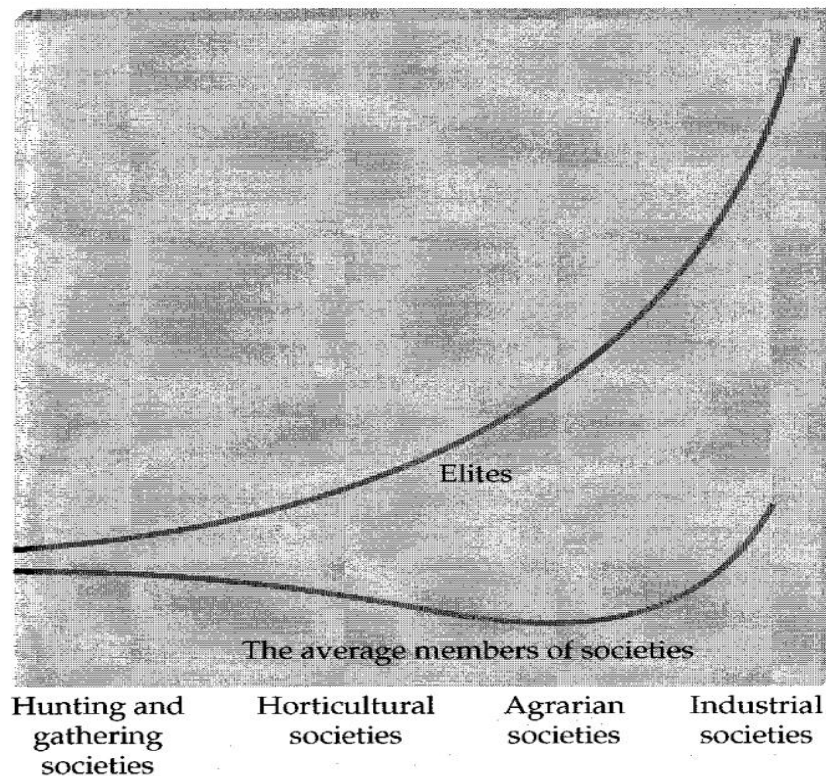
(Nolan and Lenski 2011:326)

Third, there is also an ongoing level of local conflict and contention related to the distribution of status and provision in human society (Tilly and Tarrow 2007). Referring back to Table 1, one important implication is the relative payoff from compliance and conflict. If the net payoff for compliance is positive then compliant interactions contribute to the yield of cooperative strategies. Similarly if there is a net cost to conflict the yield of strategies of dominance is reduced. Interest in the relative influence of compliance and

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[31]   A contemporary context is sketched in 'A man-made world' *The Economist* May 28th 2011 pp.81-83, and similarly in 'limits to growth' models such as Meadows, Randers and Meadows (2004).

conflict shaped the line of enquiry for this thesis (Cody, Cavana and Pearson 2007). It led to an initial hypothesis that, in the terms used in Table 1, there are two fundamental loops implied by the selectionist paradigm (see Figure 6).

Figure 6: Fundamental loops implied by the Selectionist Paradigm
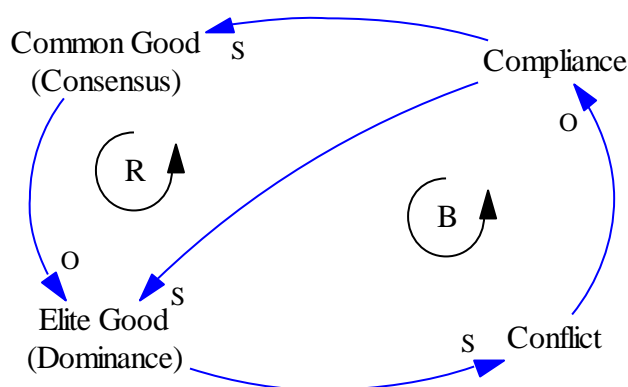
The influence diagram[32] summarises a dynamic hypothesis to the effect that there is a reinforcing loop that will account for either an increase or decrease in elite dominance, depending on the strength of a balancing loop driven by a fall in compliance. The role of corporate actors in managing compliance is taken up in the next part.

Hierarchies and corporate actors

Wilkinson and Pickett identify a core determinant of the health gradient as 'Corporate Power – the elephant in the living room' (Wilkinson and Pickett 2009:242). This part of the chapter attempts to support that assessment. Coleman addressed the evolution of the constitutions of corporate actors through the second half of the historical trajectory depicted by Lenski. Coleman discussed two consequences for natural persons that elaborate on the summary in Figure 5. In some societies, natural persons have progressively acquired greater freedom from authority and benefits from corporate capacity and, at the same time, lost power within the social systems they occupy. This

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[32]   In Figure 6 's' means 'same', that is to say the variables change in the same direction, if compliance increases consensus increases and conversely if compliance decreases consensus decreases. In the same way, 'o' means 'opposite' (Maani and Cavana 2000:26). R refers to a Reinforcing Loop with positive feedback (Maani and Cavana 2000:28) and B refers to Balancing Loop with negative feedback (Maani and Cavana 2000:31).

complicates the relationship between freedom and 'empowerment' which are thought to be fundamental to addressing social determinants of health (CSDH 2008). The Commission seems to assume the two vary together; Coleman asserts this has not been the case historically.

Coleman also argues that 'there has been and continues to be a long-term decline in authority in social systems.' (Coleman 1990:658) [33] One feature has been a tendency to replace personal authority over persons with authority over circumscribed roles or activities vested in a corporate actor. His account begins with three types of problem that began to arise in the twelfth century in Europe. Churches began to become independent from the household of the local landowner. Towns were chartered and could benefit or be penalised as an entity, where previously burgesses were dealt with severally. Kings acquired two statuses (personal and formal) to provide continuity when the individual holding office was deemed incompetent due to age or revolt. Some of the initial concepts were derived from Roman law, but:

> 'What was new [in the Twelfth Century] was the idea that certain entities had rights to engage in transactions on their own, so to speak – rights to determine on their own what they would own, buy, and sell. It was in this sense that social entities became juristic persons. They were no longer bound by the hierarchical structure, no longer constrained in the set of relations in which they engaged, no longer confined to a fixed set of relationships.' (Coleman 1974:24)

Constitutions that endowed corporate actors with legal personality were critical for 'two revolutions [that] have special relevance for . . . societal transformation: the French Revolution in 1789 and the Industrial Revolution, which began about the middle of the same century in England' (Coleman 1993:1-2). There were political and commercial implications. For commercial activity:

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[33] Turner suggests industrial economies are characterised by reducing concentrations of wealth due to increasing numbers of hierarchies and organisations associated with increasing productivity (Turner 1984:93).

'Such flexible units[34], which could be born and die, expand and contract, move into new arenas of action, and engage in market transactions, came to constitute an ideal organizational frame through which technological developments could bring about social change. The industrial revolution began and developed in England, and it did so because this reconstruction of society . . . gave the organizational instrument.' (Coleman 1974:28) [35]

Coleman concluded that in industrialised societies it is necessary to distinguish between the natural person and corporate actor (Coleman 1988:400-1; Coleman 1990:546). He elaborates:

'There are now two parallel structures of relations coexisting in society – the structure of relations among natural persons, and the structure of relations among . . . corporate actors . . . In this circumstance, a condition can arise which is wholly new to society: one person can suffer a loss of power without another person receiving a corresponding gain . . . This is a difficult but important distinction. Marx's failure to make it led to the central flaw in his analysis of capitalism, for failing to make it, he located corporate power in the hands of persons, the capitalists, "as a class" . . . It is possible, in such a [parallel] structure, for the sum total of power held by all natural persons to continually decrease with a corresponding increase in that held by corporate actors.' (Coleman 1974:36-7)

An implication of this description of the historical trend is that social analysis must include the constitutions that create and define entities in the social system, in particular the roles and rights created by those constitutions, and the power inherent in roles both in relation to others and with respect to amending or replacing the constitution. A natural person enters that analysis as a portfolio of roles over time which may or may not cluster as interests in relation to the ownership of capital in a way that can be regarded as a social 'class'.

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[34]   For example, in the contemporary environment: public companies, other commercial entities, Crown Entities, trusts, charitable trusts, and incorporated societies.

[35]   Obviously there are many other significant junctures such as the situation created in the U.S.A. when the right to charter corporations was devolved to the States (Westbrook 2007).

The main point is the distinction between rights assigned to natural persons and rights assigned to abstract corporate entities. The distribution of power is complex and is not limited to commercial activity. The objectives and practices of corporate entities may, at one extreme, be identical to those of a single natural person (such as a sole owner or absolute monarch), or, at the other, not be aligned with the interests of any natural person (for example, a corporation that owns all of the shares issued by the corporation or a self perpetuating trust) (Coleman 1982:39-42; or 1990:554-6).

This argument leads to a particular interpretation of the iterative processes that replicate social practices depicted in Figure 1. It is assumed that social selection pressures primarily act on corporate entities and those entities then constitute the main sources of social 'encouragement' and 'discouragement' for interacting human agents in their various roles. In Coleman's terms, the historical process:

> '. . . means that among the variety of interests that men[36] have, those interests that have been successfully collected to create corporate actors are the interests that dominate society. It is not so simple as persons' interests vs. corporate actors' interests, because each corporate actor acts to satisfy certain of these interests. But this state of affairs means that decisions about the employment of resources are more and more removed from the multiplicity of dampening and modifying interests of which a real person is composed – more and more the resultant of a balance of narrow intense interests of which corporate actors are composed . . .

> 'It means also that as men's interests change, the change is less easily reflected in the important activities of society, because the interests are cast into corporate structure, and the actions are insulated from the men who gave the corporate actors their power.

> 'This structure of society means that those persons whose resources have not been combined together to form corporate actors find themselves especially helpless.

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[36] Sometimes *sic* is added to quotations to note changes in expression that have occurred since a passage was written, particular relating to gender. This is not done in this paper. The time and context of the statement is noted and quotations are intended to be accurate references to statements by others.

For them, it is not only some of their interests which fail to be represented in the corporate actions of which society is made up; it is all their interests that are left out of the balance.' (Coleman 1974:49-50)

An important implication arises for interactions among persons and corporate entities:

'. . . obedience to Kant's categorical imperative[37] is undermined at this boundary between systems of personal relations and systems of corporate actor relations. The supports for a normative system have been taken away.' (Coleman 1974:97) [38]

These critical points are elaborated in Chapter 2 by reference to Coleman's comments on efficiency and in Chapter 4 in a discussion of the strength and weakness of reciprocity.

The 'constitutional' elements in the way Coleman and Runciman approach social analysis is one of the two foundations on which this thesis rests. It leads to the discussion in Chapter 2 which seeks to define the power-weighted consensus in normative regimes by identifying the fiduciary duties associated with rights transferred to or created for corporate actors. In some contexts the discrepancy between rights and duties can be used as an empirical indicator of defection from an objective to reduce health disparities. The rest of this Chapter introduces the second foundation assumption – the innate tendency of humans to compare themselves with others and develop norms of justice which is crystallised by Turner with reference to the work of Jasso.

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[37]   This is interpreted as a general observation that it is necessary to distinguish protocols that apply to interactions among natural persons and persons occupying institutionalised roles. Universal principles proposed by Kant such as 'Act only according to that maxim whereby you can, at the same time, will that it should become a universal law' and 'Act in such a way that you treat humanity, whether in your own person or in the person of any other, always at the same time as an end and never merely as a means to an end' imply a degree of reciprocity and comparability that is consistent with the trend identified by Lenski and the norm of impartiality proposed by Sen. This principle is weakened when corporate actors acquire the legal status of 'person'.

[38]   See also Coleman (1988:396-7; 1993) , Tilly (1998), and earlier Mill for his reflections on the capacity of an industrialised society to apply the 'harm principle' to institutions as well as to interactions among individuals (Mill 1989 [1879]). The issue is an apparent tension in liberal ideologies between the relative, power weighted, advantages of 'free association' and hierarchical coordination.

Biological dimensions

The final substantive section in this chapter outlines the biological basis of the hypothesis that 'hierarchy makes you sick'. Namely, that the significant causal influences creating the biological indicators in the health gradient, for example average age at death, are selection pressures created by social structures and processes. That is to say, attention is directed to the upper link, from right to left, in Figure 2[39]. The objective is to identify elements of a simple, generic social system that can simulate such a context (Krieger 1994:898; Link and Phelan 1995:84). The mediating influences of culture are outside the scope of the thesis.

An alternative argument is that social structure reflects the distribution of biological and cultural characteristics and consequently the 'gradient of health' indicates relative fitness on those dimensions and is not attributable to hierarchy or other social factors. The conclusion here is that, if it can be shown that stress, risk and effort are socially stratified there are strong arguments to support the proposition that social structure will have physical effects evident in populations and sub-populations (Wilkinson 2000:47; Marmot 2004:48 & 52). However, the level of dominance creating the stratification must be assessed directly and cannot be deduced from the existence of a health gradient. Biological and cultural factors can act independently of social factors, some are protective and mitigate the effects of social pressures and others increase exposure. Consequently inequalities in health outcomes can both over and under-estimate levels of social disparity. For this reason it cannot be assumed that all social groups have the same initial distribution of fundamental biological[40] or cultural attributes, although it might be a reasonable modelling assumption in many situations because of the fundamental dynamics outlined below.

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[39]   The substantive discussion of comparative health outcomes has been led and sustained by R.G. Wilkinson (Wilkinson 1996; Wilkinson and Pickett 2009) and M.G. Marmot (Marmot and Wilkinson 1999; Marmot 2004; CSDH 2008) and extensively supported by others including contributions from New Zealand (Blakely, Fawcett, Atkinson, Tobias and Cheung 2005; Fawcett, Blakely, Robson, Tobias, Harris and PakiPaki 2006; Blakely, Tobias, Atkinson, Yeh and Huang 2007).

[40]   The question of which generation is taken to be the initial distribution and when comparisons are made is an open question at this stage.

The basis of the hypothesis that 'hierarchy makes you sick' (Bottero 2004:186)[41] is that natural persons 'embody' the effort, stress and risk associated with their location in the social system. The social dimension of these effects is attributed to the relative efficiency of the social environments people occupy; greater effort is required of those with less power[42]. The allocation of relative risks and stress (Marmot 2004:109) can be expressed as a ratio of either demand-reward (Marmot 2004:139-41) or effort-reward (Marmot 2004:205 & 217). Bottero has summarised the direct and indirect effects of chronic stress (Bottero 2004:190), and illustrated the benefits of 'feelings of empowerment and self-worth' (Bottero 2004:186) and 'access to resources' (Bottero 2004:187). Conversely ill health is attributed to low control, anger, worry, failure, stigmatisation, a sense of inferiority and lack of social capital (Bottero 2004:195-7). This aligns with lay 'common sense' about causes of poor health (Reinken, De Lacey and Salmond 1980; Blaxter 1997; Cody 1999:57; Marmot 2004:7; Milstein 2005:17 quoting JM Mann 1999; Smith 2006).

Wilkinson adopted a Darwinian framework 'to clarify why health is so strongly related to social and economic circumstances' and used 'evolutionary theory to make better sense of why we are particularly affected by the nature of the social structure and social environment.' (Wilkinson 2000:2). He seeks to establish a baseline of physical characteristics common to all humans. He notes that humans evolved biologically as hunter-gathers. Hunter-gatherer bands are believed to have been the only form of human organisation for, say, 1.5 million years with the exception of the last 10-15,000 years. Significant biological and cultural selection pressures acting on hunter-gatherers included: living in a group structured by face-to-face interactions; continuously obtaining food, particularly meat, that could not be stored and accumulated; managing threats from other species; and, resolving conflicts by creating new bands. In such settings, it is argued, co-operation was an essential survival strategy and humans evolved with an aversion to dominance (Wilkinson 2000:22-3; Turner and Maryanski 2008).

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[41] Many reports note frequent and strong correlations between social constraint and health outcomes, commonly referred to as a 'health gradient' (Mackenbach and Kunst 1997; Wilkinson 2000; Marmot 2004; Blakely, Fawcett et al. 2005; Blakely, Tobias et al. 2007; De Vogli, Ferrie, Chandola, Kivimäki and Marmot 2007). Two gradients are relevant: the general trend and the shape of the distribution for the deciles ranked highest for deprivation.

[42] Coleman (1990:799-800) elaborates on this point, see Chapter 2.

The essential point is that humans are poorly adapted for interactions that require sustained submissive compliance, hence hierarchies of dominance as well as social isolation and ongoing disorder are sources of stress (e.g. Wilkinson 2000; Marmot 2005; Wilkinson 2005). The physical effects follow prolonged arousal of fight-flight-freeze responses and similar metabolic reactions. The biological response evolved when intense, short-lived reactions were required for survival and hence reproduction. Societies have created sources of chronic stress, particularly for those lower in hierarchies. The effects can be regarded as physical 'wear and tear'[43] or premature ageing hence the relative rates of mortality and chronic disease among stratified populations[44]. Following this line of argument, limiting dominance and isolation (Wilkinson 2000:16), or conversely, maintaining personal control and participation (Marmot 2004:2), are critical to human wellbeing[45]. On that basis Wilkinson and Marmot (Wilkinson 2000:62; Marmot 2004:12) arrive at the same typology of generic strategic interaction as Runciman, namely cooperation and dominance.

Emotions directly implicated in the fight-flight-freeze range of responses are accentuated by the nature of the human brain (Marmot 2004:7). Attention and sensitivity to the nature of interactions create 'potent sources of anxiety' (Wilkinson 2000:3-4). Anxiety in this sense is the experience of loss of control, also referred to as loss of autonomy and ontological insecurity (Marmot 2004:211-2). In this account anxiety and anger are closely related (Wilkinson 2000:57). Violence is a response to both personal and institutional disrespect, as are isolation and depression. Wilkinson also relates this response to shame, evaluation anxiety (Wilkinson 2000:52-3), and submissiveness to avoid dangerous and fruitless conflict (Wilkinson 2000:54-5). Marmot integrates these elements in the concept of a 'status syndrome' (Marmot 2004) with various cultural manifestations (Marmot 2004:88). Similarly, Layard (2005:238) summarised recent work that reports a strong

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[43]   'The accumulated physiological impact of chronic stress has been called 'allostatic load' (Wilkinson 2000:42), see also Geronimus and the discussion that followed (Geronimus, Hicken, Keene and Bound 2005)

[44]   Wilkinson and Marmot compare hierarchy and mortality among nations, migrants and non-migrants of the same ethnicity and nationality, and social classes.

[45]   Both authors note parallels with work by Robert Putnam particularly the egalitarian aspects of *Making Democracy Work* (Putnam 1993; Wilkinson 2000:15).

association between location on a pleasure-pain dimension, arousal, emotional sensation, metabolism and health.

Turner (2007) uses this body of ideas to propose a biological basis for sociological analysis (Turner and Stets 2005; Stets and Turner 2006; Turner and Maryanski 2008:Chap 4). His argument is that, during an early phase of human evolution, natural selection of the human brain refined four primary emotions[46] that provide the basis of cognition, inter-personal and symbolic attachment, language, and the development of more subtle and effective sanctions. The primary emotions can mix[47] to form second-order emotions of shame, guilt and alienation (Turner and Maryanski 2008:101). Turner notes a predominance of negative emotions in the range of human emotion. He suggests this probably supported both social control in small cohesive groups and the formation of new groups when that could be done with relatively low costs. It is assumed that in recent millennia the brain has evolved relatively slowly compared to cultures and societies and consequently the fundamental emotional repertoire has remained constant. There are two implications. Firstly, humans have evolved a strong innate capacity to compare and imitate that forms the basis for human relations. Secondly, there is potential for a 'mismatch' between the biological and social selection pressures that shape human interaction (Gluckman and Hanson 2006; Turner and Maryanski 2008).

Turner applies this reasoning in his commentary on Jasso's rigorous analytical framework for relating emotional responses to social structure (Jasso 1993b). Turner notes that '. . . Jasso (2001a, b, 2006) has seen justice evaluations as a specific case of a more general comparison process, and this, too, was an important lead in developing a more robust theory.' (Turner 2007:293) If the salience of comparison can be assumed it provides the basis for some specific theoretical predictions. The line of reasoning is:

> '[J]ustice evaluations are, as Jasso emphasizes, a function of a person's share of resources as a logarithmic ratio of what they perceive to be a just share. Over-reward or under-reward relative to perceptions of just shares generates a sense of injustice, although Jasso argues that it takes considerably more over-reward to

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[46]   Satisfaction-Happiness, Aversion-Fear, Assertion-Anger, and Disappointment-Sadness

[47]   The metaphor used is 'primary colours'

produce injustice than it does for under-reward. As we will see, the reason for this difference is the emotions involved. Under-reward immediately generates anger (because anger is tied to the amygdala and hence is instantaneously aroused), but for a person to feel guilt requires activation of several sub-cortical areas of the brain responsible for all three negative emotions (i.e., anger, fear, and sadness). This activation will inevitably be somewhat slower in producing emotions like guilt which are the outcome, I believe (Turner, 2000), of ''mixing'' all three negative emotions. (Similarly, shame is also activated by mixing the three negative emotions.)

'Moreover, over-reward initially will cause pleasure and happiness, with individuals only experiencing guilt, it appears, when they perceive that their over-reward causes an unjust under-reward to others. This process of activating guilt for over-rewards takes more time to complete because (a) the initial effects of pleasure must be overcome through a more deliberative assessment about the costs of such pleasure to others, and then, (b) the mixing of anger, fear, and sadness to produce guilt will take longer than the activation of any single emotion alone. In contrast, the activation of anger occurs before cognitive assessment and is more likely to be the first emotional response to under-reward (because the ancient and primal amygdala generates emotional responses very rapidly, often well before – in neurological time – cognitive awareness and appraisal occur).' (Turner 2007:292-3)

In summary, humans' inherited capabilities to imitate, identify with and discriminate among others (including abstract reference points (Jasso 2006:303)) are the basis for sensitivity to differences in social position and behaviour. This sensitivity has physical effects. The innate tendency to identify and compare provides the basis for introducing a public norm of impartiality in Chapter 2.

Scope

In subsequent chapters the discussion is limited to hierarchy in a single population on a single dimension. This was done to simplify the initial modelling and on the basis that that model could be extended to include between-group comparisons (Jasso 2007b). Consequently there is no discussion of health disparities between sub-populations such as

those based on gender or ethnicity[48]. This final comment is included to note that there are limits to the extent to which universal biological processes can be assumed to determine health outcomes, for example when comparing female and male populations, age cohorts, or changes through the life cycle.

There is a fundamental evolutionary argument that female populations may have greater biological resilience than males; indicators include birth ratios, life expectancy in some societies, and metabolic responses to social stress. Wilkinson raises the possibility that females have a greater propensity to develop peer relations which might account for some of the gender differences in average age at death in 'wealthy societies'. Similarly Marmot suggests there is a stronger lateral 'tend-befriend' response in females (Marmot 2004:93-95, 144-6). It is not clear to what extent this propensity is inherited or acquired. Generalisation from observations of primate behaviour suggest that the selection pressures that define a successful female (i.e. a female who has successors) are not as strongly associated with social ranking as those that define a successful male.

On the other hand there are specific risks faced by females in many social settings, for example maternal mortality during child birth or mortality of females prior to or at birth. Some risks may take the form of epigenetic influences passing from grandmother through mother to daughter (Gluckman and Hanson 2005). On the other hand, it might also be the case that low status males are more likely to be exposed to social stress in high risk situations (Wilkinson 2000:33; Marmot 2004:120 & 141).

Finally, the thesis does not address re-ranking of distributions (Jasso 2007a:491) through the life cycle. It is assumed that mobility attributable to health will not account for the health gradient and that other forms of social mobility tend to reduce the gradient. Wilkinson's comment on this point is:

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[48]   There are general discussions of 'between group' health disparity that compare populations distinguished by culture, ethnicity and race (e.g. Fawcett, Blakely et al. 2006:3) and more specific reviews of health care practices (e.g. Harris, Tobias, Jeffreys, Waldegrave, Karlsen and Nazroo 2006a; Harris, Tobias, Jeffreys, Waldegrave, Karlsen and Nazroo 2006b). Similar findings of disparities are reported for other sectors such as rental housing and secondary schooling.

'With the initial studies, it seemed possible that these health inequalities reflected a process of selection whereby the healthy moved up the social scale and the unhealthy moved down. However, studies following people from birth to middle age and beyond showed that health-related social mobility makes only a small contribution to health inequalities. Indeed, compared with the non-mobile population who do not change class, socially mobile people tend to diminish the class difference because their health tends to be intermediate between that of the class they leave and the one they join.' (Wilkinson 2000:6)

Marmot makes a similar point about mobility within a single society (Marmot 2004:58 & 60). He also compares jurisdictions (Japan and the United States) and the inter-generational implications of migration from Japan to the U.S. His brief review contrasts core institutions and concludes that life expectancy is attributable to different locations on a continuum between individualism and collectivism (Marmot 2004:176-85). That is a theme in the chapters that follow.

CHAPTER 2: GOVERNANCE AND IMPARTIALITY

Introduction

This chapter takes up the discussion of the constitution of corporate actors, the interaction of corporate entities with natural persons, and pressures selecting social practices, with more specific reference to governance and impartiality. Governance is, at least in principle, a focal point within corporate entities where there is a response to demands for norms and sanctions. In this chapter the norms of greatest interest are those that support or subvert a principle of impartiality in the distribution of freedom-based capabilities among natural persons. The context for governance is outlined in the World Health Organisation Commission on the Social Determinants of Health (CSDH 2008). The Commission also endorsed *Development as Freedom* (Sen 1999) and hence emphasised equitable allocations of 'freedom-based capabilities' as a strategy to reduce health disparities. More recently Sen developed procedural aspects of his strategy in *The Idea of Justice* (Sen 2009).

Sen's argument for civic norms of impartiality and public reasoning is outlined and related to Jasso's work on justice introduced in Chapter 1, and then discussed with reference to Heckman's proposal to invest in the cultural capability of disadvantaged children. The final parts describe other features that are necessary in a small model of societal dynamics.

Governance and Power

The WHO Commission on Social Determinants of Health (CSDH 2008) was a major initiative to frame the discussion of health disparity. The CSDH summarised the consensus of elite opinion among those who assert that social determinants of health are shaped by the distribution of power, effective rights and the institutions of governance. The Commission endorsed *Development as Freedom* (Sen 1999) as a strategy for improving health equity[49] and identified governance as a significant factor among the determinants of health (see Figure 7). Consequently the report provides a useful focus for the general issues raised in Chapter 1.

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[49]   Sen was a Commissioner

Governance is the first feature of the socioeconomic and political context identified in Figure 7. The figure implies an expansive definition of the scope of governance influence and a particularly limited feedback loop that only comes through the health-care system. Presumably the limited feedback was to simplify the diagram because the other systems identified in the framework are also implicated in the distribution of health and well-being (Beckfield and Krieger 2009:2). The discussion that follows assumes that a functioning system requires strong feedback loops to the governance system from all the segments in the framework.

Figure 7: CSDH Conceptual Framework
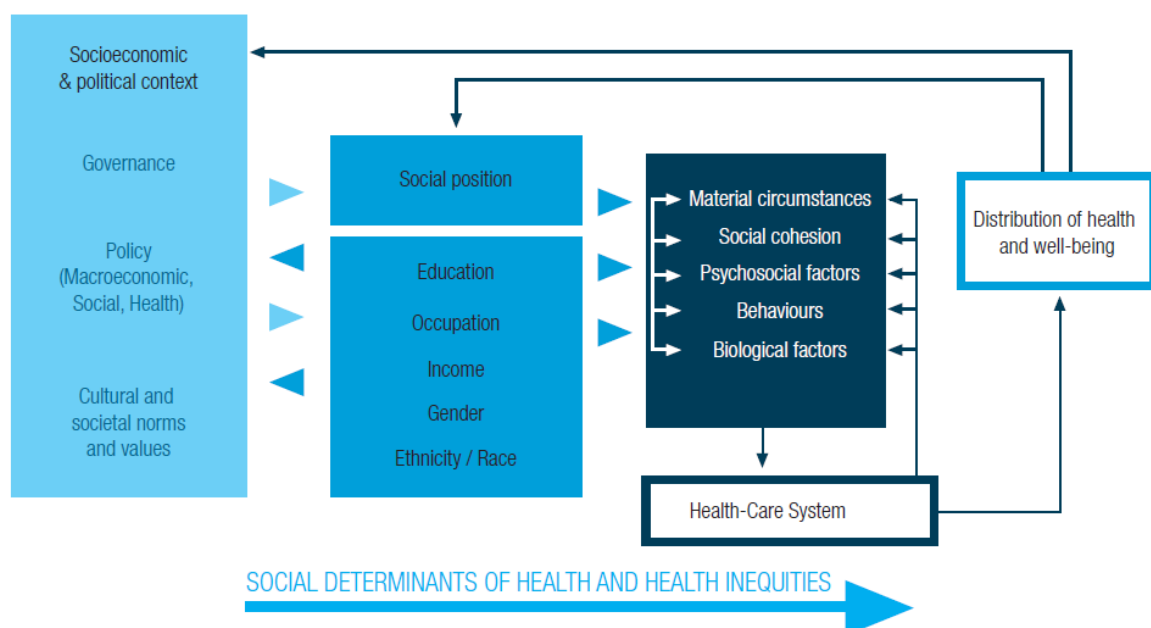
Source: Amended from Solar & Irwin, 2007

(CSDH 2008:43)

The definition of governance used by the Commission is:

> '. . . the UNDP [United Nations Development Programme] definition of governance, which is as follows: "[the] system of values, policies and institutions by which society manages economic, political and social affairs through interactions within and among the state, civil society and private sector. It is the way a society organizes itself to make and implement decisions. It comprises the mechanisms and processes for citizens and groups to articulate their interests, mediate their differences and exercise their legal rights and obligations. It is the

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rules, institutions and practices that set limits and provide incentives for individuals, organizations and firms. Governance, including its social, political and economic dimensions, operates at every level of human enterprise, be it the household, village, municipality, nation, region or globe"'. (Solar and Irwin 2007:22 as cited in 'Gender-sensitive and Pro-poor Indicators of Good Governance')[50]

Specifically, with respect to rights:

'The international human rights framework is the appropriate conceptual structure within which to advance towards health equity through action on SDH (Social Determinants of Health). The framework is based on the 1948 Universal Declaration of Human Rights[51] (Solar and Irwin 2007:8 ICESCR 1966).

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[50] The references in the Solar and Irwin paper are, at times, cryptic and indicative and have been included here verbatim. The CSDH Discussion Paper includes one direct comment on implications for governance. Under the heading 'Intersectoral Action' mention is made of experience with collective management of small forests which refers to a:

> . . . 'conceptual framework for emergent governance' that suggests how levels of decision-making from global to local can be brought into flexible but coherent connection ('loose coupling') by linking intersectoral policymaking and participatory approaches. 'Participatory approaches' in this context means 'political processes that self-consciously and directly engage the people interested in and affected by [policy] choices', as well as the officials charged with making and carrying out policy. . . . Specific elements of collaboration in governance include 'sharing resources (including staff and budgets), working to craft joint decisions, engaging the opposition in creative solutions to shared problems, and building new relationships as needs and problems arise' (Solar and Irwin 2007:57)

Although forestry and natural resource management generally provide useful examples of governance arrangements, this is a very limited menu of options for a critical aspect of the system.

[51] The UDHR holds that 'Everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing and medical care and necessary social services' (Art. 25) and, additionally, that 'Everyone is entitled to a social and international order in which the rights and freedoms set forth in this Declaration can be fully realized' (Art. 28). The human rights aspects of health, and in particular connections between the right to health and social and economic conditions, were clarified in the 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR). In ICESCR Article 12, State

Power is a determinant of how rights are exercised. The Commission's position is:

> 'Health equity depends vitally on the empowerment of individuals and groups to represent their needs and interests strongly and effectively and, in so doing, to challenge and change the unfair and steeply graded distribution of social resources (the conditions for health) to which all men and women, as citizens, have equal claims and rights (CS, 2007)[52].

> 'Underlying the structural drivers of inequity in daily living conditions addressed throughout this report is the unequal distribution of power. Inequity in power interacts across four main dimensions – political, economic, social, and cultural[53] – together constituting a continuum along which groups are, to varying degrees, excluded or included.' (CSDH 2008:155)

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signatories acknowledge "the right of everyone to the enjoyment of the highest attainable standard of physical and mental health" and commit themselves to specific measures to pursue this goal, including improved medical care, but also health-enabling measures outside the medical realm per se, such as the "improvement of all aspects of environmental and industrial hygiene"'.

[52] Framing power-weighted claims based on various types of association is discussed below. In this context 'citizen' is taken to imply the coverage of a legal jurisdiction and consequently to focus on a particular set of governance arrangements.

[53] These are not the dimensions of power used in this thesis. Discussing the differences would require a lengthy digression. This would have little value because the general stance is similar but the Commission's position is more diffuse and involves more theorists, and makes no reference to Runciman or Coleman. The Commission's position is included here, and in the next footnote, to provide some context for the discussion of governance in the main text. In the Commission's papers the *political dimension* comprises both formal rights embedded in legislation, constitutions, policies, and practices and the conditions in which rights are exercised including access to safe water, sanitation, shelter, transport, energy, and services such as health care, education, and social protection. The *economic dimension* is constituted by access to and distribution of material resources necessary to sustain life (e.g. income, employment, housing, land, working conditions, livelihoods). The *social dimension* is constituted by proximal relationships of support and solidarity (e.g. friendship, kinship, family, clan, neighbourhood, community, social movements) and the *cultural dimension* relates to the extent to which a diversity of values, norms, and ways of living contribute to the health of all and are accepted and respected (SEKN, 2007).

A background Discussion Paper outlines the Commission's concept of power[54]. The paper distinguishes between 'power to' and 'power over' and emphasises the institutional mediation of power. This thesis is directed towards institutionalised mediation of 'power over'. The earlier summary of Runciman's approach implied that power is the equivalent of a capacity to influence the relative fitness of strategies (Runciman 2009b:143-44), expressed most simply as payoffs in the matrix of an evolutionary game. That concept can be extended to include power to change the game, or mix of games, in at least one of the modes of production, coercion or persuasion.

Coleman adds detail to that framework. He treats power as a macro vector associated with the actors or types of actor in a system (e.g. Coleman 1990:687). The vector is created at the micro level by the relative ability of actors to control resources weighted in value by others' interest in those resources. The ability of actors to acquire and deploy power is contingent on the composition of the social system referred to as social capital. In Coleman's scheme the value of social capital can be measured for each actor in terms of the power it affords them, including the effectiveness of and limits to sanctioning regimes that support their interests (Coleman 1990:815-17). The distribution of power changes

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[54]   The Discussion Paper elaborates the reasoning as follows. It notes that power is 'arguably the single most important organizing concept in social and political theory' yet the concept remains contested and subject to diverse and often contradictory interpretations. Classic treatments of the concept of power have emphasized two fundamental aspects: (1) 'power to', i.e., what Giddens has termed 'the transformative capacity of human agency', in the broadest sense 'the capability of the actor to intervene in a series of events so as to alter their course', and (2) 'power over', which characterizes a relationship in which an actor or group achieves its strategic ends by determining (or at least strongly influencing) the behaviour of another actor or group. Power in this second, more limited but politically crucial sense may be understood as 'the capability to secure outcomes where the realization of these outcomes depends upon the agency of others'. 'Power over' is closely linked to notions of coercion, domination and oppression; it is this aspect of power which has been at the heart of most influential modern theories of power. The Discussion Paper notes that coercive power can take covert forms. For example, power expresses itself in the ability of advantaged groups to shape the agenda of public debate and decision-making in such a way that disadvantaged constituencies are denied a voice. At a still deeper level, dominant groups can mould people's perceptions and preferences, for example, through control of the mass media, in such a way that the oppressed are convinced they do not have any serious grievances if habitual action is interpreted as 'the everyday practices of a well-intentioned liberal society'.

when real rights – as opposed to rhetorical rights – are transferred. Later sections in this Chapter include examples of how Coleman developed this idea.

The strongest indication of how the Commission proposes that power be deployed to shape social determinants of health is the five citations of 'Development as Freedom' (Sen 1999; see also Marmot 2000). For example the Commission states that:

> 'Having the freedom to participate in economic, social, political, and cultural relationships has intrinsic value (Sen, 1999). Inclusion, agency, and control are each important for social development and health (Marmot, 2004). Restricted participation also results in deprivation of fundamental human capabilities, setting the context for differentials in, for example, employment, education, and health care. For instance, differential access to education leads to inequity in all-cause mortality.' (CSDH 2008:156-7) (References to figures in the document that has been cited have been deleted.)

Sen has subsequently described in some detail his prescription for a just regime, giving equivalent weight to substantive and procedural features in the context of impartial public reasoning (Sen 2009). The next section considers the procedural aspects and is followed by a substantive example that Sen regards as within the broad scope of capability development.

Procedural Impartiality

This section takes the generic concepts of social roles and practices and applies it to Sen's argument in *The Idea of Justice* (Sen 2009). Sen proposes 'impartial[55] public reasoning' as a norm that provides a basis for reducing disparities in 'freedom-based capabilities'. In that sense the norm is a public good, similar in principle to property rights (Mueller 2003:10). A norm of impartiality provides a useful reference for integrating the issues raised up to this point, including the salience of 'freedom' (Figure 5), modes for deploying a complex range of resources, and the elements of the social system outlined by the CSDH (Figure 7).

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[55]   In earlier work Sen and Runciman argued that a norm of impartiality was not sufficient to ensure justice under some conditions (Runciman 1962:35; Runciman and Sen 1965:557)

One of the strengths of *The Idea of Justice* is that the structure of the discussion is consistent with the process of public reasoning that it advocates. Sen's commentary is a dialogue with Rawls that is extended to acknowledge several traditions of thought. A step towards employing that approach is included in the conclusion to Chapter 5. Two features of Sen's argument are used here: the thought experiment he creates by introducing the role of 'impartial spectator' into a process of deliberative decision making, and the typology of processes he envisages for reaching impartial decisions. These features provide a basis for identifying aspects that Sen does not address and which become the core issues as this discussion proceeds.

Both Sen and Rawls develop their arguments with reference to abstract social processes, despite Sen's recurring criticism of Rawls for transcendental theorising. An important difference between them is that Rawls assumes a social system with a constitution created from an 'original position'. That is to say, with roles, practices and distributions agreed behind a 'veil of ignorance' that prevents those with an interest in the outcome knowing how roles and resources will be allocated in the social system. Sen argues against the idea of a 'closed system' of negotiation and decision making and outlines an alternative. He advocates Adam Smith's device of testing decisions by taking into account the perspective of a notional 'impartial spectator'. In the same vein, Sen criticises Rawls for assuming that the same set of basic principles, liberty and the allocation of additional resources to those in greatest need, would invariably emerge from negotiations in the 'original position'.

Both approaches have value. As Freeman (2010) suggests, Rawls' radical approach can generate significant insights and contributions to political thought and is an exemplary declaration of ideology. Sen places more emphasis on recognising competing ideologies in an open and incremental process of decision making that tests the relevance of all perspectives that can be supported by sustained public reasoning. This goes beyond the parochial views of those most directly affected, and seeks to develop a consensus about the principles of justice that apply equally to all. That approach is more applicable here.

For these purposes the main difference between Rawls and Sen is their emphasis on negotiation and arbitration respectively. To over-simplify, Rawl's participants negotiate and, unless there is consensus, Sen's make submissions to an adjudicator. Consequently, Sen's concept of 'agreement' is thinner than Rawls and, in some contexts, implies

mandating authority rather than reaching agreement on substantive issues. Sen identified 'two grand ways of bringing about the attainment of mutual benefits through cooperation, namely agreed contracts that can be enforced, and social norms that may work voluntarily in that direction.' (Sen 2009:203) Sen asks 'whether mutual benefit and reciprocity must be the foundations of all political reasonableness'? (Sen 2009:205) He concludes that 'mutual benefit, based on symmetry and reciprocity, is not the only foundation for thinking about reasonable behaviour towards others. Having effective power and the obligations that can follow unidirectionally from it can also be an important basis for impartial reasoning, going well beyond the motivation of mutual benefits.' (Sen 2009:207) Sen does not discuss situations where none of these processes are viable, or obligations associated with corporate governance are either not defined or not discharged. Nonetheless the three core forms of interaction – mutual benefit, effective power and recognised obligations – provide a useful starting point for considering how specific claims might generate 'ethical pronouncements' (Sen 2009:360) followed, if successful, by the creation or transfer of a right[56].

These forms of interaction are at the centre of the discussion that follows, particularly in Coleman's work later in the chapter and in the structure of Heckathorn's model introduced in Chapter 3. The types of interaction are, firstly, agreements to facilitate mutually beneficial cooperation by aligning interests (Runciman and Sen 1965; Sen 2009:138, 203 & 376ff). Secondly, 'voluntary' norms introduced to maintain cooperation using reciprocal sanctions. Sen commends Ostrom's (e.g. 2000) comparative research on

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[56]   For Sen, the exemplary pioneers are Tom Paine and Mary Wollstonecraft (Sen 2009:206). Sen regards Declarations of the United Nations as important contemporary claims for rights and a suitable basis for integrating substantive and procedural aspects of impartiality. 'The inclusion of second-generation [i.e. economic and social] rights makes it possible to integrate ethical issues underlying general ideas of global development with the demands of deliberative democracy, both of which connect with human rights and quite often with an understanding of the importance of advancing human capabilities.' (Sen 2009:381). Sen points to real consequences, for example, he notes the correlation of even incipient democracy with the absence of famine and, in other settings, the expansion of formal education with claims for gender equality. Rights can be established sequentially. Examples include seeking equivalent recognition of minorities on various dimensions, such as claims intended to reduce discrimination based on religious affiliation or ethnicity.

the governance of 'the commons' (Sen 2009:203). Thirdly, reasoned action motivated by an ideological commitment to 'unilateral obligations that we may acknowledge because of our power to achieve social results that we have reason to value (without necessarily benefiting [personally] from those results).' (Sen 2009:138).

With respect to the third type of interaction, Sen says very little about sanctions that might support compliance with a normative obligation to act impartially (Sen 2009:204) or processes of mandating that might legitimate the action he envisages. He provides a general test of governance, namely, the extent to which obligations arise as the result of 'public reasoning' in 'unobstructed discussion' (Sen 2009:386). The test of 'viability in impartial reasoning is seen, in this approach, as central to vindication of human rights, even if such reasoning leaves considerable areas of ambiguity and dissonance.' (Sen 2009:359) Reasons, including 'reasons to value', provide a basis for changing habitual action (Sen 2009:187), but some reasons to value will not cross the threshold required to change habitual action (Sen 2009:367), or if it is an issue of relative power, the status quo.

This framework can be used to observe and compare governance practices. However it does not go on to address pressures that might eliminate the types of interaction Sen has emphasised or prevent them from emerging. An initial step towards considering the types of pressures that act against 'public reasoning' to reach consensus begins later in this chapter and accounts for the selection of the model discussed in Chapters 3 and 4. Sen seems to set aside these considerations when he suggests that 'there is nothing particularly mysterious about our respect for sensible rules of conduct, which can qualify the pursuit of what we rightly – and reasonably – see as goals that we would in general like to advance.' (Sen 2009:192) Almost every phrase in this statement is problematic in an institutionalised environment in which there are reasonable and unreasonable commitments to diverse goals that limit capacity for collective action. This thesis is based on the belief that the interactions outlined in Figure 1 can at times be 'mysterious', or at least the reasons for maintaining the status quo are not always evident to participants in a social system.

However, the notional role of 'impartial spectator' gives direction to how Sen's normative regime might evolve. The two quotations that follow are included to show: development in Sen's concept over time, his advocacy for a role without a direct interest

in or involvement with the situation being considered, and the distinction Sen makes between 'spectator' and 'arbitrator'. The emphasis has been added in the quotations to draw attention to those points.

The earlier version includes the following:

> 'Smith's use of the impartial spectator relates to contractarian reasoning in a somewhat similar way to that in which models of fair arbitration (*which can be done by anyone*) relate to those of fair negotiation (in which participation is confined to the members of the group in the original contract).' (Sen 2002:454)

This passage is repeated later in 'The Idea of Justice' with some significant amendments:

> 'Adam Smith's use of the impartial spectator relates to contractarian reasoning in a somewhat similar way to that in which models of fair arbitration (*views on which can be sought from anyone*) relate to those of fair negotiation (in which participation is confined to the members of the group involved in the original contract for a given 'people' of a particular sovereign country). In Smithian analysis, the relevant judgements can come from outside the perspectives of the negotiating protagonists; indeed, they can come from, as Smith puts it, any "fair and impartial spectator". In invoking the impartial spectator, it is not, of course, Smith's intention to give over the decision-making to the final arbitration of some disinterested and uninvolved person, and in this sense *the analogy with legal arbitration does not work here*. But where the analogy does work is in making room to listen to voices not on the grounds of their coming from the group of deciders, or even from interested parties, but because of the importance of hearing the point of view of others, which may help us to achieve a fuller – and fairer – understanding.' (Sen 2009:130-1)

The 'spectator' in this scenario is a disinterested participating observer and so the role designation in what follows is interchangeable; 'impartial specator' when Sen is being quoted directly or impartial commentator when he is not. The quotations also indicate some uncertainty about how the model of arbitration is to be defined.

To summarise, the system that Sen describes has three interacting roles ('spectator', arbitrator and reasonable person) and three types of interaction (mutual benefit, effective

power and recognised obligations). Participants are seeking an optimal mix of consensus and dominance-compliance. Conflict is not a feature of this type of system. This enquiry continues with a view to discovering conditions in which Sen's normative regime could survive. Before taking that further the next section considers a sociological approach to addressing substantive issues of justice or impartiality.

Substantive Comparisons

Structuring claims

This section has two parts. Jasso was referred to by Turner in Chapter 1. She provides a framework for ranking comparisons based on claims to justice, and theoretical content that produces hypotheses related to levels of conflict and capacity to organise. The other part is Robeyns' synthesis of Sen's capability-based approach. The concept of a 'capability set' provides a substantive basis for making comparisons of relative freedom. Claims for 'freedom from' and 'freedom to'[57] are the basis for reducing disparities using the procedure outlined in the previous section.

Distributions

Jasso's macro-model provides a framework for assessing implications of introducing Sen's norm of impartiality into public reasoning about a social system. The model is based on ranked distributions and hypothetical social strata. The strategy is to: identify an appropriate distribution, rank the units of analysis and express the distribution as a quantile function (P) of individual identity, calculate the average value for the population (G), censor the population at some point in the ranking (p), and, calculate the averages for the two sub-groups formed by p. That completes the set up for ordinal rankings. When cardinal scales are used there is an additional parameter (k) that defines inequality (Jasso 2005; Jasso 2008). Rank is on the X axis and the relevant variable on the Y axis. The unit of analysis is usually natural persons, thought of here as holdings of freedom-based capabilities acquired from a portfolio of social roles. The Y axis represents a level of relative justice-injustice.

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[57]   'Freedom with' is implicit in the concept of collective good, the core concept in the Heckathorn model introduced in the next chapter.

Jasso provides a comprehensive set of distributions for both ordinal and cardinal rankings. This discussion focuses on two of those distributions; the ordinal comparison-justice function and the cardinal power version of the comparison-justice function (Jasso 2005:35; 2008:10). The comparison-justice distribution was selected as an appropriate starting point on the following basis: Lenski's analysis of the distribution of freedom across 95 societies of three types concluded that, on average, the median level of freedom was greater than the mean (Nolan and Lenski 2011:308); Marmot and others have noted a decreasing rate of increase in the benefits from reduced social constraints; Sen and Lenski use similar concepts of freedom; Sen's concept of freedom is an integral element of his discussion of justice; and Sen and Jasso use a similar concept of justice. This provides the rationale for using the logarithmic ratio referred to by Turner in the previous chapter and shown in Figure 8.

Figure 8: Four social structures using Jasso's Comparison-Justice function
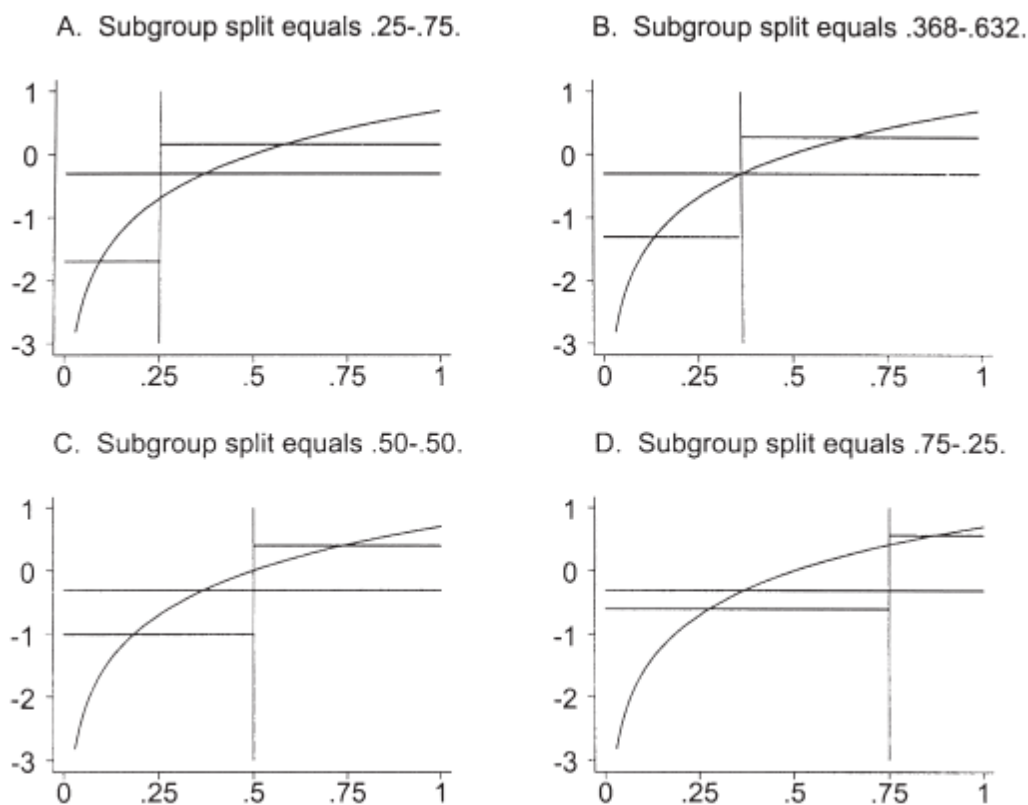
(Jasso 2005:35)

The four charts represent the ordinal version of the function in Table 2, that is when $k = 1$ and p is the only parameter. There are two parameters in the cardinal version of the

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Comparison-Justice function, *p* and *k*. As *k* increases inequality decreases. The two parameters provide an economical and fruitful was of describing social structure including change over time.

Table 2: Jasso's Justice functions

Good's distribution	Personal identity	Subgroup identity		Group identity
		Lower subgroup	**Upper subgroup**	
Justice (ordinal)	$\ln(2\alpha)$	$\ln(\frac{2}{e}) + \ln(p)$	$\ln(\frac{2}{e}) - \frac{p\ln(p)}{1-p}$	$\ln(\frac{2}{e})$
Justice (cardinal)	$\ln[\frac{(k+1)\alpha^{1/k}}{k}]$	$\ln(\frac{k+1}{k}) - \frac{1}{k} + \frac{\ln(p)}{k}$	$\ln(\frac{k+1}{k}) - \frac{1}{k} + \frac{p\ln(p)}{k(1-p)}$	$\ln(\frac{k+1}{k}) - \frac{1}{k}$

(Jasso 2008:10)

The four charts in Figure 8 are read as follows. The vertical line is defined by the parameter *p*, the ideologically defined point at which the population is censored into two subgroups. In example A *p* = 0.25. In public policy discussions in New Zealand the value of *p* is usually set as the lowest quartile (0.25), quintile (0.2), or decile (0.1)[58]. In the example that follows Heckman uses *p* = 0.1. The complete horizontal line is G, the average for the population; the shorter horizontal lines are the averages for the upper and lower sub-groups (S_U and S_L). Jasso hypothesises that each stratum formed in this way will have a unique and characteristic orientation to a set of interests. The orientation is denoted by P for the distribution of personal or individual identities, S_U or S_L for the relevant sub-group and G for the group or population as a whole. On that basis each stratum relates to the social reference levels differently. The top sub-group has a collective culture that ranks priorities as $P > S_U > G$, the next strata is primarily oriented to the collective interests of the sub-group with interests ranked $S_U > P > G$, and so on for the set of five strata, except for the unique case in Figure 8B where there are only four strata.

The gradient at any point on P is interpreted as an indicator of social distance in a social hierarchy. Consequently, given the shape of the distribution in Figure 8, the prediction is that lower deciles, with more differentiated identities indicated by the greater gradient, will be less cohesive, more prone to internal conflict, and face greater challenges to

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[58]   If the focus was on the distribution of wealth *p* would normally be 0.8 or greater.

organising to advance common interests. Conversely higher ranked stratum can address these issues with less effort. In scenarios such as Figure 8A the difference between S_L and G for the bottom subgroup could attenuate identification with G[59]. These hypotheses are relevant to the discussion of efficiency in the next section and in Chapter 5.

The hypothetical social structure can also be related to the discussion of emotion in Chapter 1. The sign of the value on the Y axis can be read as an emotional response, negative being a response to perceived under-reward and positive responses with lesser intensity a response to over-reward. Emotion at the 'point of justice' is neutral. Conflict elicits emotion. The functions predict the level of conflict between the sub-populations formed by p based on the difference between the averages of the two sub-populations (Jasso 1993a). Assuming k is constant, reducing p intensifies conflict and presents greater challenges to organising a collective response. These hypotheses are used to interpret Figures 42 and 43 in Chapter 5.

Freedom-based capabilities

Specifying a relevant freedom-based capability provides a strategy for introducing substantive content into an impartial process considering claims to justice. The content of this type of analysis is specific to the context and changes as the social dynamic proceeds. The main elements of freedom in Sen's formulation are capabilities and choice, interpreted as degrees of freedom (Jasso 1993b). The basis for comparison in the 'freedom-based capability approach' is outlined as follows:

> 'Any substantive theory of ethics and political philosophy, particularly any theory
> of justice, has to choose an informational focus, that is, it has to decide which
> features of the world we should concentrate on in judging a society and in
> assessing justice and injustice. It is particularly important, in this context, to have
> a view as to how an individual's overall advantage is to be assessed . . . [In the
> capability approach] individual advantage is judged . . . by a person's capability
> to do things he or she has reason to value. A person's advantage in terms of
> opportunities is judged to be lower than that of another if she has less capability –

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[59]   Jasso assumes perfect information. This assumption could be compared with, say, Runciman
         (1972), Fararo (2001; Fararo and Kosaka 2003) and Black (1995; 2002) on social distance.

less real opportunity – to achieve those things that she has reason to value. The focus here is on the freedom that a person actually has to do this or to be that – things he or she may value doing or being.' (Sen 2009:231-2)

The capability framework is intended to organise variables relevant to the issue under consideration and to avoid burying information in a single index (e.g. Gross Domestic Product) or a single concept (e.g. utility).

Robeyns summarises the ideology and application of the approach as follows:

'[T]he capability approach is clearly a theory within the liberal school of thought in political philosophy, albeit arguably of a critical strand. Note that the word 'liberal' in political philosophy refers to a philosophical tradition that values individual freedom, and should not be confused with the word 'liberal' in an everyday political sense.' (Robeyns 2005:95)

This is a fundamental point that provides direction to consideration of how the model could be applied and developed and, for that reason, is referred to at the conclusions of Chapters 4 and 5.

Freedom includes an ability to choose between alternatives, rely on procedural fairness, and engage politically. The autonomy of the individual is qualified by the normative requirement for 'reasons' for valuing particular capabilities. The approach is

'. . . primarily and mainly a framework of thought, a mode of thinking about normative issues; hence a paradigm — loosely defined — that can be used for a wide range of evaluative purposes. The approach focuses on the information that we need in order to make judgements about individual well-being, social policies, and so forth, and consequently rejects alternative approaches that it considers normatively inadequate; for example, when an evaluation is done exclusively in monetary terms.' (Robeyns 2005:96)

In practice the capability approach

'. . . comes in a variety of forms, in part because of the wide scope of the approach, but also because the approach is radically *underspecified*: there are a number of theoretical lacunae that can be filled in a variety of ways. How one

makes these specifications depends in part on the kind of theory (for example, a theory of justice, or a theory of welfare economics), or the kind of application (for example, a critique of existing social practices, or a measurement exercise), but it also depends in part on particular normative and epistemological assumptions. Three theoretical specifications have emerged from the literature as particularly important: the choice between functionings and capabilities, the selection of relevant capabilities, and the issue of weighting the different capabilities for an overall assessment (also known as the question of indexing or trade-offs). (Robeyns 2006:353)

The general approach is summarised in Figure 9.

Figure 9: An interpretation of Sen's capability-based approach
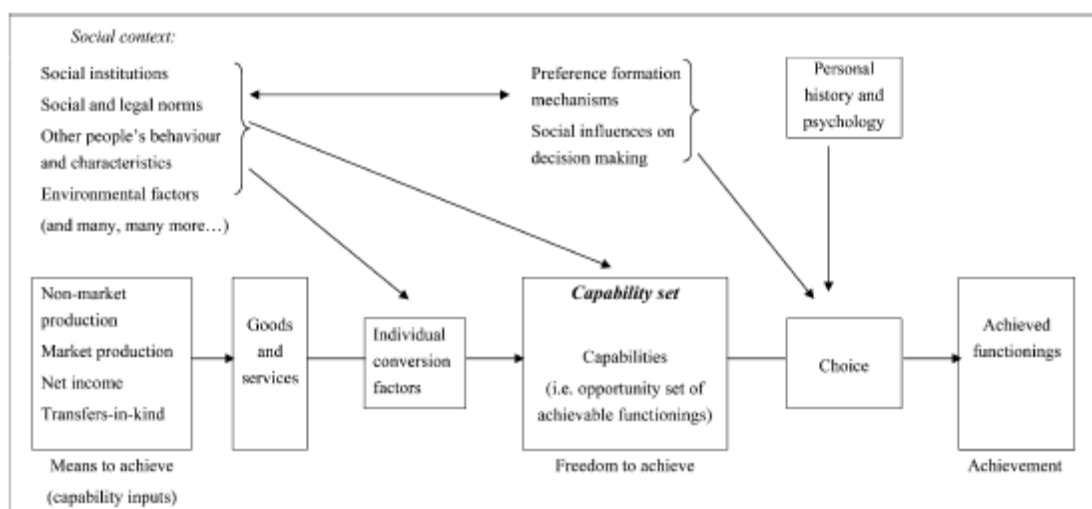
FIGURE 1. A stylised non-dynamic representation of a person's capability set and her social and personal context.

(Robeyns 2005:98)

Sen (2009:235) cites the source of Figure 9 as an authoritative contribution to the development of the capability-based approach. It differs from the scheme used in this thesis. For example, based on the distinctions made previously, the reference to psychology conflates biological and cultural influences and the diagram outlines a different approach to defining the social context. The common ground in the approach

taken in the thesis and Robeyns' outline is that, firstly, the social context defines conversion factors[60] that affect the way the social context is experienced by individuals. Secondly, the capability set available to a person determines the extent of their 'freedom to achieve'. Thirdly, the core element in the analysis of freedom is the capability set; achievement is only relevant insofar as it provides relevant information about opportunities provided in the social context. Feedback to the capability set attributable to choices and achieved functioning raise another set of issues that are not discussed in the thesis.

An exemplary case

Sen suggests that the most useful guidance for applying the approach comes from a study of examples. He commends (Sen 2009:234) Heckman's (2007) model of human capability formation as an important example of the general approach. That model is based on claims that action should and can be taken to reduce cultural constraints created in early childhood; it does not extend to procedural aspects of negotiating or adjudicating the claims. The example is used here to create a reference point that can be used to estimate defection from a norm of impartiality. Heckman did not refer specifically to norms of justice.

Heckman claims that resources should be reallocated to realise potential cultural capabilities in the lower subgroup (in this case the lowest decile) of the child population in the United States of America. He avoids direct justice comparisons in two ways. Firstly, by emphasising cultural capabilities that can, in principle, be acquired by most humans without constraining others, that is to say there is no direct discussion of subsequent competition for institutionalised roles. The main indicators of success are

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[60]   There are 'three groups of conversion factors. First, personal conversion factors (e.g. metabolism, physical condition, sex, reading skills, intelligence) influence how a person can convert the characteristics of the commodity into a functioning. If a person is disabled, or in a bad physical condition, or has never learned to cycle, then the bicycle will be of limited help to enable the functioning of mobility. Second, social conversion factors (e.g. public policies, social norms, discriminating practises, gender roles, societal hierarchies, power relations) and, third, environmental conversion factors (e.g. climate, geographical location) play a role in the conversion from characteristics of the good to the individual functioning.' (Robeyns 2005:99)

emotional and cognitive attributes. Secondly, by using an economic argument that early intervention brings forward expenditure currently committed to cohorts in the lowest decile in the form of remedial action required because of a lack of formal education or following conviction for a criminal offence.

The strategy does not address reallocation of resources across social strata. Heckman selects relatively small projects to estimate favourable benefit-cost ratios for early intervention and compares those results with the costs of operating large mature or decaying institutions such as prisons and schools. Nonetheless, as far as it goes, the logic of the argument is strong and it has been influential.

Heckman makes a well supported claim that his model of capability formation unifies the evidence on investment in child development (Heckman 2007:13252)[61]. The main strand in Heckman's case is that emotionally nurturing environments produce more capable learners, and these environments can be reliably created by organisations providing early education. More generally, humans realise their potential more fully throughout their life when investment occurs at the earliest appropriate phase in the life cycle. The appropriate point in the life cycle for investment to occur depends on the issue. For some phases of human development it occurs *in utero.* Heckman notes, as an example, that attempts to compensate later for nutritional deficiencies during pregnancy seem to increase, not mitigate, the risk of diabetes and heart disease[62]. The emotional pre-conditions for effective learning occur early in life. IQ stabilises at ten years of age, and it is probably very difficult to learn to speak a language without an accent after the age of twelve. Some cognitive development occurs through to the early twenties.

An assumption in Heckman's model is that, 'all capabilities are produced by investment, environment and genes. These capabilities are used with different weights in different tasks in the labor market and in social life more generally.' (Heckman 2007:13252) It is

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[61]   A relevant assessment is provided in a report from the NZ Families Commission Research Fund (Waldegrave and Waldegrave 2009).

[62]   Gluckman (Gluckman and Hanson 2006) includes a discussion of responses to environmental pressure over generations. He suggests that because grandmothers carry the genetic material of their granddaughters from conception there is potential for a 'mismatch' between the optimal adaptation for the earlier and later generations.

also assumed that parental propensity (but not capacity) to invest, and, a person's potential ability attributable to biological inheritance, are distributed similarly in all social strata. Heckman concludes there is a low association between infants' potential capabilities and the socio-economic position of their parents[63], but 'ability gaps between individuals and across socioeconomic groups open up at early ages, for both cognitive and noncognitive skills, as do gaps in health status.' (Heckman 2007:13251).

The baseline data used to support the modelling assumptions was compiled using indicators of educational achievement stratified in quartiles by permanent household income and by ethnicity (Cunha, Heckman, Lochner and Masterov 2006). Socio-economic stratification of achievement was significant by the age of five and levels of achievement continued to diverge as age increased. Consequently, the timing and sequence of the attention children receive is critical to the development of their capabilities (also referred to as human capital). Other evidence is offered to show that the later remediation occurs, the less effective it is, and when remediation is provided, recipients derive less benefit from the same level of investment than contemporaries who do not require remedial action. Consequently, if both groups receive the same level of investment later in the life cycle inequality continues to increase (Heckman 2007:13252). In either case ongoing investment is required to realise the value of early investment.

The approach to stratification is explained as follows:

> 'We focus our analysis on children from disadvantaged backgrounds because at current levels of social inequality they benefit the most from policies that supplement early environments. Disadvantaged children are at risk of being permanently poor and uneducated, and of participating in crime. In our simulation, disadvantaged children come from a background where mothers are in the first (lowest) decile in the distribution of parental skills[64]. If no intervention occurs, the

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[63] However, he suggests further study of the distribution of potential at birth is warranted (Heckman 2007:13252).

[64] For the purposes of this illustration there is no need to discuss the shift from socio-economic circumstances to parental skill. This discussion assumes the issue is parental capacity to invest attributable to access to social, including economic, resources.

children receive investments equivalent to the first decile of the distribution of parental investments.' (Cunha and Heckman 2007:43)

With this conceptual framework and data Heckman (2006:1901) estimated the benefit-cost ratio of early intervention to be about 8.75. The benefits are thought of as personality traits or abilities that contribute to positive 'choices' or behaviour, and the costs are various forms of public expenditure later in the life cycle associated with unemployment, crime and ill-health among young people and adults. In the model the main influence on (average) individual capabilities for each social stratum is the trajectory of parental investment given constraints on household budgets determined by environmental factors.

The argument is summarised in Figure 10:

Figure 10: Rates of return to human capital investment
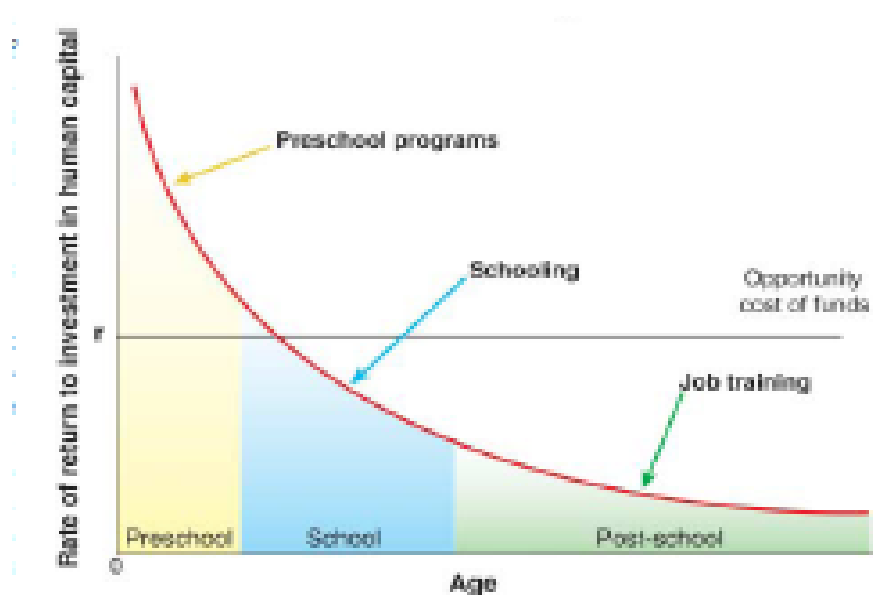
(Source, Heckman 2006:1901)

Figure 10 is explained as follows:

> The chart shows: 'rates of return to human capital investment in disadvantaged children. The declining figure plots the payout per year per dollar invested in human capital programs at different stages of the life cycle for the marginal participant at current levels of spending. The opportunity cost of funds (r) is the payout per year if the dollar is invested in financial assets (e.g. passbook savings) instead. An optimal investment

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program from the point of view of economic efficiency equates returns across all stages of the life cycle to the opportunity cost. The figure shows that, at current levels of funding, we overinvest in most schooling and post-schooling programs and underinvest in pre-school programs for disadvantaged persons.'

This case for augmenting parental capability to invest in the cultural capabilities of their children has crossed the threshold of claims fit for public reasoning, both in principle using Sen's criteria and empirically based on its currency in public documents (e.g. Waldegrave and Waldegrave 2009; Gluckman and Hayne 2011). Heckman's case has been used to demonstrate that it is feasible, following Sen, to inject specific and reasoned arguments into the high level framework developed by Jasso. A generic application of Jasso's framework is reviewed in Chapter 5.

Societal Dynamics

The final section of this chapter identifies three aspects of the dynamics of societies that relate to the distribution and use of power. These are: efficiency and the allocation of costs, norms as a power-weighted consensus, and the allocation and exchange of rights and corresponding duties. The ideas are core concepts from Coleman's *Foundations of Social Theory* (Coleman 1990).

Efficiency

The points outlined in this part of the thesis follow from the comments in the previous chapter about the historical trend to constitute and legitimate the action of corporate entities. One consequence is that 'rational action' assumptions are probably applied more consistently by corporate actors than natural persons[65]. Heckman's decision to base his case to governing entities on a claim of efficiency is consistent with this tendency.

Coleman described an important implication of the approach:

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[65]   See Collins (1996:331) for a general application of rational action theory at a meso-level of analysis. Beinhocker (2005; 2006) has provided a full outline of evolutionary logic using a Corporate Business Plan as the core set of practices or strategies that are subject to selection pressures.

'. . . the [common] connotations of efficiency obscure the role power plays . . . The calculation of economic efficiency can be carried out only after a particular distribution of power or resources is taken as given. Another way of saying this is that all persons' benefits and costs are not counted equally. They are instead weighted by each person's power or resources . . . There is, then, a sense in which the use of the concept of economic efficiency to examine systems where the costs and benefits of an event are experienced by different persons hides an implicit struggle in which the strength of one's voice is determined by the extent of one's resources. It should be recognized that differential power of persons is intrinsically bound up with the concept of efficiency, and that any statement concerning the efficiency of an action is based on a particular distribution of resources. Such a statement should not be accepted without questioning the distribution of power on which the calculation is based . . . A different distribution of power may be brought about by the reallocation of rights . . . and an action that was efficient under the old distribution may become inefficient under the new one.' (Coleman 1990:799-800)

Relative efficiency is also gained by corporate actors with hierarchical structures that allow resources to be deployed with less effort than in lateral networks of equivalent size. Fewer interactions are required to satisfy participants in a formal organisation[66]. Natural persons who derive benefits from the exercise of power and deployment of resources can also operate more efficiently than those without those resources. Those with fewer resources must use a greater proportion of what is available to achieve comparable outputs with implications for cumulative effort, stress and risk. It is a greater proportion in two senses, one being when the same absolute amount is used from a smaller stock of

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[66] If each interaction is thought of as two accounts that must remain positive to be sustained, then 'in an informal organisation (i.e. a network) consisting of 10 actors, 90 account balances are necessary; a formal organisation with ten agents needs only 11 account balances (Coleman 1993:8) and only a net surplus is necessary to maintain overall viability'. The net surplus can then be deployed to create extrinsic incentives, such as salaries and enhancements to individual human capital. Coleman has extrapolated this generalisation to compare requirements for reciprocal, individual and global viability (Coleman 1990:428-9), and applied the logic to topics such as the fiscal sustainability and sanctioning capacity of the welfare state, and the viability of employment contracts (Coleman 1990:655-8)

resources (such as the proportion of household expenditure used to secure accommodation), and the other is when greater absolute effort is required (such as ease or difficulty of travel or communication).

Norms as a power-weighted consensus

The social allocation of effort, stress and risk (and hence a determinant of the health gradient) is an expression of a 'power-weighted consensus' of the normative regimes in the system. Normative regimes are formed from iterated, organised, and possibly competing feedback from 'third parties' affected by interactions, either positively or negatively (Coleman 1990: Chapter 30)[67]. Coleman noted problems conceptualising this feedback: 'the major problem for explanations of system behaviour based on action and orientations at a level below that of the system is that of moving from the lower level to the system level.' He suggested making provisional use of a concept of 'social capital' for 'making the micro-to-macro transition without elaborating the social-structural details through which this occurs.' (Coleman 1990:305) In Coleman's scheme social capital[68] takes the following forms: obligations and expectations including trust, information potential, norms and effective sanctions, authority relations, appropriable social organisations, and intentional organisation. The value of social capital to actors or roles is measured as relative power.

The aspect of interest here is that rights form, '(through some poorly understood process) [as] a collective right to exercise social control over certain actors' actions, via norms enforced by sanctions. Once established, these norms come to constitute auxiliary "rules of the game," enforced more or less fully by the actors in the system.' (Coleman 1990:21) As a step towards improving understanding of the process, Coleman used the analytical strategy of beginning from a 'perfect social system'. In a perfect[69] social system social capital is complete and resources are fully fungible. Each actor's potential power is usable at every point in the system; there are no transmission losses and no

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[67] Coleman described his work on 'Externalities and Norms in a Linear System of Action' as the culmination of his theoretical contribution (Swedberg 1990:54&56).

[68] Coleman's definition of social capital is the only one used in this discussion. See the CSDH Working Paper (Solar and Irwin 2007) for other uses of the term.

[69] 'Perfect' (Coleman 1990:719-21) in a positive, not a normative sense.

transaction costs (Coleman 1990:720). Exchange systems which are not at equilibrium can increase the value attributed to resources by reallocating control of those resources, however, such exchanges do not affect the distribution of power (Kalter 2000).

Reallocating rights of control is the essential aspect of the micro-macro transition in this discussion. That is the essential difference between a perfect social system and a 'perfect market'.

> 'Potential activities in a perfect social system include not only exchange of divisible goods but also exchange of partial rights of control over indivisible events. . . . Because the value of each outcome of each event is known . . . control over indivisible events can occur and outcomes can be determined with exchange of resources. In such a system there is no conflict because all confrontations are virtual. The weaker side sees that it will lose and deploys its resources elsewhere, rather than wasting them on a lost cause. Norms exist, and sanctions are potentially present but are never used, because target actors know whether or not their power-weighted interests are greater than those of the sanctioners. If not, the target actors will obey the norm; otherwise, they will disregard that norm, and potential sanctioners will not sanction because they know it would be waste of resources.' (Coleman 1990:720)

These are useful assumptions for modelling. Most features of a perfect system are assumed in the chapters that follow. For example, it is assumed social capital is complete, strategy selection is based on the payoffs available without other structural constraints, and the relative frequency of strategies determines the pattern of interactions. The main difference in the model described in Chapter 4 is that the response to costs of maintaining social relations (Coleman 1990:426-35), including the cost of organising, sanctioning and sustaining conflict, are not instantaneous.

When these features of the social system are integrated with Sen's set of impartial practices the social environment can be summarised as shown in Figure 11.

Figure 11: A social environment
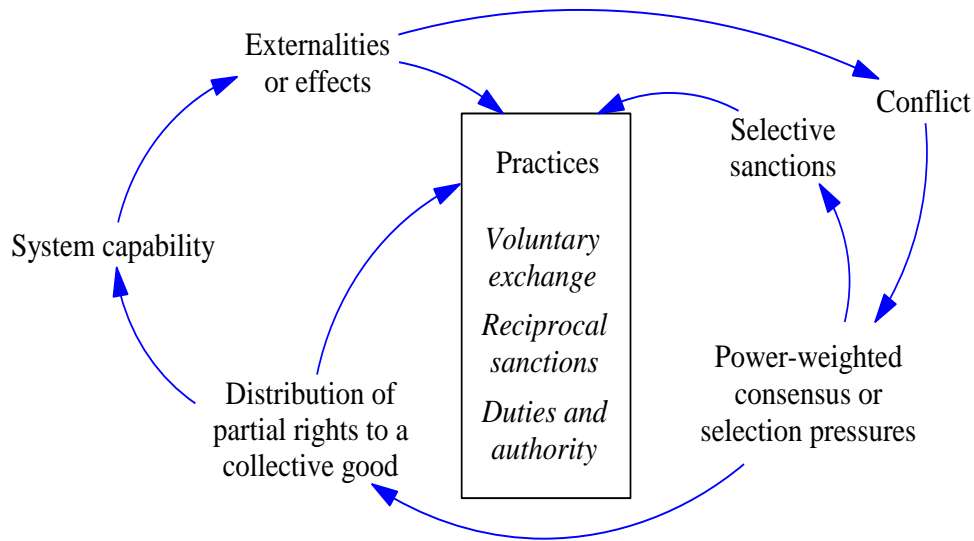
Rights and duties

Sen does not address the implications of establishing impartiality as a norm in an environment dominated by corporate entities. Coleman began to address some of the issues. As a practising sociologist steeped in the politics of public policy (e.g. Peterson 2010:183-202), Coleman urged sociologists to attend to implications of institutional design (Coleman 1993:1&14). His logic was 'if the social system is in fact self-governing, it does not need social theory to inform a set of policy advisors or economic advisors[70]. It needs social theory to inform those who have constitutional rights of control over social policy so that they can exercise those rights in an informed fashion.' (Coleman 1990:784)

Coleman was at an early stage of working through the implications of the three sets of practices listed in Figure 11 with reference to duties associated with corporate governance. His central problem was envisaging allocations of rights that both reduced harm to natural persons adversely affected by corporate activity and maintained the

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[70]   Coleman identified numerous problems associated with applying research findings as public policy
        (Coleman 1990:610-49). His professional commitments also provide some controversial case
        studies (Moynihan 1993; Tilly 1997) created by moving from abstract models to (coercive) action
        (Heckman 1996:98)

viability of productive entities. Wilkinson is working through the same problem in his interest in the contribution of cooperatives to reducing health inequality[71]. Examples of harm to natural persons range from toxic pollution to a claim for restitution from a corporate actor that relocates production and employment and thereby causes others to incur losses, particularly children and others who depended on care provided by kin and communal arrangements (Coleman 1990:569). In some hypothetical normative regime a group of households that have lost productive work as a result of a corporate decision might seek compensation for the loss of capacity to educate their children and the consequent loss of human capital in the next generation (Coleman 1990:656-7). The rights Coleman envisages are substantial.

The approaches Coleman considered included an exchange of rights to avoid harm by redefining social efficiency, that is to say, redistributing power so that voluntary exchange can compensate for losses. In that way the relevant costs and benefits are introduced into the process of decision making. An alternative course of action is based on a credible threat that harm will require restitution, a type of reciprocity. The third approach considered the possibility of creating a role of Trustee to protect interests that would otherwise lack weight. Coleman's analysis is adopted here because it seems to provide a way to identify well defined indicators of elite responsiveness – an important parameter in the model to follow.

The approaches outlined by Coleman raise a comprehensive set of questions. For example, when discussing the type of constitution that would provide for voluntary exchange between a corporate actor and natural persons he offered the following comment:

> 'Where the set of persons who experience the externalities of the corporation's action is identifiable, a superior solution [to regulation] would be to use powers of government to eliminate the costs of organisation for that set of persons and to provide the organisation with rights to tax all those who experience the externalities so that the offensive action, if uneconomic (in the broad sense that

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[71]   http://www.equalitytrust.org.uk/take-action/economic-democracy

persons are willing to pay a tax sufficient to induce the corporation to refrain from it), would be eliminated.

> '. . . a further step would be necessary to reduce transaction costs . . . (namely) a transfer of rights from the corporation generating the externalities to the actors experiencing them – thus reducing the transaction costs necessary to achieve a socially efficient state. This is not the way governments have addressed these problems, but it is the means by which social efficiency would be achieved, whether that involves continuing the externalities or eliminating them.' (Coleman 1990:571)

Coleman points to the possibility that the threshold of change (taking or not taking the action) depends on which case is treated as the status quo (Coleman 1990:797).

The scenario of greatest interest here is one in which Coleman envisages reconstituting roles in corporate governance to include trustees for societal interests, with those trustees having the capacity to decisively influence corporate decision making, individually and collectively. One way of approaching this possibility, he suggests, is to ask: 'If directors are to become in effect trustees, in whose interests should they act? One answer is:

> 'The trustees would serve the interests of those who experience negative externalities from the existence and power of corporations. I indicated earlier what some of those interests are: child care, youth socialization, and care of dependents and unemployable persons. However, a more detailed examination of corporations' negative externalities for persons in society would be necessary if such a criterion were to be used.' (Coleman 1990:578)

Following from Coleman's question, this thesis seeks to develop a perspective of a notional role by drawing on the possibilities introduced by Sen (disinterested and active 'spectators' or commentators) and Coleman (notional trustee). The roles would have the powers and fiduciary duties (Westbrook 2007) necessary to estimate elite responsiveness to norms of impartiality. Such a role might, for example, review comparative levels of socially structured investment in young children, particularly those affected by social constraints on parental investment, identify violations of the norm of impartiality, and adjudicate on the extent to which the violations are justifiable (Gert 1995:122-3). Dew

and Taupos' (2009:1007) proposal of 'sociologically-informed public health' research is a potential source of support for roles of that kind. Modelling might support that activity; some considerations are discussed in the next chapter.

CHAPTER 3: MODELLING AND SELECTING A MODEL

Introduction

The conceptual framework adopted in the previous chapters defined the requirements for the modelling method and provided a template for a 'concept model'. The template consists of a small set of macro characteristics of a large variety of social roles, with the relative frequencies determined by sanctions acting as selection pressures. System Dynamics meet the requirements for a method of modelling. That is discussed in the first section of this chapter. The model was provided by Heckathorn's model of the 'The Dynamics and Dilemmas of Collective Action' (Heckathorn 1996), supplemented by a subsequent discussion of the relationship between the core model and ideological orientation (Heckathorn 1998). The model is described in the later sections. The main features of the model are outlined in the following order: the payoff matrix, the production function for a collective good, and applications of the model, mainly with reference to ideological regimes and the influence of norms and sanctions.

Sociology and System Dynamics

Numerical modelling is a flexible way of examining the logic of an argument (Hanneman 1988; Hanneman 1995). System Dynamics applications provide a platform for exploring the endogenous feedback implied by the selectionist paradigm and produce outputs that include charts that allow users to visualise change over time. In addition, the applications are accessible, economical and simple to use. On the other hand, sociologists seldom use System Dynamics modelling. Agent-based modelling is preferred among those who have commented directly on the topic. The weight of opinion is that the emphasis has moved 'From Factors to Actors', that is from macro variables to agent-based models simulating rule-based micro interactions (Macy and Willer 2002:144). Hanneman's advocacy and models associated with 'Limits to Growth' are noted as influences in earlier stages of social modelling (Halpin 1999), with perhaps continuing applicability to 'macro level' models (Sawyer 2003:331) . Gilbert has been influential in disseminating this assessment (Gilbert and Abbott 2005; Gilbert and Troitzsch 2005).

On the other hand, Fararo and Hanneman are two sociologists who have seriously addressed modelling using differential equations to generate change of over time. Both

mount strong arguments for including such models within a range of potential modelling strategies. Fararo distilled his conclusions from a review of leading sociologists[72] which he synthesised as 'generative process model building' based on axiomatic and dynamic hypotheses (Fararo 2001:246-7). He attributes the initial move in this direction to Parsons' distinction between theoretical and empirical systems[73]. In Parsons' terms a theoretical analysis 'has two goals: causal explanations of events and the attainment of generalized analytical knowledge'. More specifically, it should be a dynamic analysis and 'here [Parsons] seems to mean, as the term "dynamic analysis" suggests, a system of differential equations. In our day, such a system is said to specify a dynamical system.' Fararo used the elementary Lotka-Volterra Predator-Prey model to exemplify this type of system (Fararo 1989:73). Parsons noted difficulties with the strategy related to the nature of sociological variables and proposed 'a "second best type of theory" . . . [simplified by] "removal of *some* of the generalized categories from the role of variables and their treatment as constants" (Parsons 1954: 216)' (Fararo 2001:99-101). Forrester (1995; 2007) used the same approach to address policy problems and in doing so established the field of System Dynamics.

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[72]   Runciman is dismissive of Fararo's approach, although it seems to anticipate some of the implications of his own strategy. In Runciman's opinion 'the philosophy of social science is best left to philosophers. They are much better at it – as you can see, for example, in the opening chapters of John Searle's book of 1995 on the social construction of reality. And they are very skilled at distinguishing good arguments from bad ones. When they turn their attention to the writings of sociologists, the result, as in Max Black's critique of Talcott Parsons, can be not merely salutary but devastating. When, on the other hand, sociologists try to do philosophy, they all too often end up doing the sort of guffy stuff that used to be called 'social philosophy' at the LSE in the days of the now forgotten Morris Ginsberg, or what the American sociologist Thomas J. Fararo calls 'philosophy of general theoretical sociology', which is neither the one thing nor the other.'(Runciman 2007:3)

[73]   'In a paper first published in 1945 called "The Present Position and Prospects of Systematic Theory in Sociology, Parsons (1954: Ch. 11) frames the rationale for a structural-functional approach. A *theoretical system* is defined as a system of concepts – analytical and structural elements – in relations of logical interdependence. An *empirical system*, by contrast, is "an interconnected whole," an actuality that is described and analyzed by the use of the theoretical system.' (Fararo 2001:99)

Hanneman is associated with the largest body of explicitly sociological System Dynamics modelling identified during the literature search (Hanneman and Collins 1987; Hanneman 1988; Jacobsen and Hanneman 1992; Hanneman 1995; Hanneman, Collins and Mordt 1995; Collins and Hanneman 1998). Apart from using software developed by originators of the field of System Dynamics (DYNAMO and Stella[74]) he seems to have had no association with those who named and have maintained the community of System Dynamics practitioners. The work of one of Hanneman's collaborators, Jacobsen, included a contribution to the System Dynamics Review (Jacobsen and Bronson 1987). Fararo commended the rigour of Hanneman's models of 'State Legitimacy and Imperialist Capitalism' (Hanneman, Collins et al. 1995) and solidarity (Collins and Hanneman 1998). Turchin (2003:205-6) has provided a critique of the State Legitimacy model which reveals some of the basic challenges to developing a fully logical and validated model. Later Hanneman was associated with work to convert some of Turner's causal loop diagrams or quasi-mathematical equations (Turner 1984; Turner 2004) into 'stock-flow' models[75]. Turner has produced explicit 'quasi-mathematical' accounts of evolutionary processes at various levels of organisation (Turner 1995; Turner 2003).

Although Gilbert and Troitzsch are sceptical about Systems Dynamics as a modelling method they present two examples, World3 (the 'Limits To Growth' model) and a representation (2005:32-45) of Martinez Coll's model of Maynard Smith's Hawk-Dove-Bourgeois game (Martinez Coll 1986)[76]. The Martinez Coll model was a key element in this search for a template for a model. It created a point of convergence for Runciman and Colemans' comments about the potential significance of the Hawk-Dove game and System Dynamics modelling, and led to Heckathorn's model of 'The Dynamics and Dilemmas of Collective Action' (Heckathorn 1996). Heckathorn's model is based on and extends the model used by Hirschleifer and Martinez Coll. In addition to the direct

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[74] Later models used Madonna as the software application.

[75] Personal communication.

[76] It seems Gilbert's version produces the frequencies of the Martinez Coll model but not the yields. We have revised his formulae as follows, e.g. yieldd = Doves*rdd + Hawks*rdh + LawAbiders*rdl and yields = yieldd*Doves + yieldh*Hawks + yieldl*LawAbiders (cf. Gilbert and Troitzsch 2005:41). This version of the model was followed by further joint work in the same vein by Hirschleifer and Martinez Coll (1988; 2001).

relevance of the model to the issues raised in the first two chapters, it also seems to have potential to incorporate explicit feedback and provide a useful addition to the set of small generic System Dynamics models.

Small models are a specific topic of interest in the Systems Dynamics community (Lane and Smart 1996; Rahn 2005; Forrester 2007; Ghaffarzadegan, Lyneis and Richardson 2011). Several examples were considered. One was the political archetype proposed by Rahn (2005) based on a model subsequently published by Richardson (2006) and Weaver (2006). Other examples of models or modelling strategies that provide generic templates of social dynamics include: the Lotka-Volterra equations recommended by Fararo, publications by Faia (e.g. 2002), illustrations of fundamental concepts such as 'attractor' (Skyrms 1997; Sallach 2000; Mackenzie 2005), hypotheses such as those contained in 'Daisyworld' (Zeng, Pielke and Eykholt 1990; Jascourt 1992; Ford 1999) and the Long Wave model (Sterman 1986), and the Hardy-Weinberg principle (Hannon and Ruth 1997:99-108). The only apparent intersection of theoretical sociology and the work of a leading member of the System Dynamics community was Phillips' collaboration with Senge (Phillips 1972). Their model included a trajectory of freedom and anticipated further insights from developing the model further. In the event Phillips remained an advocate of causal loop diagrams (Phillips 2001) but, it seems, has not proceeded with the modelling (Phillips 2009).

The rest of the thesis aims to demonstrate that Heckathorn has devised a model that meets some of the most important modelling standards of the System Dynamics community. It is a formal statement of general hypotheses which is applicable to a domain, suitable for tailoring to specific situations by parametrisation (see also White 2000), and allows meaningful experimentation with generalised case studies (Lane and Smart 1996:102). The model provides strong hypotheses that produce a range of plausible scenarios, draws attention to some sources of resistance, and generates alternatives (e.g. game changing) that might reveal implications for resistance and conflict. In that sense the model assists the user to identify hypothetical options based on alternative sets of decision making rules that are not necessarily derived from past practice (Forrester 2007:365-6). Further, it is a compact, generic model that classifies systems in a way that accounts for dynamics and provides useful guidance when searching for empirical evidence in a mass of data. The main limitation, for the purpose of this thesis, is the absence of some feedback loops.

The Conceptual Basis of the Model

Heckathorn designed the 'Dynamics and Dilemmas of Collective Action' model (Heckathorn 1996) to give an account of the production of a generic collective good in the range between no production (0) and full production (1). Commenting on a later version of the model Centola and Heckathorn suggested the approach can be applied to various systems of collective action. They wrote:

> '[I]t is possible that our use of structural incentives to analyze the maturation of social movements may be applied to a wider range of organizational trajectories. . . . Our analysis of the micro-incentive structures of collective action may be easily generalized into a model of the dynamics of organizational development, transforming the *collective action space* into a multi-purpose *structural incentive space*.'(Centola and Heckathorn 2010:47-8).

The version used here does not include the modifications in the 2010 model[77] but it does have a range of generic features. It is based on the two-by-two payoff matrix of a basic evolutionary game referred to by Runciman and Coleman. This is an economical way to summarise micro interactions and macro selection pressures having regard to Giddens' comments on modelling which were discussed in Chapter 1. Selection pressures can take the form of the power-weighted consensus in competing normative regimes, using the example of a norm of impartiality introduced in Chapter 2. The objective in this Chapter is to provide a means to move from the static representations in the figures that have been used in previous chapters to a model that can be used to generate an extensive range of theoretically informed Behaviour Over Time (Maani and Cavana 2007).

The core element in this model is the payoff matrix. Table 3 depicts two interacting strategies (A and B) with four payoffs (a, b, c and d) and the alternative designations used by Heckathorn and derived from earlier work on the dynamics of the Prisoner's Dilemma (R, S, T, P). In what follows the A strategy is Cooperation, and the B strategy Defection. The ordinal ranking of the values of the cells can be varied. Each order generates a

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[77]   E.g. probabilistic distribution of value, a decision making algorithm, and provision to vary coalition size

characteristic selection dynamic which determines whether one strategy dominates and the other becomes extinct or the two strategies coexist.

Table 3: Generic Two by Two Matrix

	A	B
A	a or R[78]	b or S
B	c or T	d or P

The five dynamics created in this way are summarised in Figure 12.

Figure 12: Frequency-dependent selection dynamics between two strategies, A and B
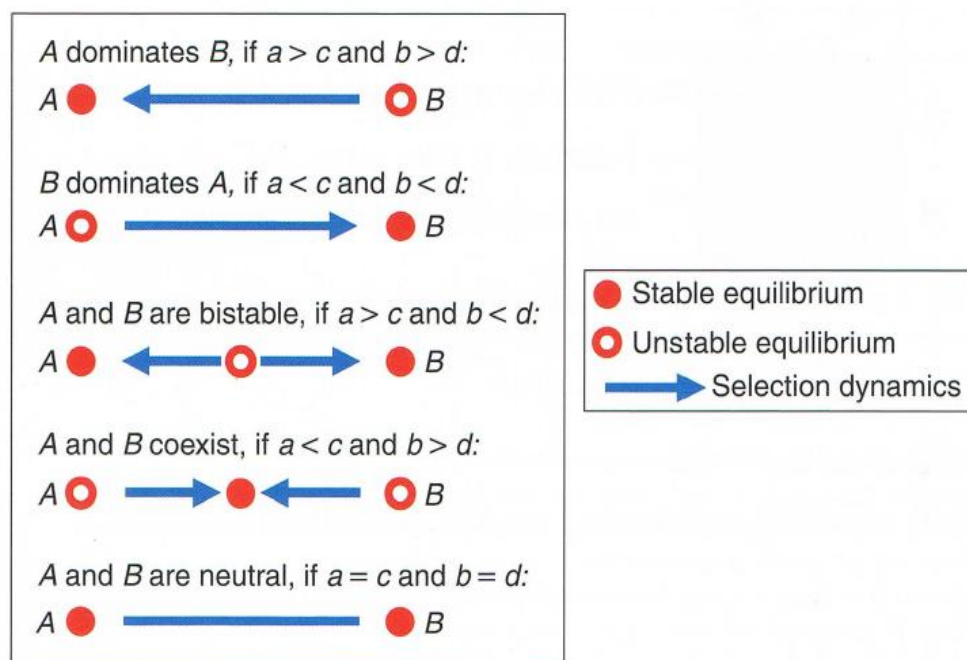
(Novak 2006:50)

'There are five possibilities for the selection dynamics between two strategies: (i) A dominates B, (ii) B dominates A, (iii) A and B are bistable, (iv) A and B coexist in a stable equilibrium, and (v) A and B are neutral variants of each other' (Novak 2006:50)

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[78] T: Temptation; R: Reward; P: Punishment; S: Sucker

Heckathorn applies and develops the concept of relative payoffs. His core matrix in Table 4 contains three parameters which determine the relative frequencies of strategies that contribute to or defect from the production of a collective good. The three variables are: a value for the collective good (V), the net average cost of contributing to collective action (K_{c1}), and an exponent defining a production function for the collective good (F). The payoff matrix is:

Table 4: Generic payoff matrix for rows in the first-level game

	Cooperate	Defect
Cooperate	$R = V - K_{c1}$	$S = V(1 - .5^F) - K_{c1}$
Defect	$T = V(1 - .5^F)$	$P = 0$

(Heckathorn 1996:256)

The cell labels T, R, P and S are used for all games, although the initials are only directly applicable to the Prisoner's Dilemma. Table 4 states that in interactions when both actors contribute the payoff is the full value of the collective good less the cost of coordination. When one defects and the other contributes both receive a payoff in which the value of the payoff is a proportion of the full value. The proportion of the full value (V) is determined by the level of the collective contribution and the relevant production function (F). In those cases the contributor incurs the cost of coordination and the defector does not. If both defect there is no payoff. In the cells S and T the value of the collective good (V) is multiplied by the level of contribution (L) calculated on the basis of $L = 1 - (D/N)^F$ where D is the number of actors in the system who are defecting and N is the total number of actors in the system. Throughout this discussion it is assumed that interactions are pair-wise consequently there are three possible values of D/N: 2/2, 1/2 and 0. Consequently in Table 4 L is implied for the R and P cells because for Contribute-Contribute L = 1 and for Defect-Defect L = 0.

Figure 13 illustrates a set of values for L when F is constant. Other functions can be used which treat F as a variable such as the logistic function that produced the trajectory created by an increasing proportion of contributors shown by the dotted line in Figure 14.

Figure 13: Production functions showing the relationship between the proportions of contributors and collective good produced
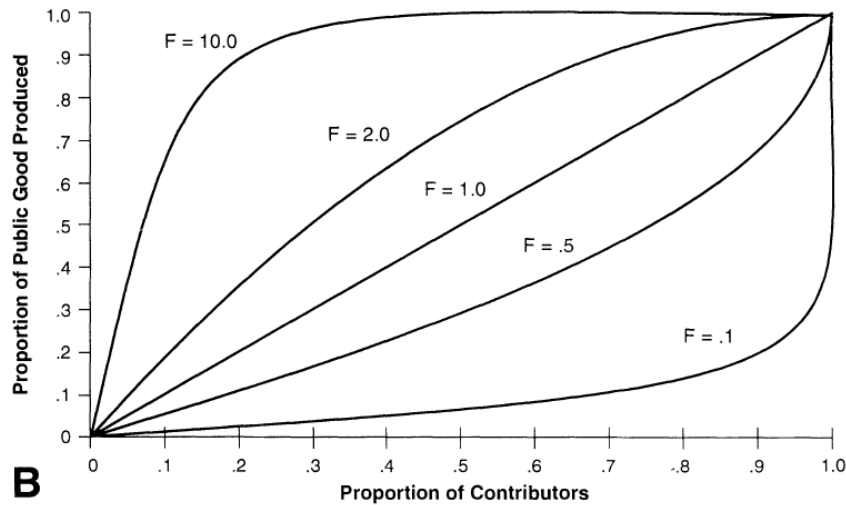
(Source, Heckathorn 1996:252)

On that basis the values of the three variables, V, K and F, determine the ordinal ranking of the cells in Table 4, and more precisely the exact location in the state-space in Figure 14. The five primary games created by varying the ordinal ranking are: a Prisoner's Dilemma when the cells are ranked T > R > P > S, an Assurance Game with the structure R > T > P > S, a Chicken Game T > R > S > P, a Privilege Game R > T > S > P and an Altruist's Dilemma T > P > R > S. The relevance of ordinal ranking is discussed with reference to Table 5 below.

Potential of the Model

Applications

The basic model structure has been used by Heckathorn to analyse three types of social dynamic: social movements, ideological responses to societal dilemmas, and the influence of selective sanctions. The applications in Chapters 4 and 5 simulate ideological regimes, power and dynamics of voluntary exchange, reciprocity and sanctioning. This part outlines briefly features of the model that relate to social movements. There is potential for further use of other features of the model such as using the shape of the production

function as an indicator of elite responsiveness[79] and the interactions of a mix of ideological strategies – there are 31 combinations of the primary ideologies (Heckathorn 1998:474). Ziegler (1997) extended the application to a system with two social strata and used the model to study oscillations of asymmetric games.

Social movements

The dynamic hypothesis in the model is that a social movement is faced with a series of organisational challenges as it proceeds, and these challenges can be represented as movement through the state-space of the model created by two dimensions, the ratio of full value to costs (V/K) and a logistic production function (F)[80]. The trajectory is shown in Figure 14. Collective action in these terms has three phases (Heckathorn 1996:272ff) in which F < 1, F = 1 and F > 1 (see Figure 13). That is to say, during the initial phase the return on participation is low, at the outset very low, requiring high levels of intrinsic commitment, however the rate of increase is increasing. If the intermediate phase is reached gains from increased participation accrue at an increased rate. In the later phase there are limits imposed by lack of resources or support and the rate of increase falls.

This implies a trajectory which varies depending on the value ascribed to the collective good and costs of participation, the number of participants or distribution of resources, and the nature of coalitions which may effectively reduce the number of participants and consequent start-up problems. If organisers can locate their activity high in the game space then their objectives will be relatively easier to achieve. The trajectory that is shown in Figure 14 is for illustrative purposes only and represents a relatively small group of 25 participants. Heckathorn and Centola (Centola and Heckathorn 2010) have produced a revised version that addresses other issues related to the mobilisation of social

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[79]   F can be used to simulate elite responsiveness (F > 1) or resistance (F < 1) as shown in Figure 13 (Centola and Heckathorn 2010:4). Other interpretations can be used e.g. the nature of the task (Heckathorn 1998:457).

[80]   For example $L_i = 1/1+e^{(.5-Pi)10}$ where P_i is the proportion of contributors in the group and L_i is the level of collective good produced.

movements such as the critical mass of coalitions, the distribution of local value and the significance of homophily[81].

Figure 14: Heckathorn's game-space diagram showing the set of games generated by the relationship between the shape of the production function (F) and the relative value of the public good (V/K).
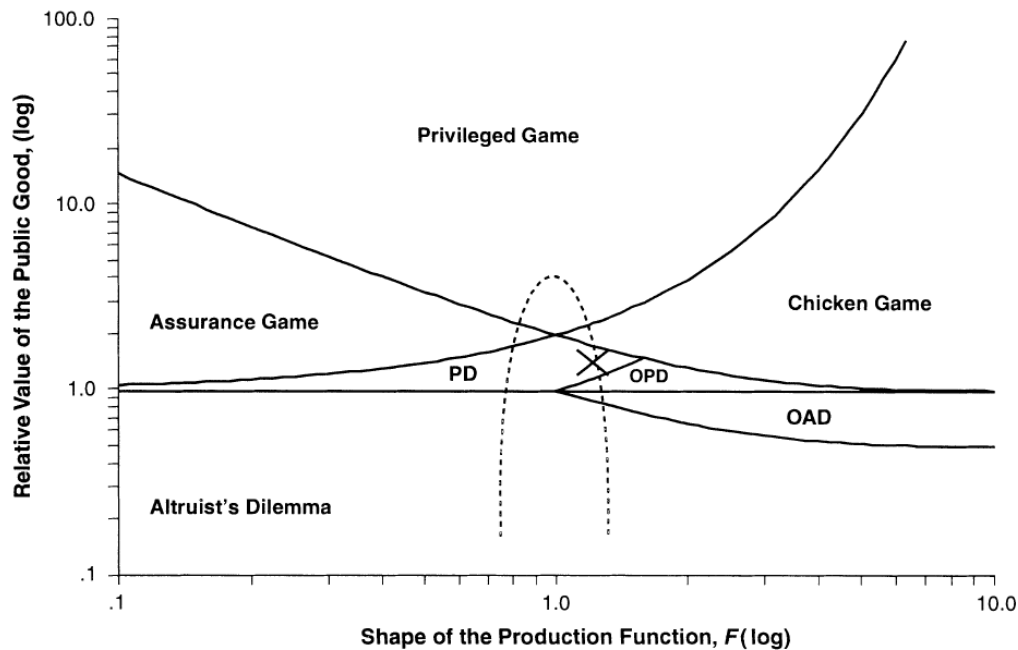
(Heckathorn 1996:257)

Ideologies

Each primary game can also be interpreted as an ideological response to a social dilemma if ideologies emerge to simplify and address tensions among individual and collective priorities (Heckathorn 1998:466). The structure of each game is determined by the value of F. A tentative reformulation of Heckathorn's scheme to align it with the discussion in previous chapters is in Table 5. The table identifies the primary ideologies. Ideologies are not mutually exclusive and some have greater affinities than others. This discussion only addresses the three primary ideologies associated with regimes in which the value of the collective good exceeds the cost of production but cannot be achieved by consensus alone ($1 < V/K < 2$ in Figure 14). This seems appropriate for a norm such as impartiality which

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81   See also Gintis (2009a) and Binmore (2011) for relevant discussions.

has enduring currency but does not prevail in every setting. As indicated in the table, each ideology implies different definitions of 'impartiality' and hence 'collective good', 'defection', and 'contribution'.

Table 5: Locating dilemmas and ideologies in the state-space

Social Dilemma	Dominant Ideological Response	Focus of Impartial Action	Game & Ordinal Rank
Disorder	Authoritarianism	Constraining deviance	Assurance Game (R > T > P > S)
Opportunism	Liberalism	Allocating rights	Prisoner's Dilemma (T > R > P > S)
Exploitation	Pluralism	Balancing power	Chicken Game (T > R > S > P)
Net Cost	Anarchism	Eliminating sanctions	Altruist's Dilemma (T > P > R > S)
Subversion	*Laissez faire*	Restoring rationality	Privileged Game (R > T > S > P)

(Adapted from Heckathorn 1998:466)[82].

Take for example, the dynamics of the Prisoner's Dilemma. In the short term, participants gain from defecting opportunistically when others contribute, however, if defection invades the system all lose the collective good. If say, the principle of personal freedom is the collective good then a norm might be derived from a liberal ideology that asserts that the freedom of one is contingent on the freedom of all. An impartial response could involve an exchange of rights to constrain opportunism. Such an exchange may not be possible without redefining the game as a bargaining game (with a Hawk-Dove or Chicken game structure of payoffs) (Heckathorn and Maser 1987). An example of this tension is the institutional norms and sanctions, and the absence of sanctions, relating to contracts of employment (Runciman 1995), which structure health for persons and populations (De Vogli, Ferrie et al. 2007).

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[82] The main changes from the original are: reinterpreting the Prisoner's Dilemma as a problem of Liberalism, not Collectivism (Heckathorn 1998:466), and a preoccupation with a norm of impartiality, although some of Heckathorn's examples such as the abolitionist (Centola and Heckathorn 2010:24-34) and feminist movements could be aligned with that priority.

As contrasts, in the Assurance and Chicken Games defection indicates some level of deviance or dominance respectively. Authoritarian ideologies address coordination problems by constraining disorder, deviance and dissent, with or without coercion. A unified elite can be legitimated by 'common-sense' because it is unassailable. In the model an authoritarian regime requires a high proportion of contributors to produce a significant level of collective good. Under those conditions full production of the collective good implies a demand for complete conformity. Examples with health implications include statutory provision to control behaviour relating to epidemics or severe mental disorder.

The Chicken Game simulates a bargaining dilemma in which substantive issues remain contentious. A characteristic problem is optimising resistance having regard to costs of concession and conflict incurred by the contending groups. Ideological responses to bargaining focus on issues of equity and exploitation. An example is the funding arrangements supporting the New Zealand Primary Health Care Strategy (Crampton and Foley 2008) which substantially increased the public funding of General Practices with a view to providing universal coverage with moderate sanctions. The result was partial coverage for some populations[83] and virtually universal coverage for General Practices.

The remaining contexts are represented by the Altruist's Dilemma in which costs of production exceed the value of the collective good. This occurs, for example, when sanctioning regimes maintain a level of compliance despite diminishing levels of the collective good. Discussion of imprisonment as 'a moral and fiscal failure' implies interactions are continuing although, from some ideological perspectives, the costs exceed the value of the collective good[84]. The converse is a Privilege Game in which it is in the interests of all to contribute to the collective good. The problem in that context is subversion or perversity created when actors take a loss to impose a corresponding loss on others.

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[83] For example, coverage of Maori under 6 years of age rose from about 38% in 2003 to 70% in 2007 in the Capital and Coast Health District (Carr and Tan 2009:25), an indicator of the limit of positive payoffs on providers.

[84] http://www.odt.co.nz/opinion/editorial/161773/prisons-moral-and-fiscal-failure

Norms and sanctions

Selecting a model

The rest of thesis is focussed on the version of the model that includes sanctions that influence the production of a collective good. This is the aspect of the detail in Heckathorn's modelling that is most applicable to the approach outlined in the earlier chapters. It simulates selection pressures in an evolutionary process (Heckathorn 1996:264) and is focussed on the production of a collective good which, in the context of this thesis, is taken to be a consensus (Table 1) that there should be some commitment to an impartial distribution of freedom-based capabilities. The model introduces considerations of efficiency by addressing relative power as 'efficacy' (Heckathorn 1996:263) and costs of sanctioning both to gain compliance with the norm to contribute and to oppose the production of the collective good. To that extent the model includes competing normative regimes, although an adequate analysis of that feature is outside the scope of the thesis.

In his discussion of collective goods Heckathorn refers to Mueller's definitions of public and semi-public goods (Heckathorn 1996:253). Mueller uses the example of:

> 'a system of property rights and the procedures to enforce them [as a case of] a Samuelsonian public good in that "each individual's consumption leads to no subtraction from any other individual's consumption of that good". Alternatively, a pure public good can be defined as one that *must* [or later *may*] be provided in equal quantities to all members of the community.' (Mueller 2003:10&11)

A norm of impartiality with associated rights and duties seems comparable to a regime of property rights in the sense that it can be held to be a universal rule although initial values and selection processes stratify outcomes. Judicial impartiality provides examples of this (Black 2002)[85]. Consequently, there are two processes to be considered. Firstly, direct defection from contributing to the public good which is included in the model. The second relates to Mueller's *may* in the above quotation which recognises that there are conditions when a formal public good is excludable, rivalrous and can incur increasing

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[85]   See also Fararo (2001).

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average costs (cf. Mueller 2003:11). The existence of the collective good may indicate a tendency to apply a principle or rule, not necessarily a full or consistent application.

The fundamental difference between the approach taken in Chapter 1 and the model developed by Heckathorn is the replacement of the concept of dominance with defection. This restructures the payoff matrix and means the payoff when defection interacts with defection can be set at zero. This is a limitation insofar as model is not generic in terms of the primary purpose defined in Chapter 1, however it is specific to the way the issue was formulated in Chapter 2 and the discussion proceeds on that basis.

The basic model

Figure 15 is a 'Stock-Flow' diagram of the basic model (Heckathorn 1996:264). There are a substantial number of constants and consequently potential for additional feedback loops. The variables are described in Table 6 and Appendix 1.

Figure 15: A Stock-Flow diagram for the first level model
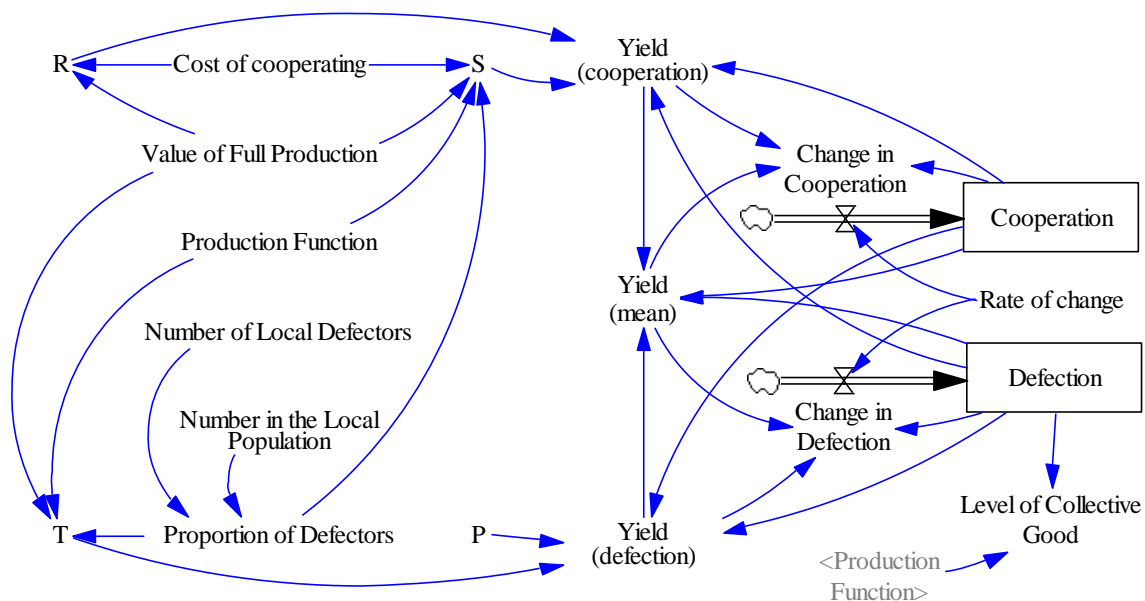
The parameters in the first level payoff matrix can be varied to represent a full logical set of elementary evolutionary games.

Strategies with sanctions

The extended payoff matrix in Table 7 contains a full logical set of strategies that include sanctions. Sanctioning implies an organised capacity to respond to externalities of

interactions and some degree of power to influence the responses of others. Heckathorn supplements the two by two matrix with five additional strategies using selective incentives, one based on direct exchanges (Tit for Tat or reciprocity), two sanctioning compliance and two sanctioning opposition to the production of the collective good. The full set of strategies is described in Table 6 and the additional payoffs are specified in Table 7.

Table 6: Full set of seven strategies

Code	Name	Description
CD	Private Cooperation[86]	Voluntary contribution with no sanctions, incurs the cost of coordination
DD	Full Defection	Voluntary defection with no sanctions, does not incur the cost of coordination
TfT	Tit-for-Tat or Reciprocity	Strategic reciprocity, incurs the cost of information to coordinate response
CC	Full Cooperation	Contributes and sanctions non-contributors, incurring costs at both levels
DC	Hypocritical Cooperation	Does not contribute but sanctions non-contributors, incurring only second level costs
CO	Compliant Opposition	Contributes and incurs the costs of opposition but does not sanction.
DO	Full Opposition	Does not contribute and reduces the efficacy of compliant sanctions, incurring costs of opposition

The second Level strategies in Table 7 have additional parameters for Costs (K) and Efficacy (E). K_{oc} is the cost of complexity or information in the TFT strategy, K_{c2} denotes the cost of contribution at the second level, and K_{o2} the cost of opposition. Similarly E_{c2} is the efficacy of sanctioning at the second level and E_{o2} is the efficacy of opposition. The additional strategies simulate constraints on voluntary interaction created by systematic sanctioning. For example, in interactions of Full Cooperation (CC) and Full Defection (DD), sanctioning available to CC moves some DD responses, with some level of

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[86]   Heckathorn names his 'C' strategy Cooperation. In general usage cooperation carries complex connotations that may or may not apply in specific cases. In this application there is no assumption that contributions are willing or motivated by a desire to co-operate.

probability, from Defection to Cooperation and consequently from the payoff assigned to S to R. The power inherent in a strategy is E_{c2} with a value between 0 and 1. If there is no power, $E_{c2} = 0$, then $1 - E_{c2} = 1$ and the payoff remains as S; conversely if compliant strategies have complete power, $E_{c2} = 1$, then all of those interactions have the R payoff. In exercising that power CC incurs costs of K_{c2}. The construction of the matrix applies those principles to all interactions.

Table 7: Heckathorn's extended matrix of row payoffs

Strategy	CD	DD	TFT	CC	DC	CO	DO
CD	R	S	R	R	S	R	S
DD	T	P	P	$E_{c2}R + (1-E_{c2})T$	$E_{c2}S + (1-E_{c2})P$	T	P
TFT	$R - K_{oc}$	$P - K_{oc}$	$R - K_{oc}$	$R - K_{oc}$	$E_{c2}S + (1-E_{c2})P - K_{oc}$	$R - K_{oc}$	$P - K_{oc}$
CC	$R - K_{c2}$	$E_{c2}R + (1-E_{c2})S - K_{c2}$	$R - K_{c2}$	$R - K_{c2}$	$E_{c2}R + (1-E_{c2})S - K_{c2}$	$R - K_{c2}$	$E_{c2}(1-E_{o2})R + [1-E_{c2}(1-E_{o2})]P - K_{c2}$
DC	$T - K_{c2}$	$E_{c2}T + (1-E_{c2})P - K_{c2}$	$E_{c2}T + (1-E_{c2})P - K_{c2}$	$E_{c2}R + (1-E_{c2})T - K_{c2}$	$E_{c2}^2R + (1-E_{c2})^2P + E_{c2}(1-E_{c2})S + E_{c2}(1-E_{c2})T - K_{c2}$	$T - K_{c2}$	$E_{c2}(1-E_{o2})T + [1-E_{c2}(1-E_{o2})]P - K_{c2}$
CO	$R - K_{o2}$	$S - K_{o2}$	$R - K_{o2}$	$R - K_{o2}$	$S - K_{o2}$	$R - K_{o2}$	$S - K_{o2}$
DO	$T - K_{o2}$	$P - K_{o2}$	$P - K_{o2}$	$E_{c2}(1-E_{o2})R + [1-E_{c2}(1-E_{o2})]T - K_{o2}$	$E_{c2}(1-E_{o2})S + [1-E_{c2}(1-E_{o2})]P - K_{o2}$	$T - K_{o2}$	$P - K_{o2}$

(For the shaded area see Table 4)

(Heckathorn 1996:262)

The 'Stock-Flow' diagram of the full model is shown in Appendix 2. The Vensim (Ventana Systems 2008) equations for the model are in Appendix 3.

The next chapter presents hypothetical scenarios generated by the model as it has been described in this section.

CHAPTER 4: MODEL VALIDATION AND DYNAMICS

Introduction

The model is a 'concept model'. Concept is used in the way the term is discussed by Jacobsen and Bronson (1987). They suggest that there are two stages in developing System Dynamics models that relate to sociological theories. The first is to clarify the definition of and relationships among general concepts. The second is to specify variables that allow for empirical validation. This chapter relates to the first phase. The scenarios that follow depict the logic of the model given various initial conditions. The scenarios are regarded as preliminary hypotheses and a step towards formulating dynamic hypotheses and incorporating endogenous feedback in the model (Sterman 2000:94).

These restrictions on the scope of the exercise limit the application of the ten types of test commonly used to assess the level of confidence that can be placed in a System Dynamics model (Forrester and Senge 1980:227; Maani and Cavana 2007:72). The standard tests fall under three general headings: model structure, model behaviour and governing policies, and are listed in Table 8.

Table 8: System dynamics 'core' confidence building tests

Model Structure	Model Behaviour	Governing policies
Structure verification	Behaviour reproduction	Changed behaviour prediction
Parameter verification	Behaviour anomaly	Policy sensitivity
Extreme conditions	Behaviour sensitivity	
Boundary adequacy		
Dimensional consistency		

(Adapted from Forrester and Senge 1980; Maani and Cavana 2007:72)

The main test of confidence used here is ability to replicate Heckathorn's outputs for voluntary interaction, reciprocity and sanctioning. Replication was necessary because, although it was requested, it was not possible to obtain a copy of the original computer programme. Replication is followed by examples of the sensitivity of the model in

scenarios of voluntary interaction and reciprocity, and then with the addition of costs and power. The scenarios are a first step towards identifying hypothetical thresholds for a variety of normative regimes. There is a final comment about governing policies or rules that can be used in the model. The model behaviour replicates closely, but not perfectly, the behaviour of the 'Dynamics and Dilemmas of Collective Action' model. Insofar as the criteria list in Table 8 can be applied to the model outlined in Chapter 3 the conclusion is that the structure and behaviour of the model is applicable to the social theory outlined in Chapters 1 and 2.

Model Structure

A standard requirement in System Dynamics modelling is to compare the model structure and parameters with the 'real system the model represents' (Forrester and Senge 1980:212). In this case the 'real system' is the conceptual framework outlined in Chapters 1 and 2. Measuring specific social conditions and comparing results with model outputs is beyond the scope of this project but Chapter 5 makes reference to how this aspect of validation might be approached. As has been noted previously, Heckathorn's modelling strategy is based on the concepts of interaction, selection pressures and rates of replication that provided the foundations for this discussion. The model also makes provision for introducing: relative power in terms of the efficacy of institutionalised practices, relative costs of three logically distinct sanctioning practices, and, elite responsiveness. The clarity of the logic provides a template for both model development and empirical observations in the domains identified by Runciman, namely the modes of persuasion, production and coercion. The classification of strategies also aligns with Coleman's and Sen's distinctions between voluntary interaction, reciprocity and selective sanctioning. On that basis it can be said the boundary of the model includes a full set of the logical combinations of the primary concepts.

The model boundary is drawn more tightly than the reference theories. From that perspective the model takes a specific approach to opposition strategies of conflict and compliance. Heckathorn has indicated that his ongoing research 'will analyze the countermobilization phase of collective action, including the emergence of opposition groups in a broad population, and the attainment of stable equilibria between opposing interest groups' (Centola and Heckathorn 2010:52) Some empirical references were used in the development of the model, for example comparisons with the dynamics of the

movement to abolish slavery in the United States (Centola and Heckathorn 2010:24-34) and the structure of political negotiations at the founding of the United States of America (Anthony, Heckathorn and Maser 1994). As outlined in Chapter 3, the modelling strategy already includes theoretical recognition of dilemmas inherent in ideologies that address both individualism and collectivism and the structure of evolutionary games.

Given that this model aims to clarify the interaction of concepts not variables (Jacobsen and Bronson 1987) it uses relative measures of the frequency and yield of each strategy, and of value, cost and production. The fundamental equation is:

$$U = VL - K_1 - K_2 - K_{IN} \text{ (Heckathorn 1996:254)}$$

That is to say net Utility (U) is the sum of the value of full production of the collective good (V) multiplied by the level of production (L) less the costs of first (K_1) and second (K_2) level organisation and the cost of information (K_{IN}) in the case of reciprocity (elsewhere designated K_{oc}). In effect five forms of pressure that determine the selection of strategic practices which can be redirected as constraints imposed by selective sanctions. Without a sound template of the kind Heckathorn provides, empirically referenced models using specific measurement scales become ad hoc and descriptive. This model directs attention to assumptions related to plausible rates of 'learning' attributable to an inherent human tendency to imitate, and the strength of incentives and disincentives, coalition size and the probability of interactions. In the base model interaction is random and pairwise; these parameters can be varied in more developed evolutionary environments.

The structure of the model has not been tested with reference to extreme conditions, for example very high levels of Value (V) or larger coalitions. The purpose of the model in the context of this thesis is to identify critical thresholds between two competing normative regimes when defection limits or eliminates the production of a collective good. From that perspective the sensitivity of the model at those thresholds is of particular importance and that is discussed after some basic behaviour has been replicated and illustrated in the next section.

Model Behaviour and Replication

The main criterion used to validate the model was the accuracy with which it replicated Heckathorn's outputs. As has been mentioned, it was not possible to get access to the original computer code consequently there might be errors of interpretation. Some differences between the outputs of the two models are noted. However the shape of the output of behaviour over time is sufficiently close to the charts in 'The Dynamics and Dilemmas of Collective Action' (Heckathorn 1996) to conclude that the main features of the model in Appendix 3[87] are compatible with the original.

The examples used here follow the three types of interaction referred to previously, namely voluntary interaction, reciprocity and selective sanctions. Some examples not included in Heckathorn's paper have been inserted to extend the range of scenarios.

In most of Heckathorn's scenarios he uses parameter values of V (Value of full production of the collective good) = 1.4, K_{c1} (First level cost of coordination) = 1, and Z (Rate of adjustment) = 0.05. When V/K = 1.4 the thresholds for ideological regimes are F = 0.485[88] and F = 1.807[89] (see Figure 14). The parameters defining the regime (F), additional costs (K) and power (E) are varied as shown in the Tables that precede each set of examples.

The model is sensitive to values to at least the sixth decimal place. Consequently initial values are expressed as simple fractions, not in decimal form, and an error variable (*e*) is used to ensure very small variations in the sum of all frequencies adjust towards 1 and are not amplified.

In the charts that follow (other than those that show output from the original model) the strategies are renamed. The initials for each strategy remain the same as those shown in Table 6 and the payoff matrix is as it was defined in Table 7. The renaming was done to explore whether the model, with its current structure, could be aligned more closely with

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[87]   The model used here was created in Vensim PLE Plus for Windows Version 5.8d.

[88]   When V = 1.4 and K_{c1} = 1, R = T or 0.4 = 1.4(1 - $.5^F$); 1 - $.5^F$ = 2/7; $.5^F$ = 5/7; ln (5/7) = F*ln(1/2); F = ln(5/7)/ln(1/2) = 0.485

[89]   When V = 1.4 and K_{c1} = 1, S = P or 1.4(1 - $.5^F$) – 1 = 0; $.5^F$ = 2/7; F*ln(1/2) = ln(2/7); F = ln(2/7)/ln(1/2) = 1.807

the conceptual framework in Chapter 1 and other applications of the model introduced in Chapter 3. The modifications are summarised in Table 9.

Table 9: Relabelled strategies

Code	Original Name	Revised Name	Rationale
CD	Private Cooperation	Contribution	Focus on the public good
DD	Full Defection	Defection	No change
TfT	Tit-for-Tat or Reciprocity	Reciprocity	No change
CC	Full Cooperation	Full Contribution	Consistent with CD
DC	Hypocritical Cooperation	Dominance	Based on authority or position
CO	Compliant Opposition	Acquiescence	[Tentatively], 'passive majority'[90]
DO	Full Opposition	Resistance	Relationship to Dominance

Voluntary interaction

The output of the model is introduced with three scenarios (Table 10) that compare the levels of collective good produced by voluntary action in different settings using the model shown in the Stock-Flow Diagram in Figure 15.

Table 10: Scenarios illustrating voluntary dynamics across selected thresholds

Scenario No.	Initial Frequencies		Ideological Regime	Costs	
	Contribution	Defection	F	K	K_{oc}
1	$1/2$	$1/2$	1.22	1	0
2	$1/2$	$1/2$	4.8	1	0
3	$9/10$	$1/10$	0.3	1	0

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[90]   (Coleman 1990:500-501)

Scenario 1: The first scenario (Figure 16) is the standard Prisoner's Dilemma in which there are no sanctions and the payoffs create incentives for opportunism. F = 1.22 replicates values used in the studies cited by Heckathorn (1996), particularly Hirschleifer and Martinez Coll . As is frequently noted, the logic of this model structure selects a sub-optimal state of complete defection and consequently produces no collective good. Possible responses which produce a collective good include regulation, an exchange of rights so each actor relinquishes control of their own strategy but gains control of others, or, in the OPD (Ordinal Prisoner's Dilemma) zone of Figure 14, participants alternate between Contribution and Defection[91]. This output replicates the output from the original model shown in Figure 17.

Figure 16: Opportunism and Voluntary Interaction (Scenario 1)
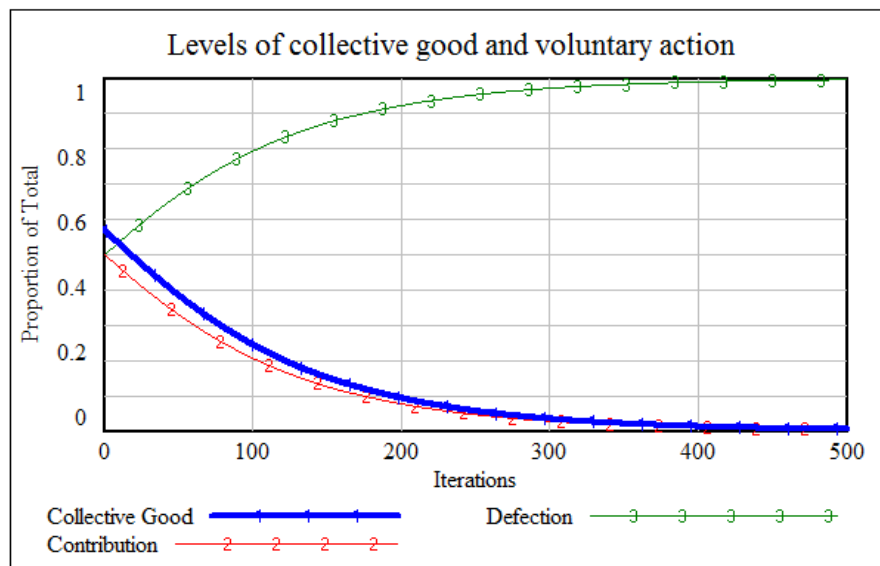
[V = 1.4; K_{c1} = 1; F = 1.22 (Heckathorn 1996:265)]

Scenario 2: As a contrast, in a bargaining environment there is a positive return on compliance (the Contribution-Defection payoff) (Figure 18), consequently a mix of Defection and Cooperation is viable. In that setting, the level of collective good rises relatively rapidly as F increases. In this type of regime voluntary action produces a level

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91   The third dynamic can be observed when the allocation of constitutional rights is unresolved and manoeuvring on constitutional issues prevents concerted action on substantive matters.

of collective good. 'Exploitation' in this context refers to exploiting positional advantage and not adhering to a norm of impartiality.

Figure 17: Heckathorn's output for the parameters in Scenario 1

Note: $F = 1.22$, $V/K_{c1} = 1.4$, $Z = .05$

(Heckathorn 1996:265)

The contrast of a liberal environment allowing defection and a bargaining environment is evident in a comparison of Figures 17 and 18.

Figure 18: Exploitation and Voluntary Interaction (Scenario 2)

$[V = 1.4; K_{c1} = 1; F = 4.8]$

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Scenario 3: With most initial frequencies voluntary action in an Authoritarian regime results in complete defection. The exception is when there is a high initial frequency of Contribution such as is shown in Figure 19. Under these conditions maintaining the status quo produces increasing levels of the collective good.

Figure 19: Disorder and voluntary interaction (Scenario 3)
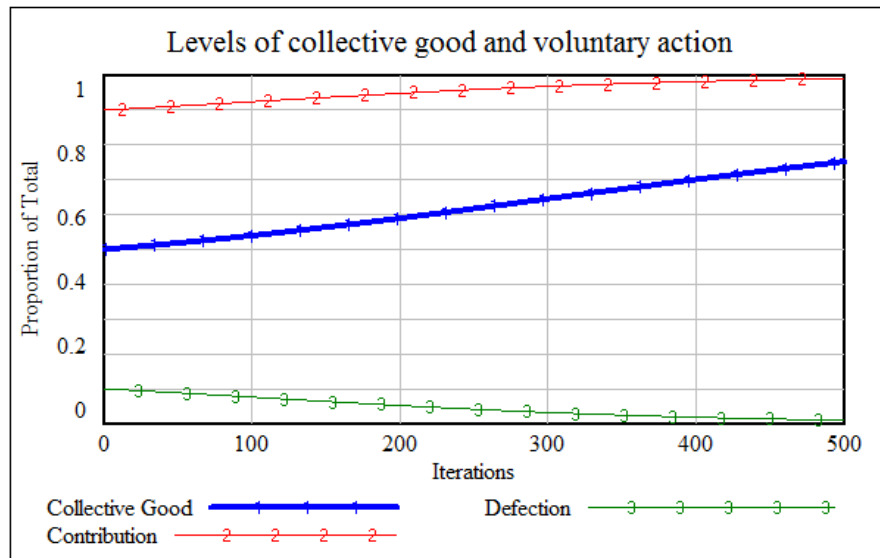
[V = 1.4; K_{c1} = 1; F = 0.3]

Reciprocity

As well as replicating Heckathorn's output, these scenarios demonstrate the first step in extending the matrix and also make some substantive points about the resilience of reciprocity in the model. Reciprocity here refers to a 'Tit for Tat' (TfT) strategy. Table 11 adds a strategy to the First Level Matrix and Figure 20 shows the implications for the Stock-Flow Diagram. The new variable (K_{oc}) recognises costs of complexity implied by a reactive strategy, including information costs (hence the designation in the generic equation K_{IN}).

Table 11: Payoff Matrix including the Tit For Tat strategy

Strategy	Contribution	Defection	TfT
Contribution	R	S	R
Defection	T	P	P
TfT	$R - K_{oc}$	$P - K_{oc}$	$R - K_{oc}$

(Heckathorn 1996:262)

The stock-flow diagram below (Figure 20) repeats the First Level model in Figure 15 and adds an additional module to represent the third strategy.

Figure 20: Stock-Flow diagram extended to incorporate reciprocity (TfT)
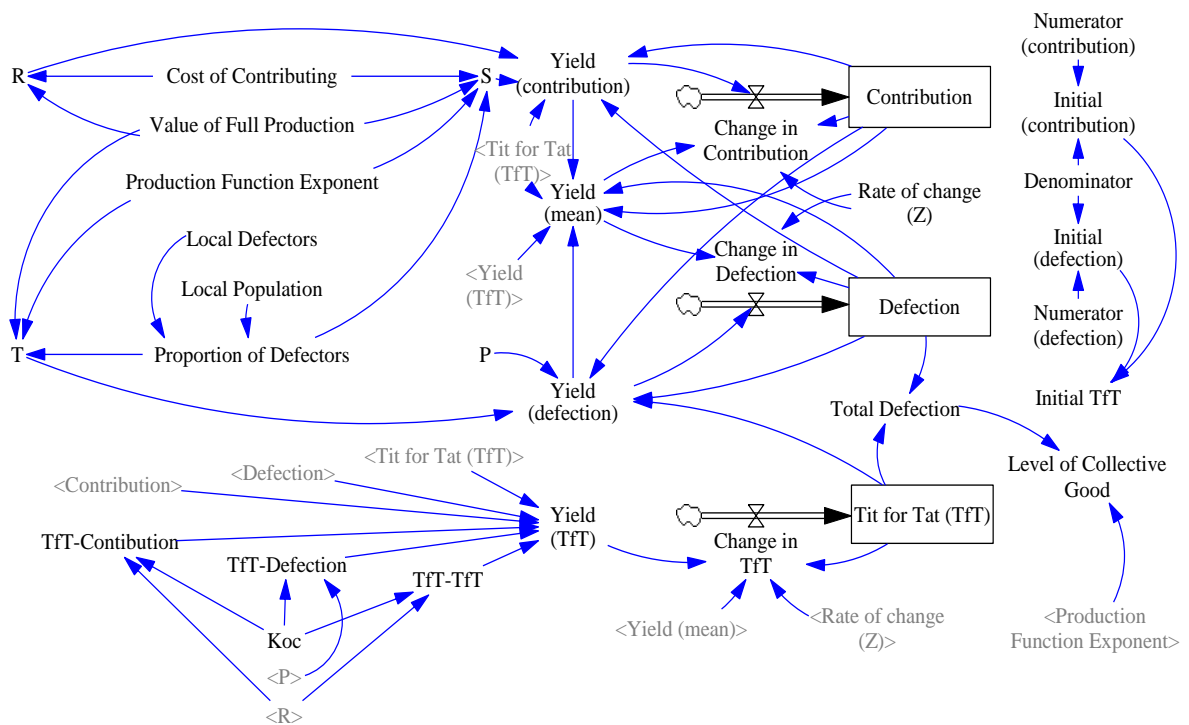
The three scenarios that follow make three points and identify two additional thresholds of defection. The points are: adding reciprocity to what was previously a Prisoner's Dilemma eliminates opportunism, reciprocity has a threshold of viability because of the additional cost of complexity, and, reciprocity is not viable in a bargaining environment because of the additional costs of the strategy.

Table 12: Scenarios illustrating reciprocity across selected thresholds

Scenario No.	Initial Frequencies			Regime	Costs	
	Contribution	Defection	TFT	F	K	K_{oc}
4	$1/3$	$1/3$	$1/3$	1.22	1	0
5	$1/10$	$9/20$	$9/20$	1.22	1	0.1
6	$1/3$	$1/3$	$1/3$	3.0	1	0

Scenario 4: In Figure 21 TfT extinguishes defection and maintains voluntary contribution. The cost of complexity or information in the Scenario has been set at zero. This pattern remains if the cost remains relatively low as might be the case in local groups with no corporate membership.

Figure 21: Opportunism and reciprocity (Scenario 4)
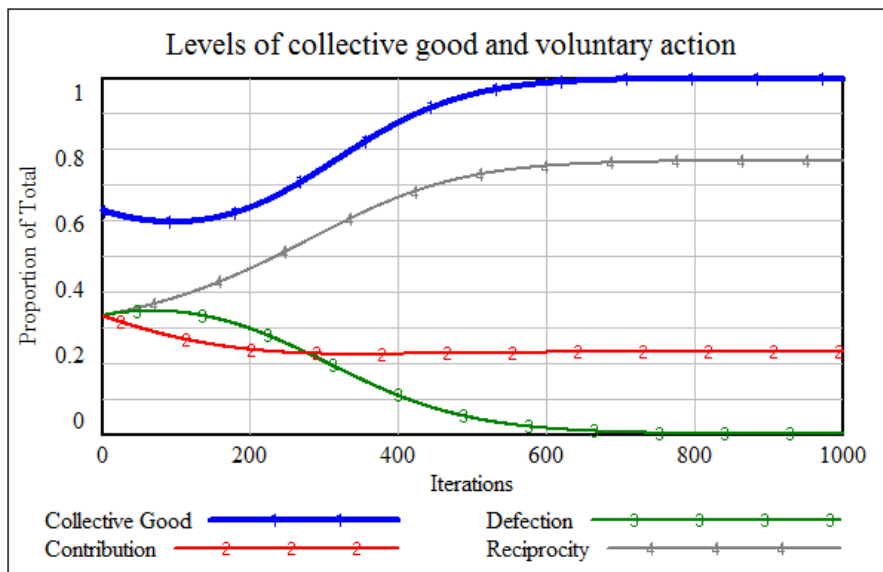
[V = 1.4; K_{c1} = 1; F = 1.22; K_{oc} = 0]

Heckathorn reported the same output, see Figure 22.

Figure 22: Heckathorn's output for the parameters in Scenario 4

Note $F = 1\ 22$, $VK_{c1} = 1\ 4$, $K_{oc} = 0$, $Z = 05$
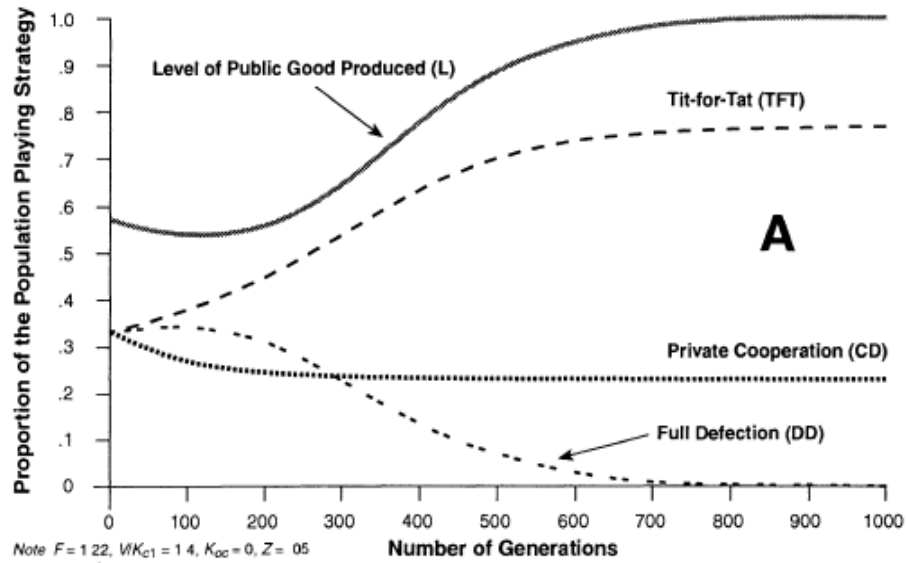
(Heckathorn 1996:268)

Scenario 5: Given some initial values (Figure 23) TfT produces unsustainable increases

Figure 23: Opportunism and reciprocity with costs of complexity (Scenario 5)
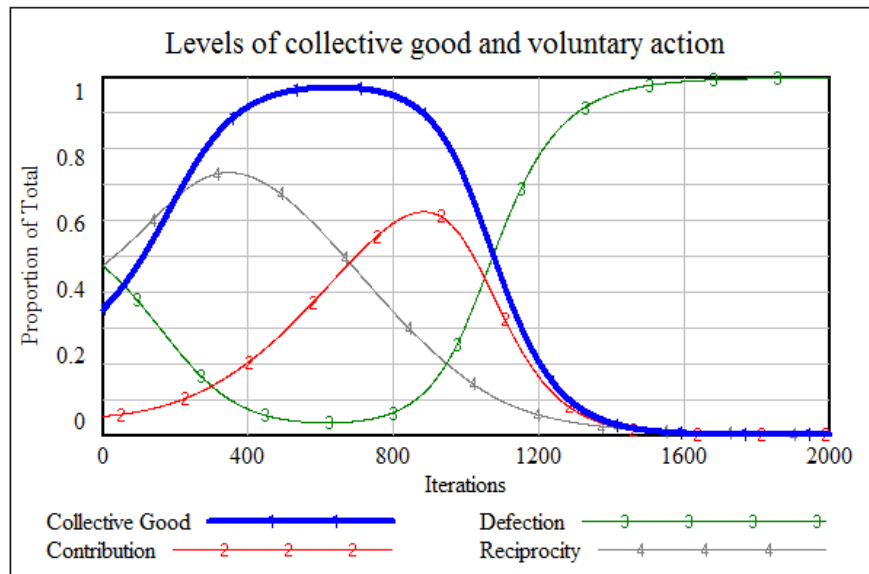
[$V = 1.4$; $K_{c1} = 1$; $F = 1.22$; $K_{oc} = 0.1$] (Note the initial values have been changed.)

in the level of collective good, consequently early trends require careful interpretation, see Figure 23. Figure 24 shows similar, but not identical, dynamics to those in Figure 23[92].

Figure 24: Heckathorn's output for the parameters in Scenario 5
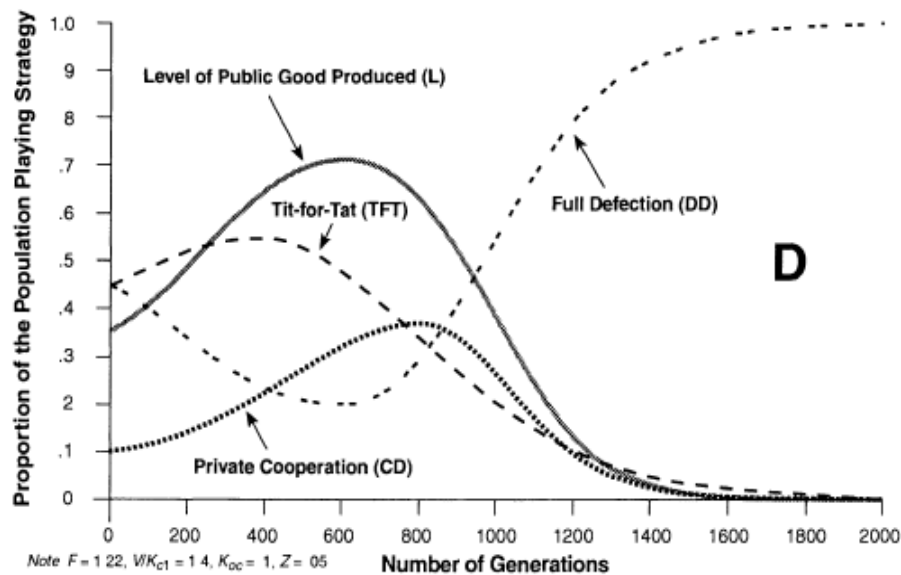
(Heckathorn 1996:268)

Scenario 6: However, even if there are no costs associated with the TfT strategy it does not survive in a bargaining environment (Figure 25). This is interpreted as a shift from a regime characterised by exchange of rights to one that balances concessions to optimise conflict.

These thresholds seem important. In the context of this discussion they point to constraints when replicating interactions in institutional settings where 'Kant's imperative' does not apply unless it is explicitly invoked. The hypotheses are also of practical interest. There is a set of health promotion initiatives that relies on principles of reciprocity and exchange, sometimes associated with community development based on local partnerships, networks and resources (e.g. Cody 1999:54). In part this approach was adopted because academic opinion suggested reciprocity was a 'winning strategy'

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[92]   The trajectory in Figures 23 and 24 is similar to that observed in community-based health projects reported in an earlier paper (Cody, Cavana and Pearson 2006; Cody, Cavana et al. 2007).

(Heckathorn 1996:266-7). It subsequently became clear this was only true, both in theory and in practice, in specific circumstances. The model points to the significance of small changes in relative cost as an explanation for why under some circumstances the strategy succeeds and under others it fails.

Figure 25: Exploitation and reciprocity (Scenario 6)
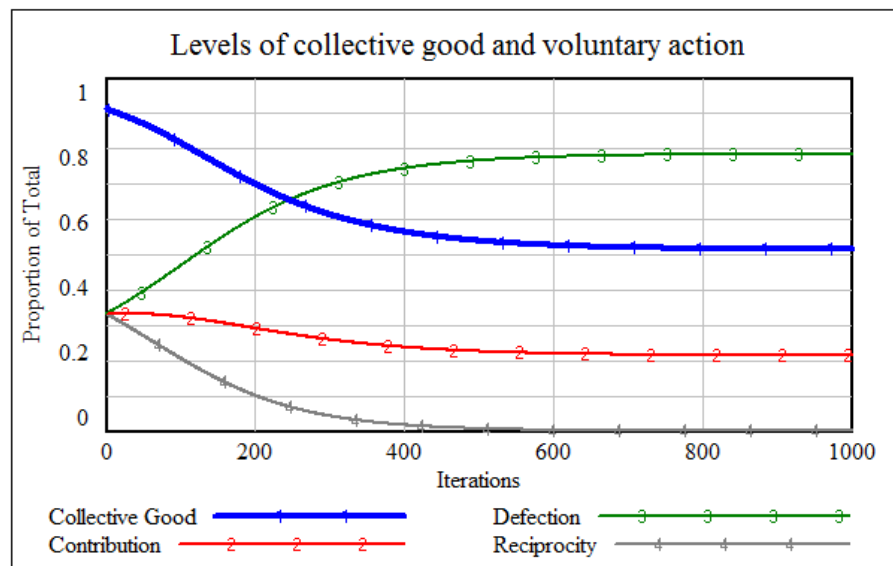
$[V = 1.4; K_{c1} = 1; F = 3; K_{oc} = 0]$

Selective sanctions

The final part of this section presents three scenarios published by Heckathorn which progressively introduce additional strategies. The scenarios in Table 13 illustrate the relative resilience of strategies. The initials used to designate strategies in the tables that follow refer to Table 9.

The three scenarios used to replicate the dynamics of selective sanctions are defined in Table 13. Figure 26 introduces a new format for charts, partly to distinguish selective sanctions from other strategies, but also because Vensim PLE Plus does not display eight variables in a single chart.

Table 13: Scenarios illustrating the implications of selective sanctions

Scenario No.	Initial Values							Regime	Costs				Power (Efficacy)	
	CD	DD	TFT	CC	DC	CO	DO	F	K_{c1}	K_{inf}	K_{c2}	K_{o2}	E_{c2}	E_{o2}
7	$1/5$	$1/5$	$1/5$	$1/5$	$1/5$	0	0	1.22	1	0.1	0.1	0.0	0.8	0
8	$1/4$	$1/4$	$1/4$	$1/4$	0	0	0	1.22	1	0.1	0.1	0.0	0.8	0
9	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	3	1	0.1	0.1	0.01	0.8	0.8

Scenario 7: Figure 26 is an example of the general point that Dominance is a resilient strategy which produces relatively high levels of collective good when the dilemmas to be addressed are opportunism or exploitation of positional advantage, given the benefit-cost ratio.

Figure 26: Opportunism and dominance (Scenario 7)
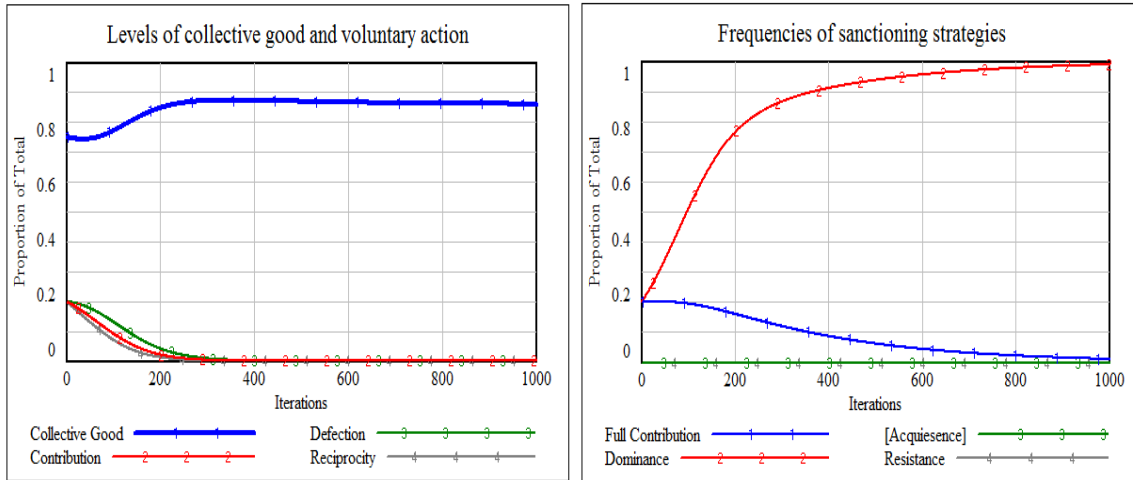
$[V = 1.4; K_{c1} = 1; F = 1.22; K_{oc} = K_{c2} = 0.1; E_{c2} = 0.8]$

Figure 26 replicates the dynamics of the original model shown in Figure 27.

Figure 27: Heckathorn's output for the parameters in Scenario 7

Note: $F = 1.22$, $V/K_{c1} = 1.4$, $K_{oc} = K_{c2} = .1$, $E_{c2} = .8$, $Z = .05$
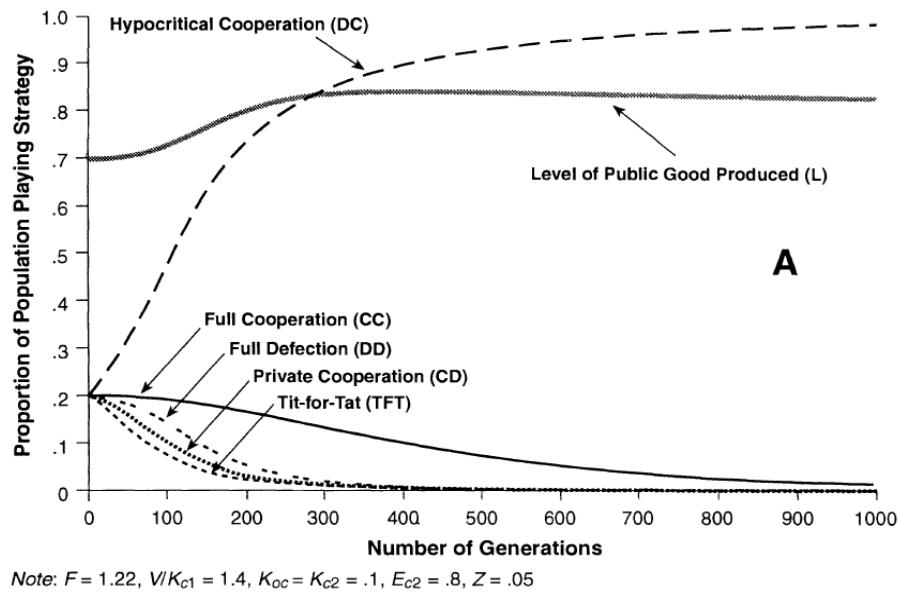
(Heckathorn 1996:269)

Scenario 8: If Dominance is removed (Figure 28), Full Contribution is an effective means of attaining a somewhat lower, but in the very long term (not shown), a more stable level of collective good.

Figure 28: Opportunism and full contribution (Scenario 8)
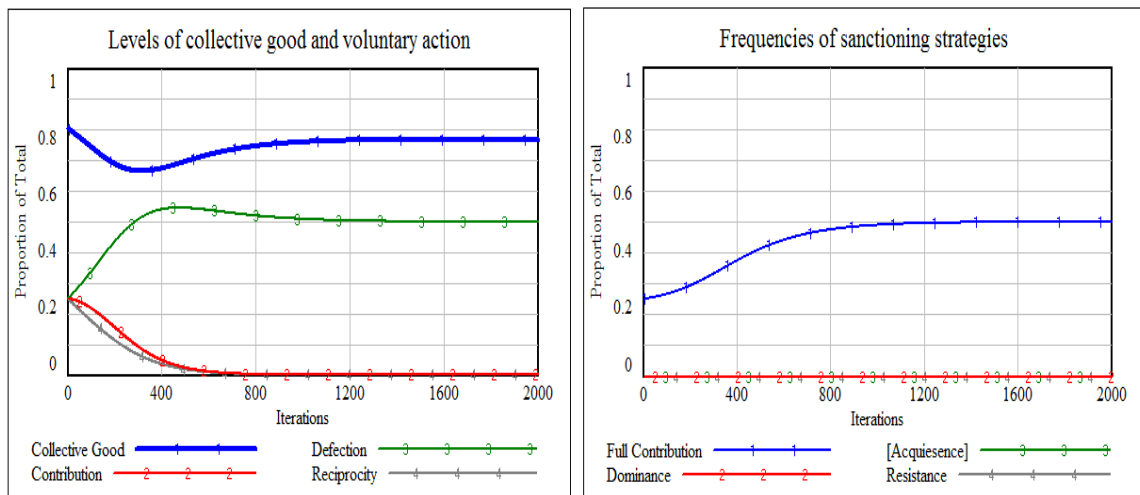
[$V = 1.4$; $K_{c1} = 1$; $F = 1.22$; $K_{oc} = K_{c2} = 0.1$; $E_{c2} = 0.8$]

Figure 28 replicates the dynamics of the original model shown in Figure 29.

Figure 29: Heckathorn's output for the parameters in Scenario 8

Note: $F = 1.22$, $V/K_{c1} = 1.4$, $K_{oc} = K_{c2} = .1$, $E_{c2} = .8$, $Z = .05$
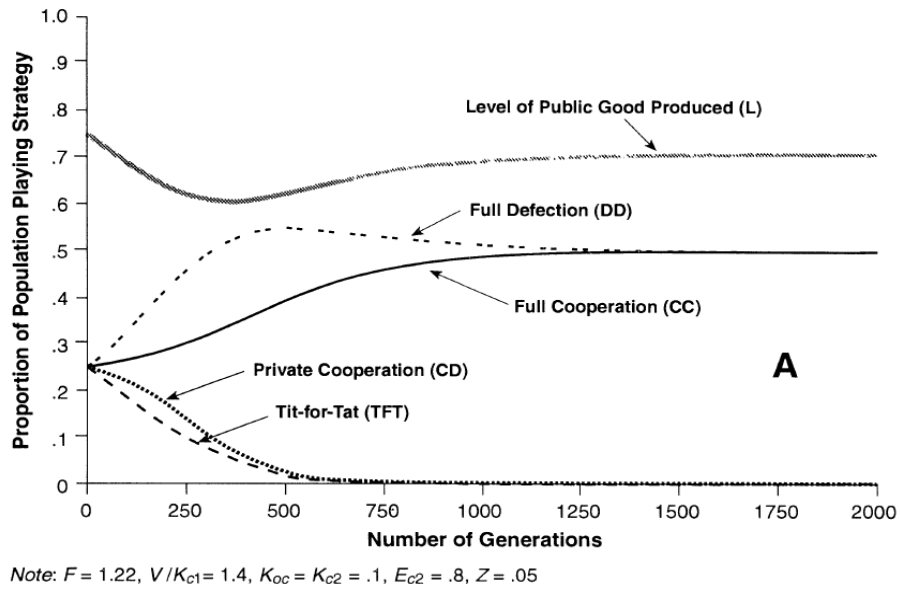
(Heckathorn 1996:270)

Scenario 9: The final replication introduces all seven strategies and presents the only example in the thesis of the cost issue in the Altruist's Dilemma (see Figure 30) with $V = 0.7$, hence $V < K_{c1}$. In this case Resistance rises to stabilise the production of a collective good.

Figure 30: Cost and the complete set of strategies (Scenario 9)
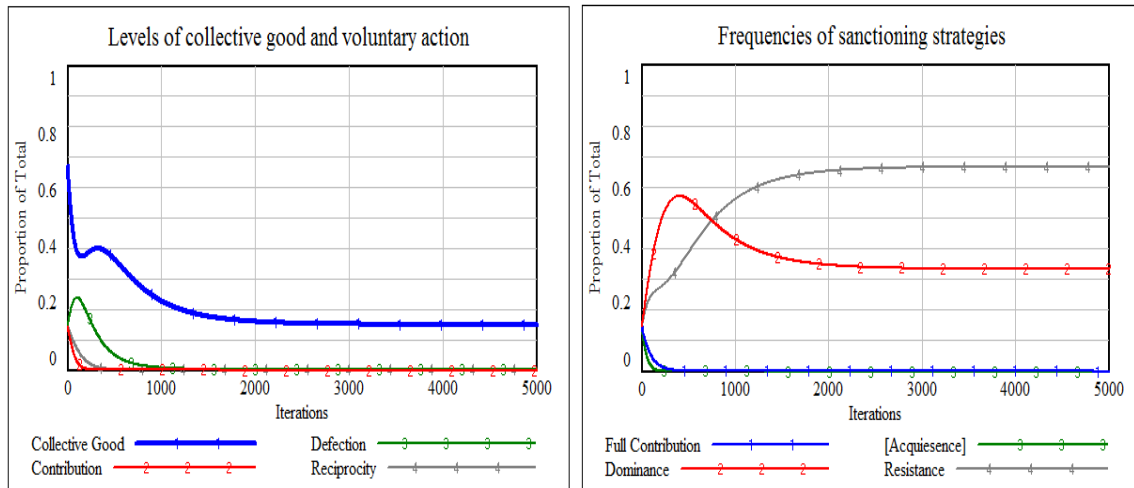
[$V = 0.7$; $K_{c1} = 1$; $F = 1.22$; $K_{oc} = K_{c2} = 0.1$; $E_{c2} = E_{o2} = 0.8$ (Heckathorn 1996:272)]

Figure 30 replicates the dynamics of the original model in Figure 31.

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Figure 31: Heckathorn's output for the parameters in Scenario 9

Note: $F = 1.22$, $V/K_{c1} = .7$, $K_{oc} = K_{c2} = K_{o2} = .1$, $E_{c2} = E_{o2} = .8$, $Z = .05$
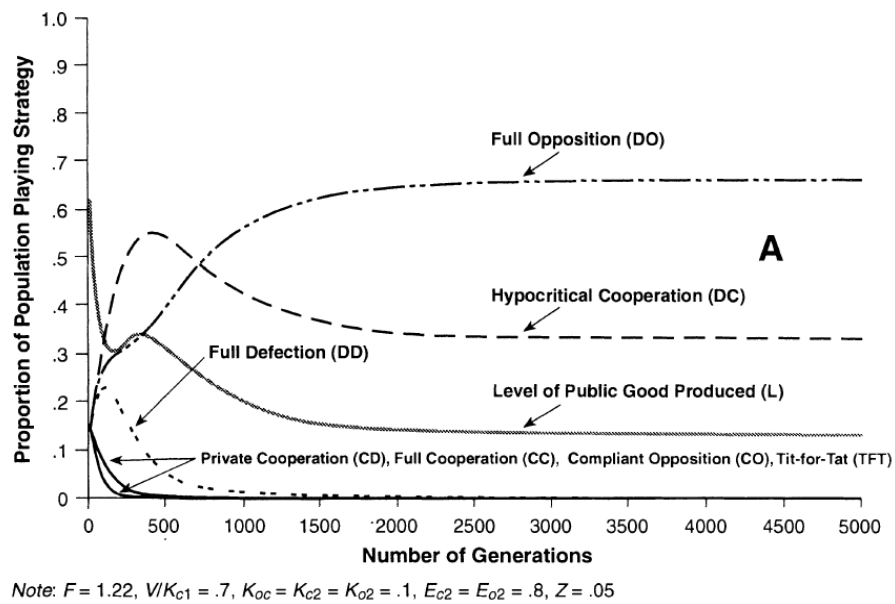
(Heckathorn 1996:272)

Sensitivity of the Model

The remaining scenarios in the chapter are intended to give an overview of the dynamics of the model over a range of values for F, E and K. The primary purpose of the model is to establish thresholds for normative regimes. The examples that follow demonstrate three features: the resilience and limits of voluntary interaction and reciprocity; the impact of the two elements of efficiency in the terms discussed in Chapter 2, namely power (E) and cost (K); and the influence of elite responsiveness (F).

Voluntary interaction and reciprocity

The scenarios defined in Table 14 are regarded as applicable to local situations, such as stable neighbourhoods and elite networks, in which power is distributed relatively equally, and additional costs of sanctioning are low. The general hypothesis is that reciprocity is resilient in such settings, but is not a sustainable strategy in institutionalised settings where costs of organisation become a significant factor.

Table 14: Sensitivity runs showing the effect of initial values used for voluntary interaction and reciprocity

Scenario No.	Initial Frequencies							Regime	Costs				Power (Efficacy)	
	CD	DD	TFT	CC	DC	CO	DO	F	K_{c1}	K_{oc}-Vectors	K_{c2}	K_{o2}	E_{c2}	E_{o2}
10	$1/6$	$1/6$	0	$1/6$	$1/6$	$1/6$	$1/6$	.1,2.3,.2	1	0	0	0	0	0
11	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	.1,2.3,.2	1	.01,.1,.02	0	0	0	0
12	$1/8$	$1/4$	$1/8$	$1/8$	$1/8$	$1/8$	$1/8$	.1,2.3,.2	1	.01,.1,.02	0	0	0	0
13	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	$1/7$	1.22	1	.02	0.5	0	0.75	0

(The Vectors in this and other Tables have the following format, illustrated in these cases in the columns for F and K_{c1}: minimum, maximum, increment. In the charts that follow the Level of Collective Good is calculated for all options in the range.)

Scenario 10: Figure 32 provides a baseline for production of a collective good from voluntary interaction without reciprocity. All strategies are treated as 'voluntary' in the absence of power or cost. As has been noted, there is general defection until S > P. The trajectories that generate ongoing levels of collective good are for F > 1.8. As F increases beyond that point i.e. (F = 1.9, 2.1, and 2.3) the level of collective good increases.

Figure 32: Voluntary interaction, without reciprocity, power or cost (Scenario 10)

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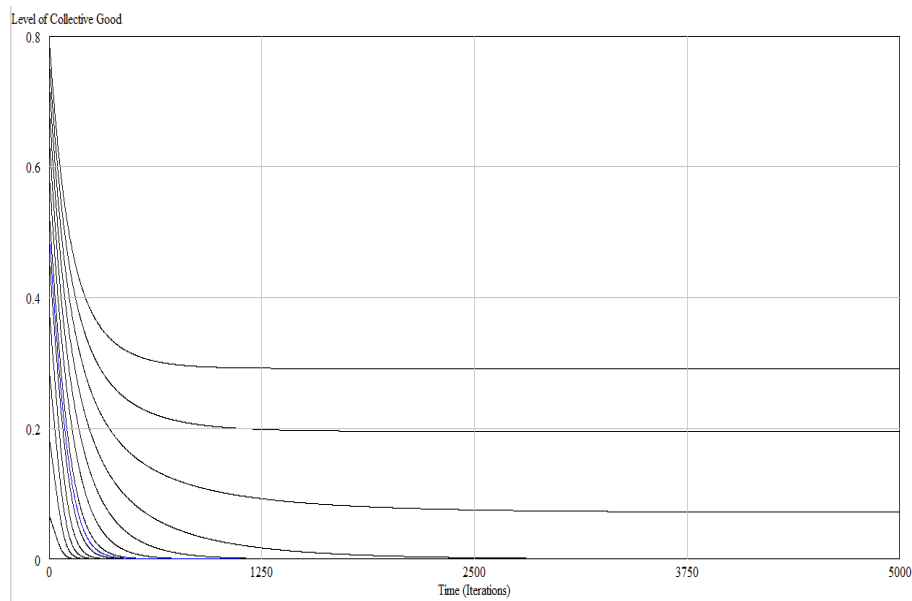
(Runs: 12 The total for each run is the number of combinations created by the vectors. In this case there is one variable (F) with 12 values.)

Scenario 11: Reciprocity is introduced in Figure 33; the initial frequencies of all seven strategies are equal (1/7). The initial level of collective good is determined by F with the most rapid increase in collective good at F $\approx$ 0.45. As the model iterates the trajectories are refined by the value of K_{oc}. At one end of the range (F = 0.1) all values of $K_{oc} \geq 0.1$ (an additional 10% of the base cost K_{c1}) produce the collective good. As F increases the influence of K_{oc} on the threshold of defection decreases until at F = 1.7 a collective good is only produced when $K_{oc} = 0$ – the final example of the influence of reciprocity in Scenario 11 at almost 3,000 iterations. As Giddens emphasised, it is unlikely that 'all other things will remain equal' in a social system for that number of iterations, including variation in the temporal duration of an iteration. Nonetheless the model outputs suggest directions for empirical enquiries. In this case the usefulness of the final example is that that it identifies a threshold between two regimes (at S = P) and the potential for rapid change after long periods of apparent equilibrium.

Figure 33: Voluntary interaction of strategies with equal initial frequencies, without power or cost (Scenario 11)
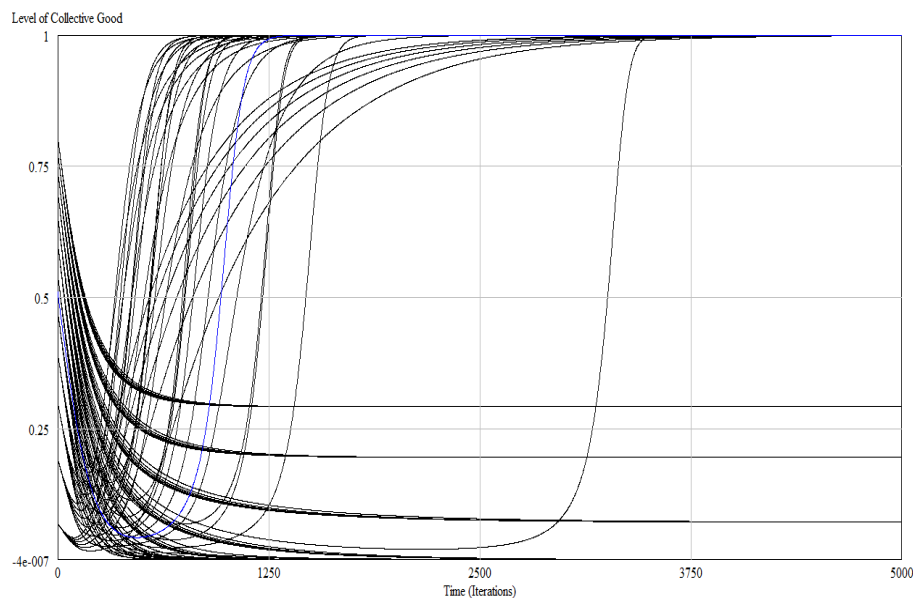
Runs: 72

Scenario 12: However, the payoffs for Tit-for-Tat imply that investment in reciprocity is eventually self-defeating. Figure 34 illustrates the dynamic introduced in Figures 23 and

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24 (Scenario 5) across a range of values for F and K_{oc}. When F < 1.8 there is an initial phase in which TfT suppresses defection, followed by a second phase in which TfT is the dominant strategy and contributes to full production of the collective good. However, the longer term effect of suppressing the frequency of the Defection strategy is that the negative influence of S on the yield of the voluntary Contribution strategy is reduced, and consequently the yield of the Contribution strategy is predominantly derived from R without the cost of complexity (K_{oc}) that is incurred by TfT. Under those conditions the frequency of Contribution increases at the expense of TfT to a point where Defection regains a relative advantage and the level of collective good collapses. Figure 34 (Scenario 12) illustrates the general point by increasing the initial frequency of Tft.

Figure 34: Voluntary interaction with increased reciprocity (initial frequency 0.25), without power or cost (Scenario 12)
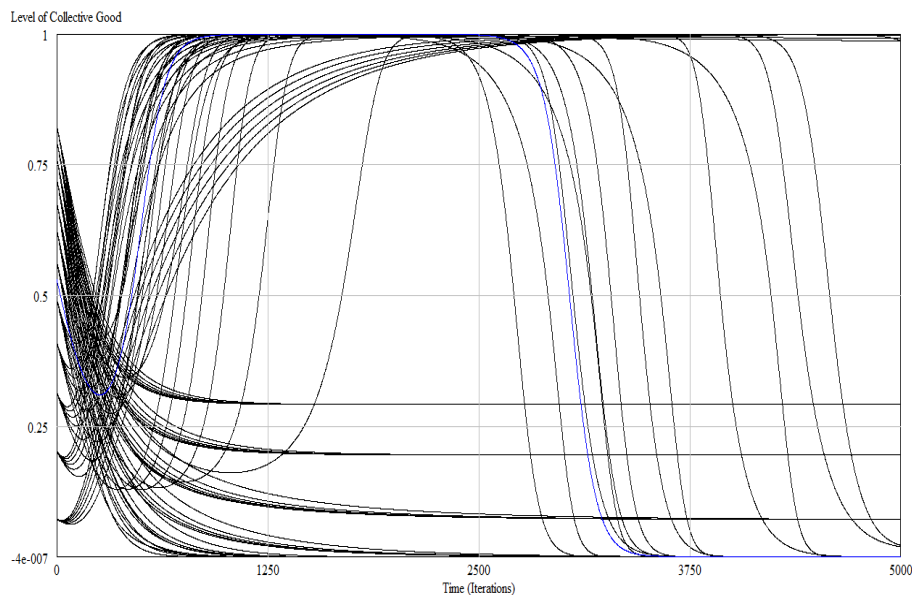
Runs: 72

Scenario 13: Figure 35 presents a specific example of the pattern in Figure 34 to show the changing composition of regimes through a longer run (25,000 iterations). The scenario assumes a relatively powerful and unchallenged Dominance strategy and that sustained reciprocity can be maintained at a relatively low cost. No power or cost has been assigned to Resistance and so it is the equivalent of Defection. The final phase is, in the terms used here, an institutionalised strategy to suppress defection created by random marginal variations or 'errors'.

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These four scenarios support a general hypothesis that, at the value of V/K considered here, reciprocity is viable or dominant in specific, local and transitional settings but does not provide a basis for stable institutions if those institutions rely on corporate actors. The early signs are misleading because the reciprocity is initially undermined by a resurgent level of Contribution creating conditions for full Defection. In regimes with F < 1.8 and given some rate of mutation (*e*) a sanctioning regime can emerge in due course. When F > 1.8 Contribution and Defection produce the level of collective good and suppress Reciprocity. For those reasons the strategy of reciprocity is not included in the discussion that follows.

Figure 35: An illustration of unsustainable reciprocity, universal defection and the emergence of a sanctioning regime (Scenario 13)
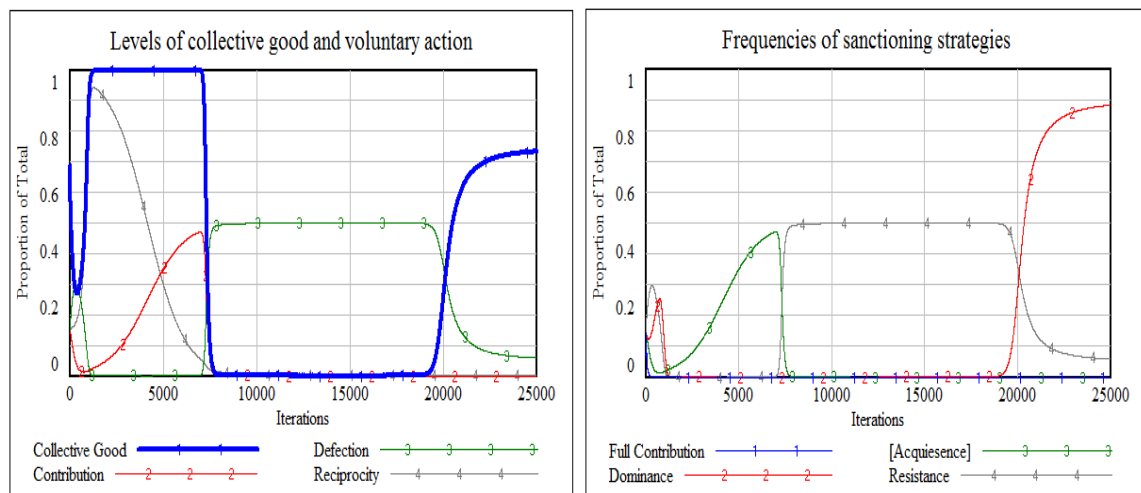
Strategies to gain compliance

The focus in this part is on sanctioning regimes in which modes of persuasion are oriented by Authoritarianism or Liberalism and to structural limits to Contribution in a Pluralist regime. Two preliminary scans of those regimes are defined in Table 15. They are to provide basic validation that as the power to require compliance increases the level of collective good increases across the three regimes of interest in the study.

One feature of the examples is that no run produces the full value of the collective good because the Dominance strategy supports a mixed strategy of contribution and defection, the mix being strongly influenced by F the variable associated with the nature of the regime and, given some level of contribution by the population, the response of the elite.

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Table 15: Scenarios with strategies to gain compliance

Scenario No.	Initial Frequencies							Regime	Costs				Power (Efficacy)	
	CD	DD	TFT	CC	DC	CO	DO	F	K_{c1}	K_{oc}	K_{c2} - Vector	K_{o2}	E_{c2} - Vector	E_{o2}
14	¹/₆	¹/₆	0	¹/₆	¹/₆	¹/₆	¹/₆	.1,2.3,.2	1	0	0,1,.1	0	0.25	0
15	¹/₆	¹/₆	0	¹/₆	¹/₆	¹/₆	¹/₆	.1,2.3,.2	1	0	0,1,.1	0	0.75	0

Scenario 14: Figure 36 presents a range of levels of collective good when the vector for F is the same as was used in previous scenarios and there are additional costs to deliver compliant sanctions which vary between 0% and 100% above the base level (K_{c1}) and are effective in 25% of interactions.

Figure 36: Power (0.25) and costs (variable) attributed to compliant sanctioning (Scenario14)
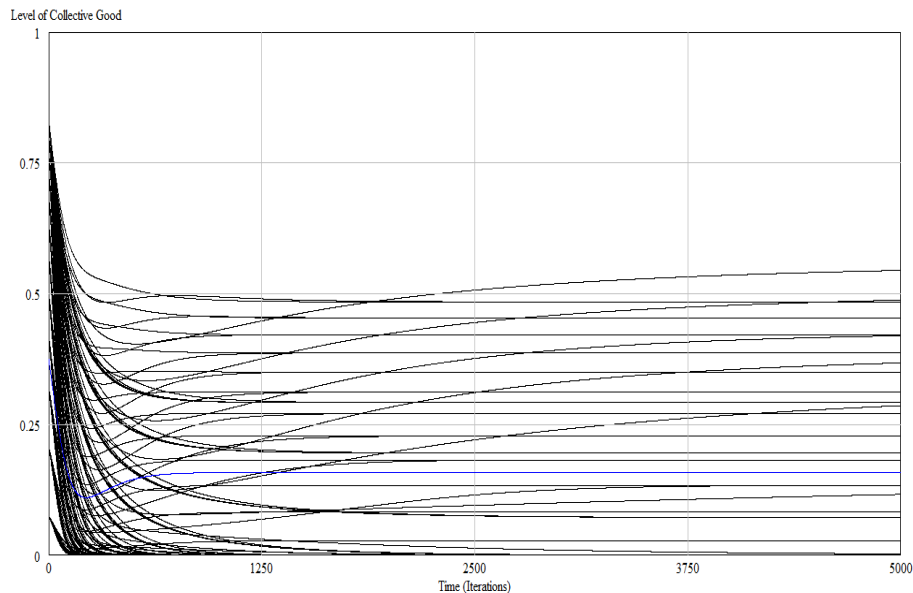
Runs: 132 (12 values of F * 11 values of K_{c2})

This scenario can be compared with the voluntary interaction depicted in Figure 32 (Scenario 10). To aid interpretation of Figure 36 the following chart (Figure 37) has been

created from the final level of collective good for each of the two constants, F and K_{c2}. The influence of cost on the relative frequency of defection is evident from the point at which production begins for each value of F. The change in the gradient is due to a change in the dominant strategy from Full Contribution to Dominance until, from $F \approx 1.8$, interactions are based on bargaining.

Figure 37: Final levels of collective good for the trajectories shown in Figure 36 (Scenario 14)
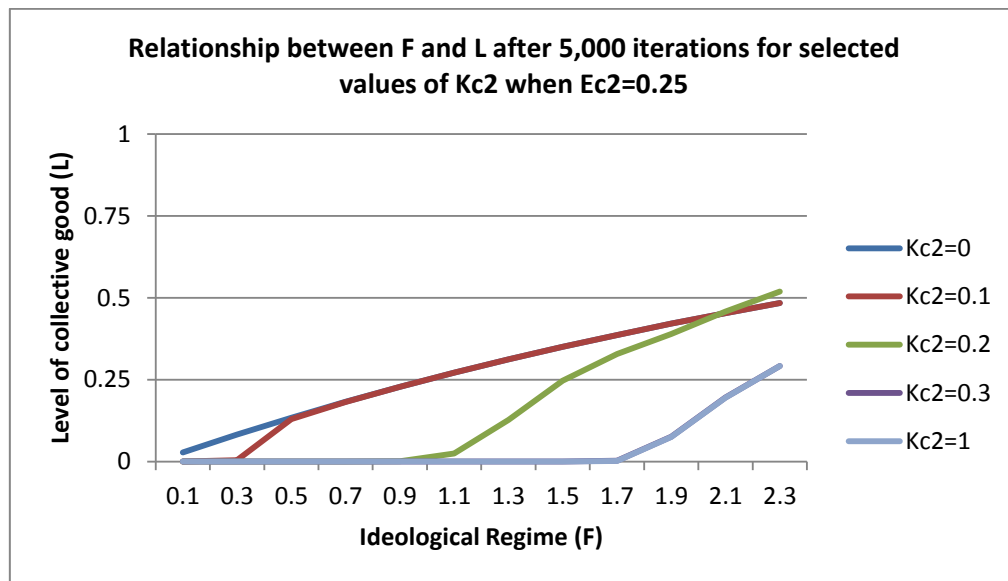
Scenario 15: That range of levels of collective good shown in Figure 38 is the result of the level increasing as F increases and falling as K_{c2} increases. The horizontal trajectories are the most common; the rising trajectories are for $K_{c2} <\approx 0.2$. When the power deployed as compliant sanctions is increased (0.75), and elite responsiveness and costs vary across the same ranges as for Scenario 14, a wider range of collective good is produced. The higher levels are attributable to Dominance excluding other strategies. The oblique and fluctuating trajectories are for low F and K_{c2}, the lower trajectories are created as K_{c2} rises and F falls.

Figure 39 repeats the analysis in Figure 37 with for the higher level of power available to constraint defection.

The gradients for low F and K_{c2} are created by the influence of Full Contribution in that range. Full Contribution and Dominance have the same level of efficacy. Overall,

increased power of compliance increases production having regard to cost and, to that extent, supports confidence in the model.

Figure 38: Power (0.75) and costs (variable) attributed to compliant sanctioning (Scenario 15)
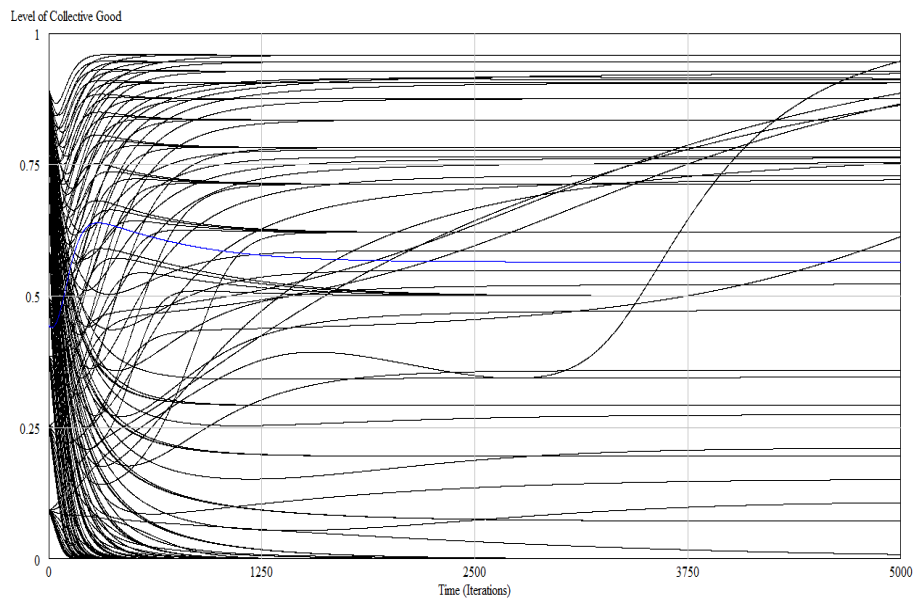
Runs: 132

Figure 39: Final levels of collective good for the parameters shown in Figure 39 (Scenario 15)

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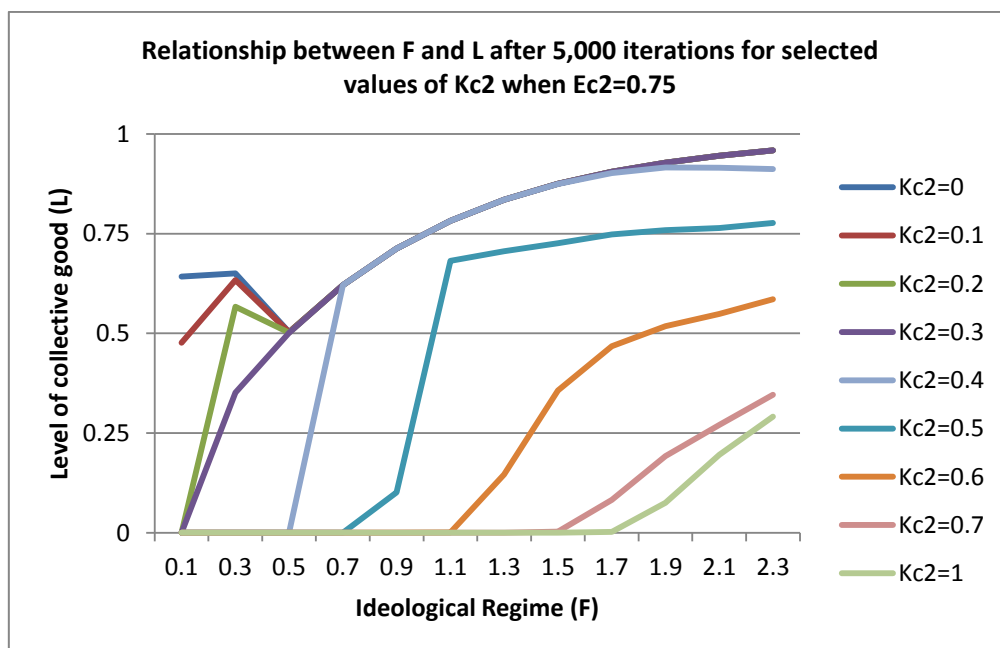
In this discussion opposition strategies have been treated as a competing normative regime. That is not the original purpose. In the model:

> 'Oppositional strategies occupy a special niche: They retreat unless a collective good is being overproduced. Hence, they thrive only in the altruist's dilemma region, when a moralistic strategy has produced a collective good with a negative net value' (Heckathorn 1996:271)

The following scenarios illustrate the influence of the main oppositional strategies, Resistance (DO) and Defection (DD), in a liberal and bargaining environment respectively, as defined in Table 16.

Both environments have a positive net value, which is not the case in the region of the altruist's dilemma.. The reference mode (the blue line in each chart) in both scenarios is $Ec2 = Kc2 = Eo2 = Ko2 = 0$. The charts show the output from a sample of 50 cases.

Table 16: Two examples of opposition to the production of the collective good

Scenario No.	Initial Frequencies							Regime	Costs				Power (Efficacy)	
	CD	DD	TFT	CC	DC	CO	DO	F	K_{c1}	K_{oc}	K_{c2}	K_{o2}	E_{c2}	E_{o2}
16	$^1/_6$	$^1/_6$	0	$^1/_6$	$^1/_6$	$^1/_6$	$^1/_6$	1.1	1	0	0, 0.99, 0.01	0, 0.99, 0.01	0, 0.99, 0.01	0, 0.99, 0.01
17	$^1/_6$	$^1/_6$	$^1/_6$	$^1/_6$	$^1/_6$	$^1/_6$	$^1/_6$	2.2	1	0	0, 0.99, 0.01	0, 0.99, 0.01	0, 0.99, 0.01	0, 0.99, 0.01

Scenario 16: The majority of cases (31) produced no collective good. In the reference mode three strategies survived with equal relative frequencies of 1/3, namely Dominance, Resistance and Defection. The main point is that as the values were varied Resistance did not survive, but in a majority of cases strengthened Defection which does not carry

additional costs. In the other cases Dominance had sufficient power-cost advantage to prevail.

Figure 40: Opposing sanctions in a liberal regime (Scenario 16)
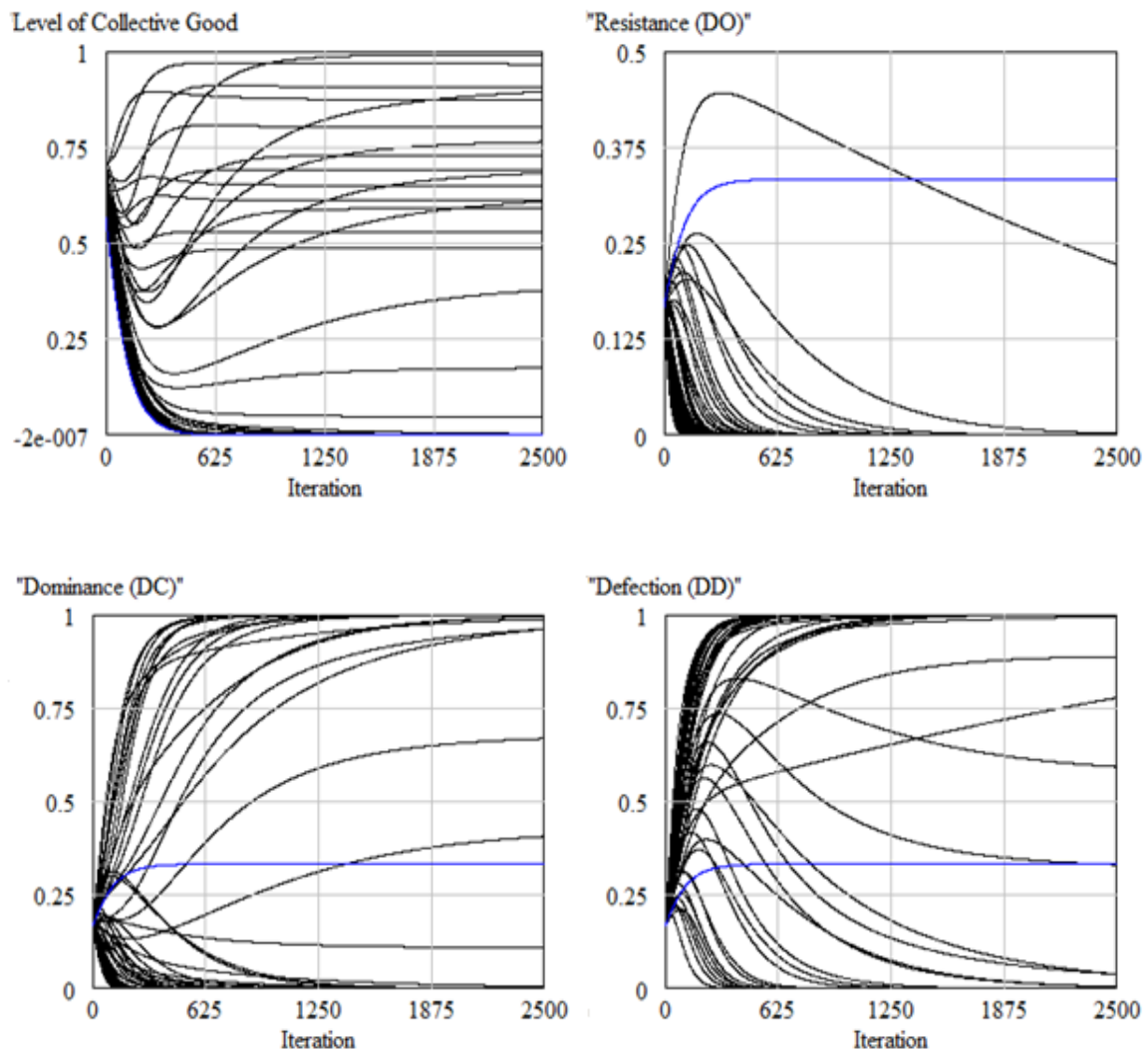
Scenario 17: Resistance and Defection have a similar relationship in the Pluralist or bargaining environment, although at somewhat lower maximum values. However, the collective good is produced in every case and voluntary contribution survives in some cases.

Figure 41: Opposing sanctions in a bargaining regime (Scenario 17)
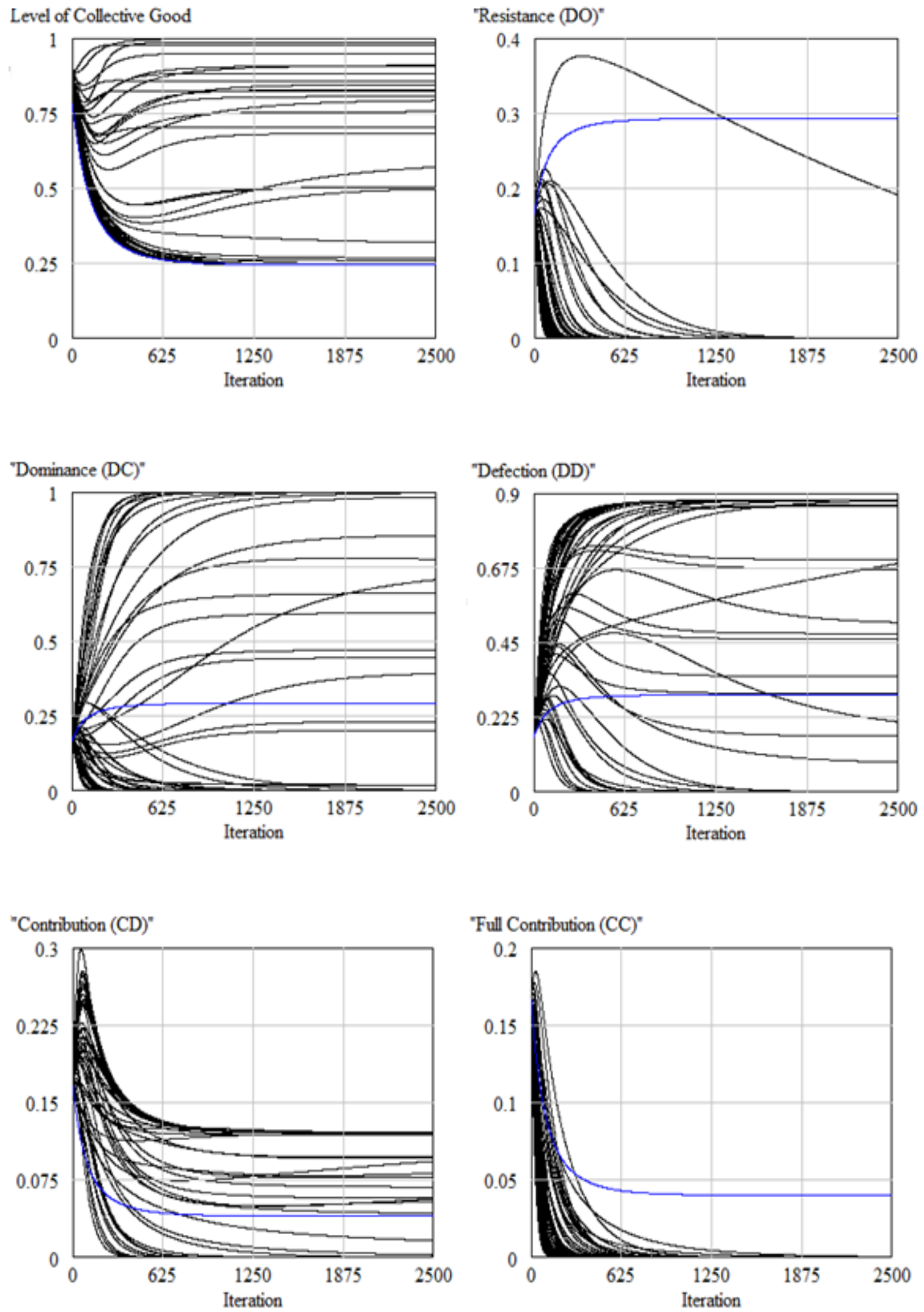
These results suggest that the DO strategy is well designed for Heckathorn's purposes but cannot be directly related to social environments in which there is ongoing institutionalised opposition to the production of collective goods. The other strategies of voluntary interaction, reciprocity and compliant sanctioning seem to be transferable to the purpose of the thesis. Further indications of marginal sensitivity in the three regime types discussed here are in Appendix 4.

Governing policies

The final set of criteria proposed by Maani and Cavana (2007:70-73) for validating a model relate to responses to policy changes. As was cited previously, this model is positioned with 'social theory [that is] to inform those who have constitutional rights of control over social policy so that they can exercise those rights in an informed fashion.' (Coleman 1990:784) More specifically to simulate a social system that is relevant to an impartial commentator or a notional trustee as those roles were introduced in Chapter 2.

The validation is this chapter is the first phase of an iterative process (Sterman 2000:87-89). The main objective was to establish that the behaviour of the model in Appendix 3 was reasonably close to the original model used by Heckathorn, and responded plausibly on the dimension of greatest interest (V/K = 1.4). That objective has been met. The review in Chapter 3 showed that the model is based on a logical template for classifying societal dynamics. In that sense it is a self-contained 'family of systems' (Forrester and Senge 1980:225) that encompasses a range of alternative and potentially opposing ideologies and definitions of what 'freedom' and 'impartiality' implies.

A second iteration of model validation is beyond the scope of the thesis. A logical option for that phase would to focus on the liberal ideology outlined in Chapter 2 and systematically explore how the model responds to small incremental changes in parameters in the space that radiates from $F = 1$ and $1 < V/K < 2$ (Figure 14). That would strengthen the relationship with the strategy outlined in Chapter 2 and is the purpose of the discussion in Chapter 5.

CHAPTER 5: USING THE CONCEPTUAL FRAMEWORKS

Introduction

This chapter completes an initial review of the conceptual strategies proposed by Runciman, Coleman and Sen (described in Chapters 1 and 2) and the potential for applying the strategies using Jasso's macro-model of social structure (Chapter 2) and Heckathorn's model of social dynamics (Chapters 3 and 4). The aim is to move towards using the models to review the allocation of 'constitutional rights of control' (Coleman 1990:784), particularly in a liberal regime where there are contending normative pressures based on interpretations of freedom.

The argument is that impartiality is a norm that can be identified and subject to public reasoning and, to the extent that the norm is treated as a collective good and evident in social interaction , impartiality will reduce the *social* gradient of health. That is to say, the gradient attributable to the distribution of power in a jurisdiction. This chapter begins to sketch how that analysis might be approached. Sen regarded Heckman's case for reducing social constraints on parents' investment in the cultural capabilities of their children as a basis for considering the distribution of freedom-based capabilities. The case, which was reviewed in Chapter 2, is used here as an illustration.

The objective of the chapter is to outline a set of questions to be addressed in a second phase of model validation and development. It does this by: applying Heckathorn's analysis of ideology and dynamics to locate public discussion within an ideological regime (Table 5), using Jasso's logic of social structure to identify points where Runciman's concept of selection pressure could be tested, and, varying Heckathorn's parameters of cost and power to simulate Coleman's concepts of power weighted consensus, efficiency and virtual conflict.

Ideological location

Heckman's proposal avoids some important issues by concluding that increasing parental capability to invest in their children's cultural capability, directly or indirectly, has a very high benefit-cost ratio. His estimate provides a useful initial point of reference, but is revised here. This is not to question the financial calculations that support his conclusion, rather to redefine the average value and costs of the collective good when the focus

moves from estimates of future benefits to the current strength of norms of impartiality. Impartiality is Sen's main principle in his quest for justice, but it is not an explicit foundation of Heckman's case. In this discussion impartiality is interpreted as a contentious but potentially sustainable norm, with significant value particularly for some social strata, but also with relatively high costs when sanctioning is institutionalised in corporate actors. Consequently, it is assumed that the appropriate location is at the Value-Cost ratio used in previous illustrations, namely $V/K = 1.4$, with $V = 1.4$ and $K_{c1} = 1$ as a base reference.

Arguments have been advanced which locate the general problem of provision for children in all of the three regimes discussed in the thesis. Angus, as Children's Commissioner, provided a summary of the debate when he classified proposals for reducing relative disadvantage of children under three headings: structure, rights, and investment (Angus 2011:13). These distinctions are interpreted here as referring to control and coordination (an Assurance Game), recognition of universal human and children's rights (a Prisoner's Dilemma), and negotiation about competing priorities for resource allocation (a Bargaining Game). Angus, in common with Heckman, moved towards an investment argument. If that assessment is reasonable then the implication within this framework is that Angus suggested advocates for children engage in a bargaining game. That is a reasoned and pragmatic assessment. However the three 'games' are not mutually exclusive and a social situation of this complexity probably includes most or all of the alternatives.

The approach taken here is that the social infrastructure available to implement Heckman's proposal in the context being discussed by Angus, namely New Zealand in 2011, could not support comprehensive bargaining – a point the Commissioner also made. It might do so in circumscribed social systems, which was perhaps the context he had in mind. However, taking a broader view, current institutional arrangements assign rights to children that include acknowledgement of collective duties, underwritten by the State, to reduce constraints on parents which adversely affect their capability to care for their children[93]. However, the institutional arrangements do not provide the means for

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[93]   For example, the Children's Commissioner Act 2003 Schedule 2 'United Nations Convention on the Rights of the Child' generally, but most specifically Articles 18.2 and 27.3.

those rights to be exercised by populations that need to invoke them. Relevant duties of that scope have not been assigned to statutory roles or corporate actors.

Taking a lead from the scheme in Figure 13, there are two questions to be addressed. One is what proportion of the collective good is being produced ? Or more specifically, how impartial is the social system? The other is what proportion of the population is contributing? Or, what is the level of support and opposition to collective action to increase the level of impartiality? The answers vary depending on how the distribution of justice in the child population is defined. A framework for considering that issue is outlined in the next section.

Social Structure

Two scenarios

Heckman's case provides sufficient information to use Jasso's theory to generate hypotheses related to social implications of his proposal. His scenario implies that the distribution of parental capability to invest in children is a relevant consideration, possibly, but not necessarily interpreted as an issue of justice. In Figure 42 Jasso's ordinal distribution is used to represent the status quo on the basis that children can be ranked in relation to provision of freedom-based capabilities on the basis for having more or less, but the level is not quantified in any other way (Jasso 2008:10). Heckman discussed responses to the circumstances of the lowest decile consequently p (the vertical line) is set at 0.1. In this discussion p is interpreted as an indicator of organisation and is constant. As shown in Figure 8, as p moves to the right the relative size of the sub-group with subordinate identities, interests and resources increases.

A cardinal ranking implies that measurable indicators become relevant and an inequality parameter, k, is introduced which, in the context of this thesis, is interpreted as a measure of impartiality. In Heckman's case the measurable indicators could be the range and quality of opportunities to learn, and the shape in Figure 43 might be closer to the state that was created in the demonstration projects used to support the case. Figures 42 and 43 provide the minimum amount of information required to consider 'selection pressures' attributable to the set of payoffs in a normative regime.

Figure 42: Social structure before augmenting parental capability to invest
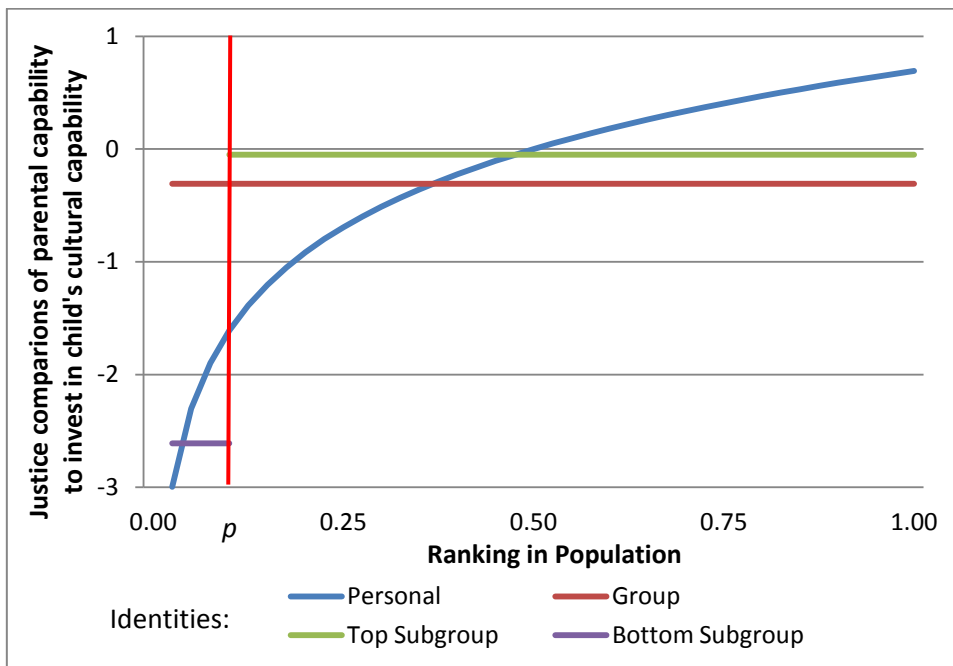
[$p = 0.1$; $k = 1$]

An analysis

Jasso's objectives included generating hypotheses that could be subject to empirical verification or rejection. With that in mind, an interpretation of the two charts follows. Heckman argued for a consistent focus on the circumstances of the lowest ranked decile on the grounds that investment for the most deprived gave the greatest benefit-cost ratio. Consequently, in Jasso's terms, the social structure remains stable[94]. The implications of the structure include: the lowest decile includes two identities ($G>S_L>P$ and $G>P>S_L$) [95]; a majority in the lowest decile has a relatively low identification with their subgroup; the interface of the decile with the next social stratum is with a substantial group that identifies primarily with the top subgroup, not with the population as a whole; and almost half the population prioritises their individual interests above either the collective or their subgroup interest.

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[94]   The distribution is approximately: $G>S_L>P$ 4%; $G>P>S_L$ 6%; $S_U>G>P$ 26%; $S_U>P>G$ 13%; $P>S_U>G$ 49%.

[95]   The designation of social strata is described in Chapter 2.

Figure 43: Social structure after augmenting parental capability to invest
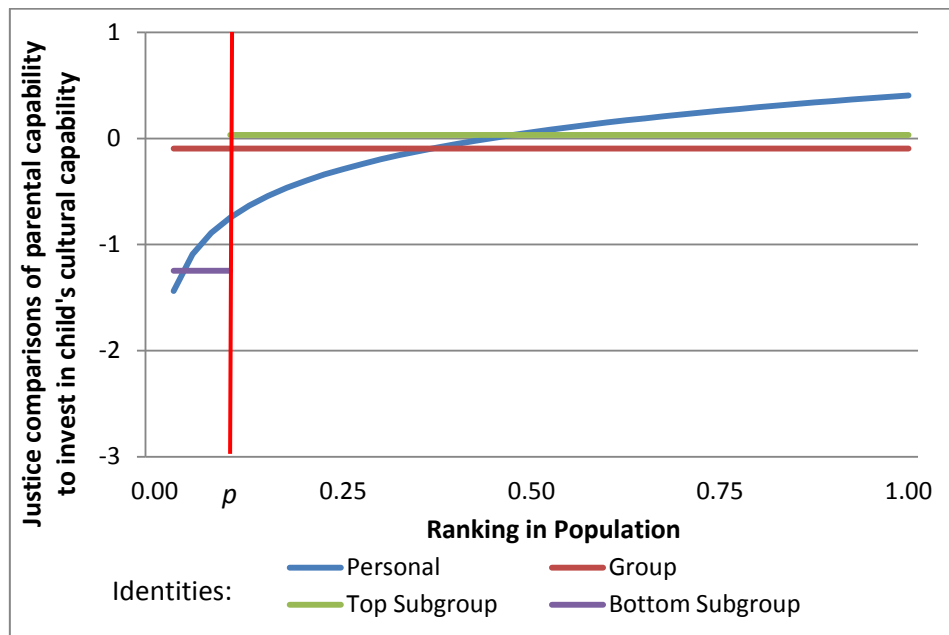
[$p = 0.1$; $k = 2$]

The gradient of personal identity (P) is interpreted as an indicator of shared interest – a low gradient implies that interests of those in adjacent positions are closely aligned and vice versa. In these scenarios $P > S_U > G$ has the greatest cohesion. The strata in the lowest decile have the least cohesion and the lowest stratum has the greatest, although remote, interest in the common good [96]. Heckman's argument seems to take account of these constraints by emphasising the long run costs to the upper subgroup of managing the lowest decile.

There is also, at least theoretically, an argument based on the idea of justice or at least a response to injustice. If reducing injustice is a salient factor then an increase in k implies that all strata gain[97]. Four types of gain can be identified: a reduction in conflict, an

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[96]   This is an implication of focussing on identities formed with reference to the Comparison-Justice function. Other distributions have different implications, for example, the elite have the steepest gradient and least cohesion if the distribution selected is a Pareto distribution with, say, reference to material wealth.

[97]   This discussion assumes there has been no re-ranking as the gradient is reduced. The selection processes used as k increases could be relevant when considering opposing strategies, including the responses of strata that lose comparative advantages.

increase in social cohesion, a reduction in the sense of injustice within the lower subgroup and the population as a whole, and a new positive sense of justice in the upper subgroup. The mathematical formulation of these conjectures are summarised in Table 17. Conflict severity 'is represented by the absolute difference between the mean sense of justice in each subgroup' (Jasso 1993a:358). Cohesion or 'subgroup effectiveness in the conflict is represented by the Gini's mean difference of the justice sentiments within the subgroup' (Jasso 1993a:358). Group identities refer to the averages of the upper and lower subgroups and the total population. The estimates of these values for Figures 42 and 43 are listed in Table 17. On this reading the change from $k = 1$ to $k = 2$ has halved the level of conflict, latent or actual, and doubled the cohesion of each group.

If the regime has the capacity to further reduce conflict related to injustice then the question posed by the model is the relative weight to give to p and k. For example, there are two options for creating a third scenario that reduces conflict severity to, say, ≈ 1.015 all other things being equal. One option is to restructure the population by increasing p to 0.2; the other is to increase k to 2.5.

Some of the considerations that might interest an impartial commentator who is considering the pressures on the practices being created or eased by the governance system can be identified in the Jasso's depiction of social structure. There will be diminishing returns from further increases in k and the upper strata are now associated with a positive self-assessment of their commitment to justice. There has been a relatively small but perceptible increase in the cohesion in the upper strata, and the $S_U > G > P$ strata still provides a substantial buffer with a vertical orientation to the upper subgroup rather than a horizontal orientation to the population as a whole. In addition, further increases in k will increase the cohesion of the two lowest strata and further reduce the relative advantage of higher strata. The majority of the population could regard these features of the social structures as reasons to stabilise the position in Figure 43.

The other option, if conflict severity or resistance to injustice remains a problem, is to increase p. That would further enhance the self-assessment of those relating to S_U. An increase in p would not in itself affect the gradient of justice for individuals, but it would increase the proportion of the population identifying with the group as a whole (G), which might, in time, redefine the balance of priorities. The sense of justice for the group as a

whole is negative until $k \approx 100$, which is close to a state of equality. The management of the interface between populations with a 'vertical' but strongly collective orientation ($S_U > G > P$) and those with a 'horizontal' orientation supported by personal priorities ($G > P > S_L$) could be critical for maintaining the social order and consequently the existing social gradient of health across the population.

Table 17: Implications for conflict and cohesion of the change from the structure depicted in Figure 46 to that depicted in Figure 47

Concept	Description	Scenarios	
		Figure 40	**Figure 41**
Conflict severity	Absolute difference between Subgroups[98]	2.56	1.28
Relative effect on conflict severity:			
Size of the Bottom Subgroup (p)	Partial derivative with inequality constant[99]	-8.27	-4.13
Inequality (k)	Partial derivative with Bottom Subgroup size constant[100]	-2.56	-0.64
Cohesion and effectiveness (- GMD: negative of the Gini Mean Difference)[101]			
Total Group	- GMD for Group	-0.0047	-0.0024
Top Subgroup	- GMD for Subgroup	-0.0035	-0.0017
Bottom Subgroup	- GMD for Subgroup	-0.2310	-0.1155
Group Identities			
Group	Mean of the total population	-0.3069	-0.0945
Top Subgroup	Mean of the Top Subgroup	-0.0510	0.0334
Bottom Subgroup	Mean of the Bottom Subgroup	-2.6094	-1.2458

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[98] $-\frac{\ln{(p)}}{k(1-p)}$ (Jasso 1993a:371)

[99] $\frac{-(1-p)-p(\ln(p))}{kp(1-p)^\wedge2}$ (Jasso 1993a:371)

[100] $\frac{\ln{(p)}}{k^\wedge2(1-p)}$ (Jasso 1993a:371)

[101]   These calculations use the formula advocated in Jasso (1979)

Based on previous observations (Cody 1999; Cody and Robinson 2000; Cody, Cavana et al. 2006; Cody, Cavana and Pearson 2011), Jasso's hypothetical social structure is regarded as very plausible. The next step is to seek to establish relationships between p and k, and Heckathorn's variable 'Proportion of Contributors' (L) (Figure 13). Before considering how dilemmas might be address using Heckathorn's model there is a brief digression to relate some of Jasso's reference values to an empirical example.

An empirical reference

This part is a brief comment on the practicality of introducing measurement and empirical research into this type of discussion (Jasso 2004:403). The interpretation in the previous part aimed to show that Jasso's framework gives useful guidance for locating where pressures on institutionalised practice might be located in social structures. For example, if the issue is parental capability to invest in their children's learning, the New Zealand Deprivation (NZDep) Index (Salmond, Crampton and Atkinson 2008) provides a profile of social constraint. The NZDep Index is calculated using nine household variables from data gathered in the national census and can be used to indicate the likelihood of socially recognised 'freedom-based capabilities'. The findings are reported for small areas of about 100 people resident in the same immediate locality. Residential stratification is sufficiently well defined for most households in each area to be in the same socio-economic position[102]. Figure 44 shows the distribution for a territorial local authority (TLA).

The marked points correspond to the key references in Jasso's scheme. Reading from left to right: the mean of the Lower Subgroup (S_L) (1310); $p = 0.1$(1245), the Group mean (G) (1060), the Group median (1065), and the mean of the Upper Subgroup (S_U) (1032). Each small area had been publicly identified by name. Given that level of information, it is possible to identify with reasonable accuracy people with local knowledge of the social pressures at each of the margins Jasso defined.

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[102]   About an eighth of households have a different level of deprivation to the area in which they are located (Salmond and Crampton 2002).

Figure 44: A distribution of social constraint in a locality[103]
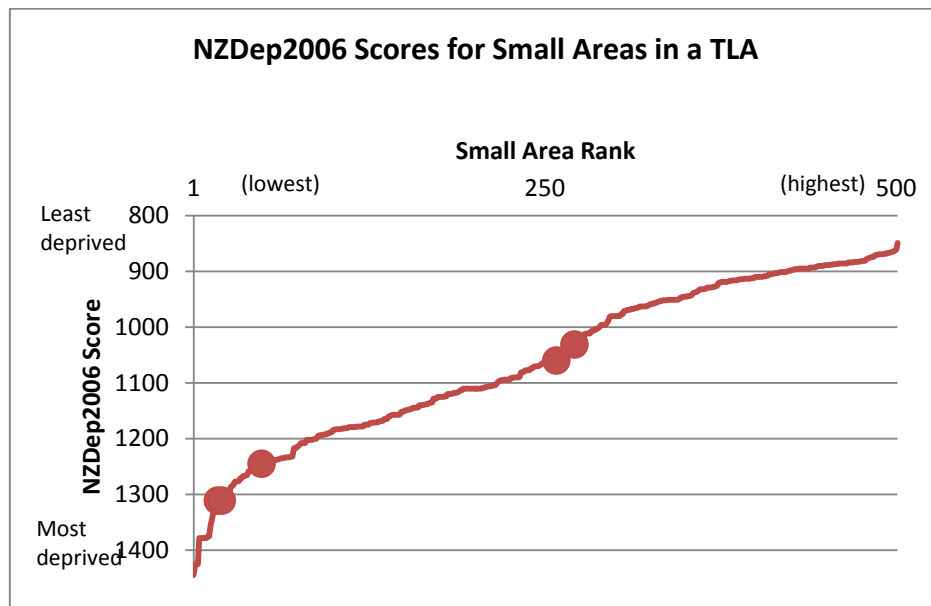
Social Dynamics

The final question is: if an impartial commentator, or interested party, was considering the distributions in the previous section, could the model defined in 'Dynamics and Dilemmas of Collective Action' (Heckathorn 1998) assist by structuring the analysis of

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[103] That national mean is normalised at 1000. The median is 975 and $p = 1140$. The index measures deprivation, that is say social constraint, not social well-being across the population. Consequently it is skewed as shown in the chart below.

Distribution of NZDep2006 scores with the NZDep2006 decile scale superimposed – high score is most deprived:
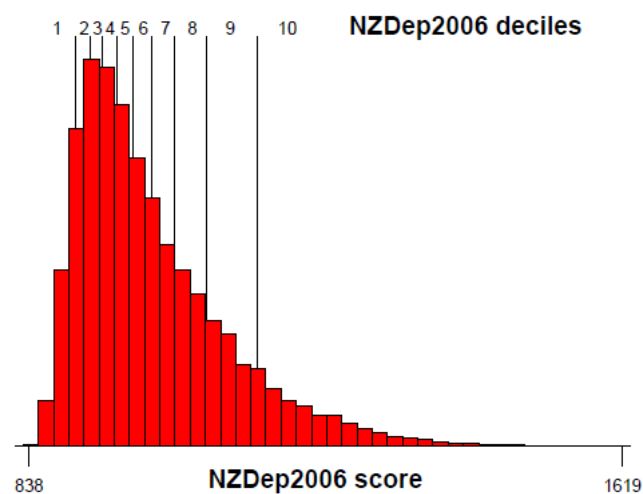
dynamics affecting *p* and *k*? In this preliminary attempt to address the question it is assumed that the level of the collective good moves in the same direction as *k*, and *p* will have some, yet to be defined, relationship to the level of contribution (L) and the production function (F).

The dynamics created by the production function implies a revised version of Figure 11. The social environment discussed in Chapter 2 did not place an emphasis on plural sources of effective power. Heckathorn's model demonstrates the relevance of that dynamic. Consequently, on the basis of results reported in Chapter 4, the scheme can be extended to two types of social practice each with two sub-types, namely local interaction in the form of either voluntary exchange or reciprocal sanctioning, and interaction mediated by institutions, either as bargaining or sanctioning.

The immediate conceptual issue that needs to be addressed is the concept of a liberal regime. Modelling plural concentrations of power engaged in bargaining is a separate phase of validation and development. The discussion in earlier chapters does not consider the extent to which defection is a form of freedom, and consequently the extent to which a high level of collective commitment is a form of authoritarian regime. The final set of scenarios in Table 18 introduces the problem. The objective of these scenarios is to pose problems that might be considered by an impartial commentator or a notional trustee, and, perhaps, provide the basis for a dialogue between them conducted in the manner envisaged by Sen.

Table 18: Locating a thresholds of defection and dominance

Scenario No.	Initial Frequencies							Elite Responsiveness (F) - Vector	Costs				Power (Efficacy)	
	CD	DD	TFT	CC	DC	CO	DO		K_{c1}	K_{oc}	K_{c2}	K_{o2}	E_{c2}	E_{o2}
19	$1/6$	$1/6$	0	$1/6$	$1/6$	$1/6$	$1/6$	0.33	1	0	0.1	0	0.745	1
20	$5/50$	$8/50$	0	$8/50$	$8/50$	$5/50$	$16/50$	0.6	1	0	0.3	0.3	0.55	0.3
21	$5/50$	$8/50$	0	$8/50$	$8/50$	$5/50$	$16/50$	0.6	1	0	0.3	0.3	0.54	0.3
22	$5/50$	$8/50$	0	$8/50$	$8/50$	$5/50$	$16/50$	0.6→1.2	1	0	0.3	0.3	0.54	0.3

Say, as a working assumption, the change from Figure 42 to Figure 43 is an increase in the Level of Collective Good from ≈ 0.3 to ≈ 0.6, and the regime can support authoritarian action to produce reform that will provide the basis for further sustainable increases, then Scenario 19 (Figure 45) is an option. A full use of available sanctions to gain compliance can be used to support an increase in contribution. In due course the changes become an accepted practice of contribution sustained by the sanctioning regime.

Figure 45: Reform in an authoritarian regime (Scenario 19)
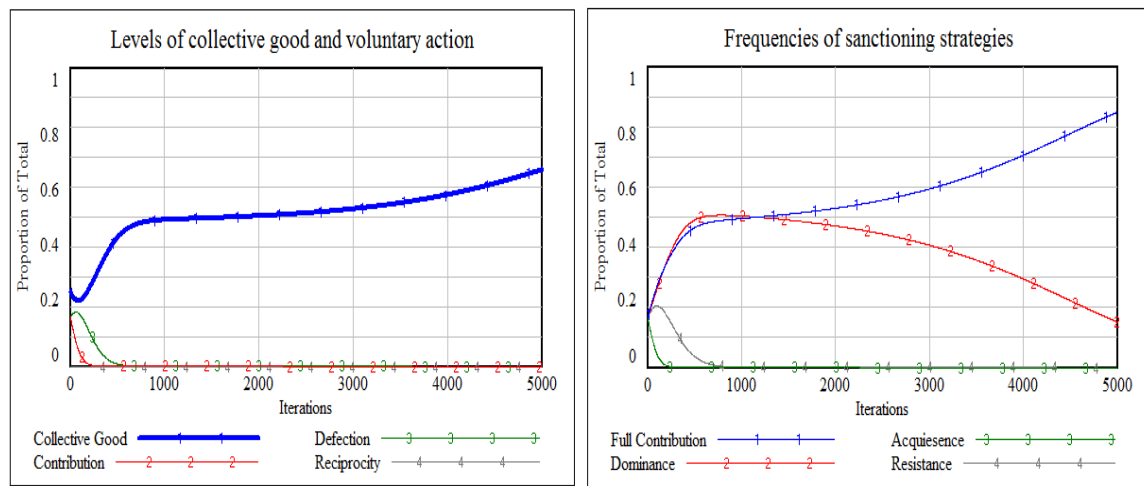
However, if the increase in collective good is to occur in a liberal regime and involves a transfer of rights then the thresholds for failure and limits to attainment are relevant. The remaining scenarios illustrate a threshold at which commitment to producing a collective good reaches a limit or trends towards extinction. Assume that Figure 42 has a level of elite responsiveness and public contribution such that $F = 0.6$[104], and that plausible distributions of power and cost are shown in Table 18. Figure 46 is a scenario with moderate power to impose the norm and less to resist.

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[104]   The payoff matrix for $F = 0.6$ is:

	CD	DD
CD	$R = 1.4 - 1$ $= 0.4$	$S = 1.4*(1 - .5\text{^}0.6) - 1$ $= -0.5237$
DD	$T = 1.4*(1 - 0.5\text{^}0.6)$ $= 0.4763$	$P = 0$

Figure 46: Approaching a threshold of defection – an increase in the collective good is produced (Scenario 20)
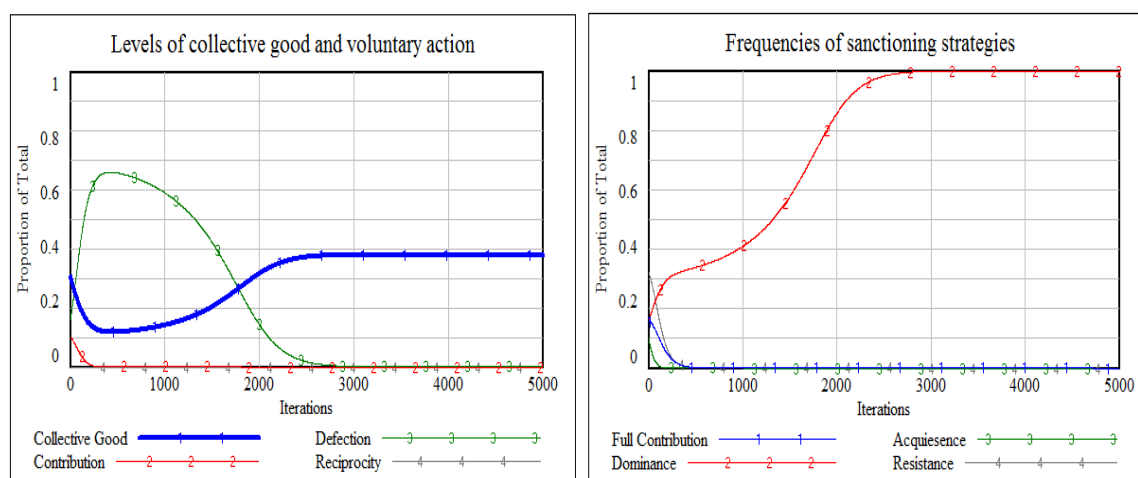
In Figure 46 the initial trajectory of the level of collective good is primarily determined by the frequency of the four sanctioning strategies that affect the level of defection: Defection, Full Contribution, Dominance and Resistance. The initial frequency of Resistance is twice that of the other three strategies, hence the initial level of collective good is ≈ 0.3. The other parameters are set to illustrate the trajectory of defection. The equilibrium is determined by the power of dominance, given that the cost of the strategy is below the level at which it would fail. Greater power would produce a higher level of collective good.

In Figure 47 there is a collapse in the level of the collective good with a 0.01 fall in the efficacy of compliant sanctions. The loss of all the collective good after a 1% reduction in power is probably not plausible taking a social system as a whole. However, it is the case that the transfer of rights relating to children between the adult members of families and the State does polarise public opinion, and on any specific issue the proposition could be settled as win or lose with no middle ground[105]. The sensitivity at the threshold may not

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[105]   For example, the Hon. Paula Bennett, as Minister for Social Development, addressed a forum of the Wellington Council of the New Zealand Medical Association on 17 August 2011 on the prospects of proposals in a Green Paper she had released recently (Bennett 2011). In her oral comments the Minister anticipated strong resistance from 'middle New Zealand' to the proposals for greater compliance with protocols for greater compliance with protocols intended to increase the effectiveness of measures to identify vulnerable children. A similar trajectory was followed

be an issue if there were more effective responses from other strategies.

Figure 47: Approaching a threshold of defection – a decrease in the collective good produced (Scenario 21)
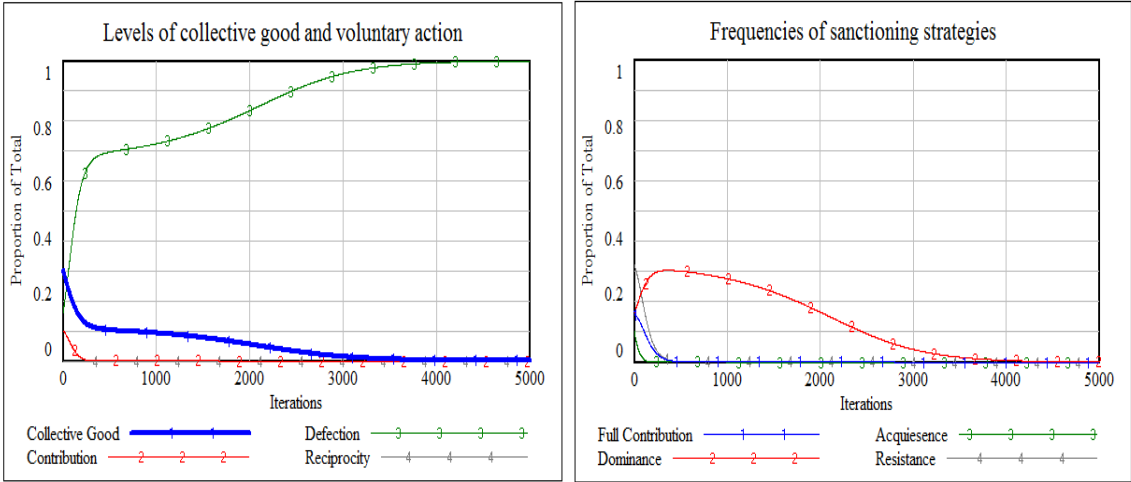
If the initial values in Scenario 21 are retained but elite responsiveness (F) is an increasing variable then the trajectory has the form in Figure 48

Figure 48: Scenario 21 repeated with increasing elite responsiveness (Scenario 22)
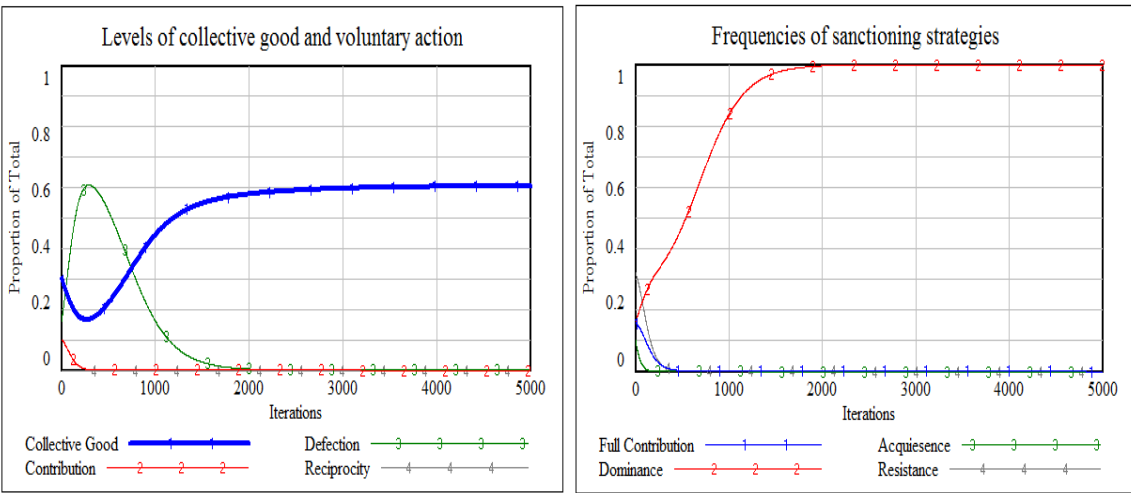
with an earlier movement to repeal s.59 of the Crimes Act which provided, in some circumstances, parents with a defence if they assaulted their child. Background information provided by proponents of repeal is at http://yesvote.org.nz/background/history-of-the-child-discipline-law/

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Perspectives of an impartial commentator or a notional trustee

The original criteria for selecting the model included identifying thresholds for normative regimes. That criterion has been met. Another criterion was whether the model could provide insights for an impartial commentator and a notional trustee. From those points of view additional questions arise from dynamics such as those illustrated in Scenarios 20, 21 and 22. One question that might interest an impartial commentator from a liberal perspective is the validity of a regime that survives with one dominant strategy that extinguishes the freedom implied by voluntary contribution and defection, and does not sustain a mix of strategies. A notional trustee might question the extent to which the interests s/he represents are based on elite responsiveness rather than voluntary contribution and regard the level of collective good too low. There are common concerns and different priorities.

This type of question provides a basis for a second review of the model. Although the model has been used for a purpose for which it was not intended, the fundamental design is sound and can probably be adapted to address questions of this kind. To adapt the model for the purpose introduce in the thesis further attention is required to the payoff matrix, the production function when there is conflict over the value of F, and the potential for feedback loops. The concept of conflict needs closer consideration and alignment with Jasso's model, and, as a related issue, the renaming of strategies in Chapter 3 may have failed to consider some of the principles used in the design of the payoff matrix. Feedback in the model might be facilitated by creating functions defining the relationship between resources (sustainable costs) and efficacy. The structure of a final model needs to include dynamics observed in empirical settings such as oscillations (Cody, Cavana et al. 2006) and limit cycles independent of initial conditions.

The next phase of validation and development should also consider systematically the perspectives of the two roles identified in Chapter 2. That exercise would note the limited use that has been made of the functions available in Vensim, in particular the possibility of structuring a 'dialogue' between the two roles as an optimisation problem. Although endogenous feedback is required to meet essential standards for System Dynamics modelling, an appropriate selection of parameters will be required for that purpose.

CONCLUSION

The subtitle of the thesis 'modelling disparities in health outcomes' was confirmed when it was envisaged there would be direct reference to health outcomes in the model. A range of examples of socio-economic stratification were considered. These included: health during pregnancy, well child provision, dental health, early and late diagnosis and subsequent prognosis, access to surgical treatment, and age at death. There were also some indirect indicators such as oral language development among children, mothers' education, employment status and income, housing and food security. Each example presented a mix of corporate decision making – public and private – and household or personal decision making – voluntary and sanctioned. The common features turned the line of enquiry towards a search for a generic template that accommodated a mix of strategies.

The thesis is an initial phase in a search that has not been completed. However, it goes some way to confirming Giddens' belief that 'there is no doubt that game-theoretical models can be very useful in empirical research, in respect of suggesting both problems to be investigated and how research results might be interpreted' (Giddens 1984:313). It is also evident that, as Giddens added, it is very unlikely that sociologists will limit their interest to closed systems in which all significant causes of change are endogenous or to processes where all other things can be considered equal.

It is evident that the work of Jasso and Heckathorn were important discoveries while the thesis was being written. Their contribution to sociology is far greater and more subtle than the use made of it here. That being the case, the structure they provide has the potential to be taken further theoretically and empirically. The more general conclusion is that formal social theory provides a useful complement to discursive approaches in sociology, and System Dynamics offers an accessible point of entry to some of the disciplines of modelling.

Modelling provides a way of analysing two substantive problems discussed in the thesis. One is the distribution of partial or power-weighted decision making, and the consequent stratification of social constraint, effort, stress and risk that creates the health gradient. The other is the persistence of this type of inequality in liberal regimes, a dilemma

personified by J.S. Mill and represented in this discussion by Sen (Mill [1859] 2008), Wilkinson (Mill 1989 [1879]), and Coleman (e.g. Robins 2006:xvi).

Further analysis of these problems may yield useful insights. An example of a useful insight is the hypothesis related to the resilience and limits of reciprocity, which is well presented by Heckathorn building on the work of Hirshleifer and Martinez Coll (Hirschleifer and Martinez Coll 1988). If equally incisive hypotheses can be developed for interactions of dominance and resistance the template could contribute to an understanding of the dynamics maintaining population health disparities attributable to the social gradient of health.

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Appendix 1: The Generic Variables used the First Level Stock-Flow Diagram (Figure 15)

Names; (Initials)	Type	Description	Unit of measurement
Contribution (frequency)	Level	Strategies (or sets of practices) that contribute to the collective good. It is assumed that all contributions are equal.	Relative frequency
Defection (frequency)	Level	Strategies (or sets of practices) that defect from contributing to the collective good.	Relative frequency
Change in Contribution	Rate	Response to selection pressures in the payoff matrix expressed as the difference between the yield of the Contribution strategy and the mean yield	Relative frequency/period
Change in Defection	Rate	Response to selection pressure in the payoff matrix expressed as the difference between the yield of the Defection strategy and the mean yield	Relative frequency/period
Value of Full Production; Value (V)	Constant	The value of full production of the collective good	An arbitrary number using the same scale as costs
Cost of Contributing; Cost (K)	Constant	The average marginal cost of producing the collective good. The marginal cost is 0 if there is pure jointness of supply.	An arbitrary scale from 0 to any positive number on the same scale as Value
Production function exponent (F)	Constant	The exponent controlling the shape of the function that links contribution to the level of collective good produced.	Input: Proportion of contribution Output: Proportion of collective good produced
Rate of change (Z)	Constant	The rate at which the selection pressures in the payoff matrix influence the relative frequency of strategies	Proportional rate of adjustment to equilibrium
Local Defectors	Constant	The proportion of local coalitions that defect when there is partial contribution.	Number, set at 1 in the basic model
Local Population	Constant	The size of local coalitions	Number, set at 2 in the basic model
Level of Collective Good (L)	Auxiliary	The proportion of collective good produced relative to production at full contribution	Proportion of full production, $0 - 1$
Contribution (yield);	Auxiliary	Sum of the payoffs for each element of the	Relative fitness

C yield		strategy multiplied by the frequency of the other strategy	
Defection (yield); D yield	Auxiliary	Sum of the payoffs for each element of the strategy multiplied by the frequency of the other strategy	Relative fitness
Mean yield	Auxiliary	Sum of the yields for each strategy multiplied by the frequency of the relevant strategy	The weighted average of the relative fitness of all strategies
T, R, S and P (see Table 4)	Auxiliary	The payoff from each type of interaction	Relative payoff referenced at $P = 0$
Proportion of Defectors	Auxiliary	The number of local defectors divided by the number in the local population	Ratio

Appendix 2: The Stock-Flow Diagram for the 'Dynamics and Dilemmas of Collective Action' model
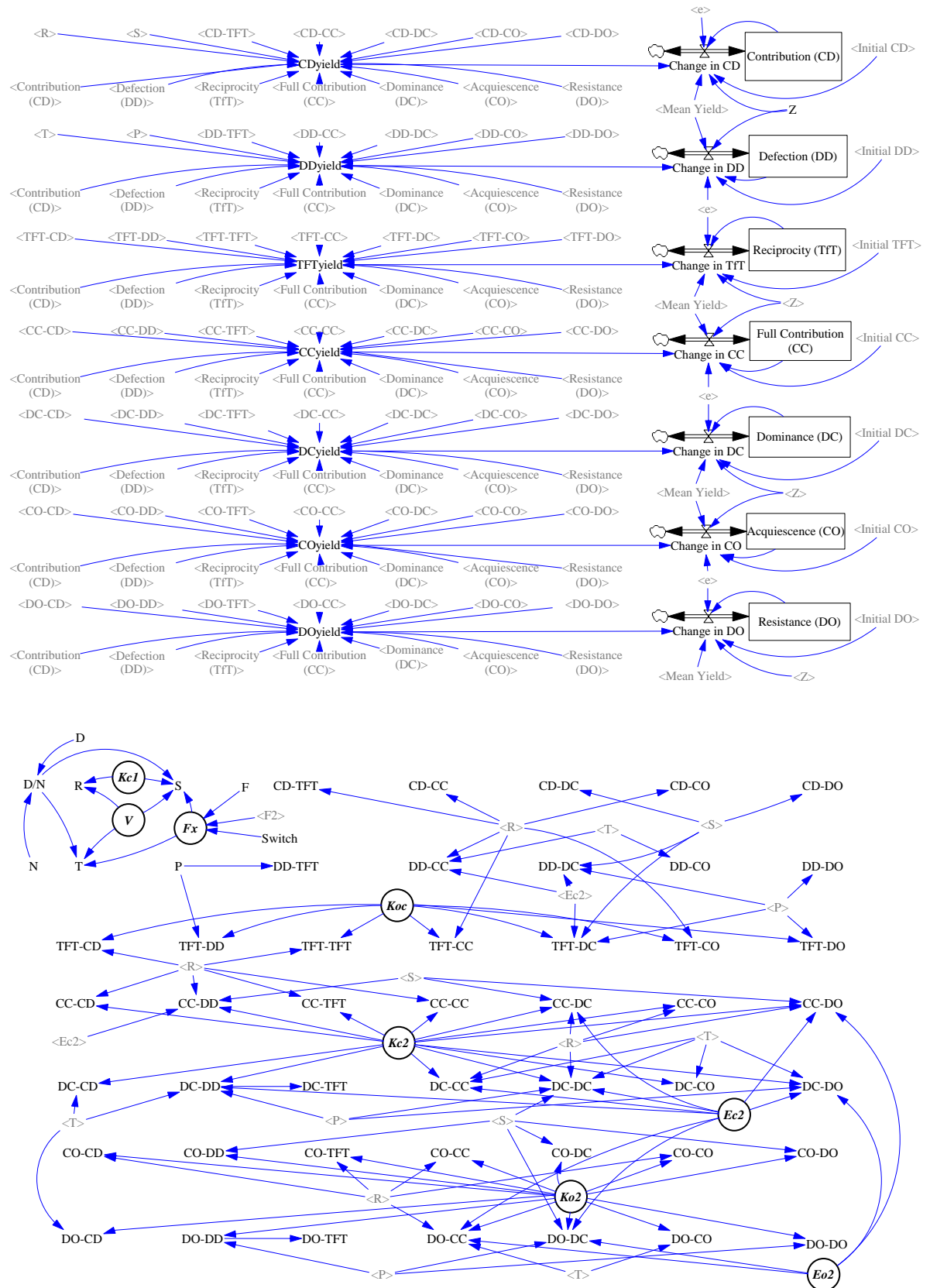
Appendix 3: Vensim equations for Heckathorn's model of the 'Dynamics and Dilemmas of Collective Action'

(001)   "Acquiescence (CO)"= INTEG (
                Change in CO,
                        Initial CO)
        Units: Dmnl
        Relative frequency of practices of Compliant Opposition as a
                proportion of Total Frequency = 1. A generic name was chosen for
                the Unit so it can be displayed alongside Level without
                relabelling.

(002)   "CC-CC"=
                R - Kc2
        Units: Value
        Second-Level replication of Full Contribution interacting with
                Full Contribution. Following Runciman the outcome is regarded as
                the net effect of inherent replication rates and social
                selection pressures, which, following Coleman include sanctions,
                distributed as power by institutions of production and
                distribution, coercion and persuasion

(003)   "CC-CD"=
                R - Kc2
        Units: Value
        Second-Level replication of Full Contribution interacting with
                voluntary Contribution. Following Runciman the outcome is
                regarded as the net effect of inherent replication rates and
                social selection pressures, which, following Coleman include
                sanctions, distributed as power by institutions of production
                and distribution, coercion and persuasion.

(004)   "CC-CO"=
                R - Kc2
        Units: Value
        Second-Level replication of Full Contribution interacting with
                Acquiescence (Compliant Opposition). Following Runciman the
                outcome is regarded as the net effect of inherent replication
                rates and social selection pressures, which, following Coleman
                include sanctions, distributed as power by institutions of
                production and distribution, coercion and persuasion

(005)   "CC-DC"=
                Ec2*R + (1-Ec2)*S - Kc2
        Units: Value
        Second-Level replication of Full Contribution interacting with
                Dominance (Hypocritical Cooperation). Following Runciman the
                outcome is regarded as the net effect of inherent replication
                rates and social selection pressures, which, following Coleman
                include sanctions, distributed as power by institutions of
                production and distribution, coercion and persuasion

(006)   "CC-DD"=

Ec2*R + (1-Ec2)*S - Kc2

Units: Value

Second-Level replication of Full Contribution interacting with
Defection (Full Defection). Following Runciman the outcome is
regarded as the net effect of inherent replication rates and
social selection pressures, which, following Coleman include
sanctions, distributed as power by institutions of production
and distribution, coercion and persuasion

(007)   "CC-DO"=
Ec2*(1-Eo2)*R + ((1 - Ec2)*(1 - Eo2)*S) - Kc2

Units: Value

Second-Level replication of Full Contribution interacting with
Resistance (Full Opposition). Following Runciman the outcome is
regarded as the net effect of inherent replication rates and
social selection pressures, which, following Coleman include
sanctions, distributed as power by institutions of production
and distribution, coercion and persuasion

(008)   "CC-TFT"=
R - Kc2

Units: Value

Second-Level replication of Full Contribution interacting with
Reciprocity (Tit-for-Tat). Following Runciman the outcome is
regarded as the net effect of inherent replication rates and
social selection pressures, which, following Coleman include
sanctions, distributed as power by institutions of production
and distribution, coercion and persuasion

(009)   CCyield=
"Contribution (CD)"*"CC-CD" + "Defection (DD)"*"CC-DD" + "Reciprocity
(TfT)"
"CC-TFT" + "Full Contribution (CC)""CC-CC" + "Dominance (DC)"*"CC-DC" +
"Acquiescence (CO)"*"CC-CO" + "Resistance (DO)"*"CC-DO"

Units: Value

Weighted sum of the replication of Full Contribution when Full
Contribution interacts with each of the other strategies. The
outcome can be attributed to selection pressures, payoffs or
learned responses .

(010)   "CD-CC"=
R

Units: Value

Second-Level replication of voluntary Contribution interacting
with Full Contribution. Following Runciman the outcome is
regarded as the net effect of inherent replication rates and
social selection pressures, which, following Coleman include
sanctions, distributed as power by institutions of production
and distribution, coercion and persuasion.

(011)   "CD-CO"=
R

Units: Value

Second-Level replication of voluntary Contribution interacting

with Acquiescence (Compliant Opposition). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(012) "CD-DC"=
    S
Units: Value
Second-Level replication of voluntary Contribution interacting
    with Dominance (Hypocritical Cooperation). Following Runciman
    the outcome is regarded as the net effect of inherent
    replication rates and social selection pressures, which,
    following Coleman include sanctions, distributed as power by
    institutions of production and distribution, coercion and
    persuasion.

(013) "CD-DO"=
    S
Units: Value
Second-Level replication of voluntary Contribution interacting
    with Resistance (Full Opposition). Following Runciman the
    outcome is regarded as the net effect of inherent replication
    rates and social selection pressures, which, following Coleman
    include sanctions, distributed as power by institutions of
    production and distribution, coercion and persuasion.

(014) "CD-TFT"=
    R
Units: Value
Second-Level replication of voluntary Contribution interacting
    with Reciprocity (Tit-for-Tat). Following Runciman the outcome
    is regarded as the net effect of inherent replication rates and
    social selection pressures, which, following Coleman include
    sanctions, distributed as power by institutions of production
    and distribution, coercion and persuasion.

(015) CDyield=
    "Contribution (CD)"*R + "Defection (DD)"*S + "Reciprocity (TfT)"*"CD-TFT"
  + "Full Contribution (CC)"*"CD-CC" + "Dominance (DC)"*"CD-DC" + "Acquiescence
(CO)"
  "CD-CO" + "Resistance (DO)""CD-DO"
Units: Value
Weighted sum of the replication of Private Cooperation when
    Private Cooperation interacts with each of the other strategies.
    The outcome can be attributed to selection pressures, payoffs or
    learned responses .

(016) Change fraction for F2=
    0.001
Units: Dmnl/Iteration
Rate of change in the exponent of the production function when
    the Switch = 1

(017)   Change in CC=
                IF THEN ELSE(Initial CC>0, Z*"Full Contribution (CC)"*(CCyield - Mean
Yield
) + "Full Contribution (CC)"*e, 0)
        Units: Dmnl/Iteration
        Change per iteration in the relative frequency of practices of
                Full Cooperation - an increase if CC Yield is > Average Yield or
                vice versa. Z controls proportion of the difference applicable
                in one iteration.

(018)   Change in CD=
                IF THEN ELSE(Initial CD>0, Z*"Contribution (CD)"*(CDyield-Mean Yield) +
"Contribution (CD)"
        *e,0)
        Units: Dmnl/Iteration
        Change per iteration in the relative frequency of practices of
                Private Cooperation - an increase if CD Yield is > Average Yield
                or vice versa. Z controls proportion of the difference
                applicable in one iteration.

(019)   Change in CO=
                IF THEN ELSE(Initial CO>0, Z*"Acquiescence (CO)"*(COyield-Mean Yield) +
"Acquiescence (CO)"
        *e, 0)
        Units: Dmnl/Iteration
        Change per iteration in the relative frequency of practices of
                Compliant Opposition - an increase if CO Yield is > Average
                Yield or vice versa. Z controls proportion of the difference
                applicable in one iteration.

(020)   Change in DC=
                IF THEN ELSE(Initial DC>0, Z*"Dominance (DC)"*(DCyield-Mean Yield) +
"Dominance (DC)"
        *e, 0)
        Units: Dmnl/Iteration
        Change per iteration in the relative frequency of practices of
                Hypocritical Cooperation - an increase if DC Yield is > Average
                Yield or vice versa. Z controls proportion of the difference
                applicable in one iteration.

(021)   Change in DD=
                IF THEN ELSE(Initial DD>0, Z*"Defection (DD)"*(DDyield-Mean Yield) +
"Defection (DD)"
        *e, 0)
        Units: Dmnl/Iteration
        Change per iteration in the relative frequency of practices of
                Full Defection - an increase if DD Yield is > Average Yield or
                vice versa. Z controls proportion of the difference applicable
                in one iteration.

(022)   Change in DO=
                IF THEN ELSE(Initial DO>0, Z*"Resistance (DO)"*(DOyield-Mean Yield) +
"Resistance (DO)"
        *e, 0)

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Units: Dmnl/Iteration
Change per iteration in the relative frequency of practices of

> Full Oppositioni - an increase if DO Yield is > Average Yield or
> vice versa. Z controls proportion of the difference applicable
> in one iteration.

(023)   Change in F2=
        (Maximum F2 - F2)*Change fraction for F2
Units: Dmnl/Iteration
Rate of change in F2 up to a maximum.

(024)   Change in TfT=
        IF THEN ELSE(Initial TFT>0, Z*"Reciprocity (TfT)"*(TFTyield-Mean Yield) +
        "Reciprocity (TfT)"*e, 0)
Units: Dmnl/Iteration
Change per iteration in the relative frequency of practices of

> Tit-for-Tat - an increase if TFT Yield is > Average Yield or
> vice versa. Z controls proportion of the difference applicable
> in one iteration.

(025)   "CO-CC"=
        R - Ko2
Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)

> interacting with Full Contribution (Full Cooperation). Following
> Runciman the outcome is regarded as the net effect of inherent
> replication rates and social selection pressures, which,
> following Coleman include sanctions, distributed as power by
> institutions of production and distribution, coercion and
> persuasion.

(026)   "CO-CD"=
        R - Ko2
Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)

> interacting with voluntary Contribution. Following Runciman the
> outcome is regarded as the net effect of inherent replication
> rates and social selection pressures, which, following Coleman
> include sanctions, distributed as power by institutions of
> production and distribution, coercion and persuasion.

(027)   "CO-CO"=
        R - Ko2
Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)

> interacting with Acquiescence (Compliant Opposition). Following
> Runciman the outcome is regarded as the net effect of inherent
> replication rates and social selection pressures, which,
> following Coleman include sanctions, distributed as power by
> institutions of production and distribution, coercion and
> persuasion.

(028)   "CO-DC"=
        S - Ko2

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Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)
interacting with Dominance (Hypocritical Cooperation). Following
Runciman the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(029)   "CO-DD"=
            S - Ko2
Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)
interacting with Defection (Full Defection). Following Runciman
the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(030)   "CO-DO"=
            S - Ko2
Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)
interacting with Resistance (Full Opposition). Following
Runciman the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(031)   "CO-TFT"=
            R - Ko2
Units: Value
Second-Level replication of Acquiescence (Compliant Opposition)
interacting with Reciprocity (Tit-for-Tat). Following Runciman
the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(032)   "Contribution (CD)"= INTEG (
            Change in CD,
                Initial CD)
Units: Dmnl
Relative frequency of practices of Private Cooperation as a
            proportion of Total Frequency (= 1).

(033)   Control=
            "Contribution (CD)" + "Defection (DD)" + "Reciprocity (TfT)" + "Full
Contribution (CC)"
        + "Dominance (DC)" + "Acquiescence (CO)" + "Resistance (DO)"
Units: Dmnl

Detecting iterations when total frequency does not equal 1.

(034) COyield=

"Contribution (CD)"*"CO-CD" + "Defection (DD)"*"CO-DD" + "Reciprocity (TfT)"

"CO-TFT" + "Full Contribution (CC)""CO-CC" + "Dominance (DC)"*"CO-DC" +
"Acquiescence (CO)"*"CO-CO" + "Resistance (DO)"*"CO-DO"
Units: Value
Weighted sum of the replication of Acquiescence (Compliant
        Opposition) when Acquiescence (Compliant Opposition) interacts
        with each of the other strategies. The outcome can be attributed
        to selection pressures, payoffs or learned responses .

(035) D=
        1
Units: Actor [1,9,1]
Defectors in the local coalition

(036) "D/N"=
        D/N
Units: Dmnl
Proportion of actors in the local coalition defecting

(037) "DC-CC"=
        Ec2*R + (1-Ec2)*T - Kc2
Units: Value
Second-Level replication of Dominance (Hypocritical Cooperation)
        interacting with Full Contribution (Full Cooperation). Following
        Runciman the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures, which,
        following Coleman include sanctions, distributed as power by
        institutions of production and distribution, coercion and
        persuasion.

(038) "DC-CD"=
        T-Kc2
Units: Value
Second-Level replication of Dominance (Hypocritical Cooperation)
        interacting with voluntary Contribution (Private Cooperation).
        Following Runciman the outcome is regarded as the net effect of
        inherent replication rates and social selection pressures,
        which, following Coleman include sanctions, distributed as power
        by institutions of production and distribution, coercion and
        persuasion.

(039) "DC-CO"=
        T - Kc2
Units: Value
Second-Level replication of Dominance (Hypocritical Cooperation)
        interacting with Acquiescence (Compliant Opposition). Following
        Runciman the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures, which,
        following Coleman include sanctions, distributed as power by
        institutions of production and distribution, coercion and

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persuasion.

(040)   "DC-DC"=
             $Ec2\hat{\ }2*R + (1-Ec2)\hat{\ }2*P + Ec2*(1-Ec2)*S + Ec2*(1-Ec2)*T - Kc2$
        Units: Value
        Second-Level replication of Dominance (Hypocritical Cooperation)
                   interacting with Dominance (Hypocritical Cooperation). Following
                   Runciman the outcome is regarded as the net effect of inherent
                   replication rates and social selection pressures, which,
                   following Coleman include sanctions, distributed as power by
                   institutions of production and distribution, coercion and
                   persuasion.

(041)   "DC-DD"=
             $Ec2*T + (1-Ec2)*P - Kc2$
        Units: Value
        Second-Level replication of Dominance (Hypocritical Cooperation)
                   interacting with Defection (Full Defection). Following Runciman
                   the outcome is regarded as the net effect of inherent
                   replication rates and social selection pressures, which,
                   following Coleman include sanctions, distributed as power by
                   institutions of production and distribution, coercion and
                   persuasion.

(042)   "DC-DO"=
             $Ec2*(1-Eo2)*T + ((1-Ec2)*(1-Eo2)*P) -Kc2$
        Units: Value
        Second-Level replication of Dominance (Hypocritical Cooperation)
                   interacting with Resistance (Full Opposition). Following
                   Runciman the outcome is regarded as the net effect of inherent
                   replication rates and social selection pressures, which,
                   following Coleman include sanctions, distributed as power by
                   institutions of production and distribution, coercion and
                   persuasion.

(043)   "DC-TFT"=
             "DC-DD"
        Units: Value
        Second-Level replication of Dominance (Hypocritical Cooperation)
                   interacting with Reciprocity (Tit-for-Tat). Following Runciman
                   the outcome is regarded as the net effect of inherent
                   replication rates and social selection pressures, which,
                   following Coleman include sanctions, distributed as power by
                   institutions of production and distribution, coercion and
                   persuasion.

(044)   DCyield=
             "Contribution (CD)"*"DC-CD" + "Defection (DD)"*"DC-DD" + "Reciprocity
(TfT)"
        "DC-TFT" + "Full Contribution (CC)""DC-CC" + "Dominance (DC)"*"DC-DC" +
        "Acquiescence (CO)"*"DC-CO" + "Resistance (DO)"*"DC-DO"
        Units: Value
        Weighted sum of the replication of Dominance (Hypocritical
                   Cooperation) when Dominance (Hypocritical Cooperation) interacts

with each of the other strategies. The outcome can be attributed to selection pressures, payoffs or learned responses .

(045)   "DD-CC"=
            Ec2*R + (1-Ec2)*T
Units: Value
Second-Level replication of Defection (Full Defection)
            interacting with Full Contribution (Full Cooperation). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(046)   "DD-CO"=
            T
Units: Value
Second-Level replication of Defection (Full Defection)
            interacting with Acquiescence (Compliant Opposition). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(047)   "DD-DC"=
            Ec2*S + (1-Ec2)*P
Units: Value
Second-Level replication of Defection (Full Defection)
            interacting with Dominance (Hypocritical Cooperation). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(048)   "DD-DO"=
            P
Units: Value
Second-Level replication of Defection (Full Defection)
            interacting with Resistance (Full Opposition). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(049)   "DD-TFT"=
            P
Units: Value
Second-Level replication of Defection (Full Defection)
            interacting with Reciprocity (Tit-for-Tat). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which,

following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(050)   DDyield=
            "Contribution (CD)"*T + "Defection (DD)"*P + "Reciprocity (TfT)"*"DD-TFT"
        + "Full Contribution (CC)"*"DD-CC" + "DD-DC"*"Dominance (DC)" + "DD-
CO"*"Acquiescence (CO)"
        + "DD-DO"*"Resistance (DO)"
        Units: Value
        Weighted sum of the replication of Defection (Full Defection)
            when Defection (Full Defection) interacts with each of the other
            strategies. The outcome can be attributed to selection
            pressures, payoffs or learned responses .

(051)   Defection=
            Defection DD + Defection TFT + Defection DC + Defection DO
        Units: Dmnl
        Sum of the fraction of defection in each of the four strategies
            in which defection occurs

(052)   "Defection (DD)"= INTEG (
            Change in DD,
                Initial DD)
        Units: Dmnl
        Relative frequency of practices of Full Defection as a
            proportion of Total Frequency (=1).

(053)   Defection DC=
            "Dominance (DC)" - (Ec2*"Dominance (DC)"*"Full Contribution (CC)" + (Ec2^
        2)*"Dominance (DC)"*"Dominance (DC)" + (Ec2*(1-Ec2)*"Dominance
(DC)"*"Dominance (DC)"
        ))
        Units: Dmnl
        Proportion of payoffs which are either T or P.

(054)   Defection DD=
            "Defection (DD)" - (Ec2*"Defection (DD)"*"Full Contribution (CC)" +
Ec2*"Defection (DD)"
        *"Dominance (DC)")
        Units: Dmnl
        Proportion of payoffs that are either T or P.

(055)   Defection DO=
            "Resistance (DO)" - ((Ec2*(1-Eo2)*"Resistance (DO)"*"Full Contribution (CC)"
) + (Ec2*(1-Eo2)*"Resistance (DO)"*"Dominance (DC)"))
        Units: Dmnl
        Proportion of payoffs that are either T or P.

(056)   Defection TFT=
            "Reciprocity (TfT)"*"Defection (DD)" + ((1 - Ec2)*"Reciprocity
(TfT)"*"Dominance (DC)"
) + "Reciprocity (TfT)"*"Resistance (DO)"
        Units: Dmnl

Proportion of payoffs that are either T or P.

(057)   Denominator=
        Num CC+Num CD+Num CO+Num DC+Num DD+Num DO+Num TFT
Units: Dmnl
The sum of all numerators.

(058)   "DO-CC"=
        $Ec2*(1-Eo2)*R + ((1-Ec2)*(1-Eo2)*T) - Ko2$
Units: Value
Second-Level replication of Resistance (Full Opposition)
        interacting with Full Contribution (Full Cooperation). Following
        Runciman the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures, which,
        following Coleman include sanctions, distributed as power by
        institutions of production and distribution, coercion and
        persuasion.

(059)   "DO-CD"=
        $T-Ko2$
Units: Value
Second-Level replication of Resistance (Full Opposition)
        interacting with voluntary Contribution (Private Cooperation).
        Following Runciman the outcome is regarded as the net effect of
        inherent replication rates and social selection pressures,
        which, following Coleman include sanctions, distributed as power
        by institutions of production and distribution, coercion and
        persuasion.

(060)   "DO-CO"=
        $T - Ko2$
Units: Value
Second-Level replication of Resistance (Full Opposition)
        interacting with Acquiescence (Compliant Opposition). Following
        Runciman the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures, which,
        following Coleman include sanctions, distributed as power by
        institutions of production and distribution, coercion and
        persuasion.

(061)   "DO-DC"=
        $Ec2*(1-Eo2)*S + ((1-Ec2)*(1-Eo2)*P) - Ko2$
Units: Value
Second-Level replication of Resistance (Full Opposition)
        interacting with Dominance (Hypocritical Cooperation). Following
        Runciman the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures, which,
        following Coleman include sanctions, distributed as power by
        institutions of production and distribution, coercion and
        persuasion.

(062)   "DO-DD"=
        $P-Ko2$
Units: Value

Second-Level replication of Resistance (Full Opposition)
interacting with Defection (Full Defection). Following Runciman
the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(063)   "DO-DO"=
P - Ko2
Units: Value
Second-Level replication of Dominance (Full Opposition)
interacting with Dominance (Full Opposition). Following Runciman
the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(064)   "DO-TFT"=
"DO-DD"
Units: Value
Second-Level replication of Dominance (Full Opposition)
interacting with Reciprocity (Tit-for-Tat). Following Runciman
the outcome is regarded as the net effect of inherent
replication rates and social selection pressures, which,
following Coleman include sanctions, distributed as power by
institutions of production and distribution, coercion and
persuasion.

(065)   "Dominance (DC)"= INTEG (
Change in DC,
Initial DC)
Units: Dmnl
Relative frequency of practices of Hypocritical Cooperation as a
proportion of Total Frequency (= 1).

(066)   DOyield=
"Contribution (CD)"*"DO-CD" + "Defection (DD)"*"DO-DD" + "Reciprocity
(TfT)"
"DO-TFT" + "Full Contribution (CC)""DO-CC" + "Dominance (DC)"*"DO-DC" +
"Acquiescence (CO)"*"DO-CO" + "Resistance (DO)"*"DO-DO"
Units: Value
Weighted sum of the replication of Resistance (Full Opposition)
when Resistance (Full Opposition) interacts with each of the
other strategies. The outcome can be attributed to selection
pressures, payoffs or learned responses .

(067)   e=
1- Control
Units: Dmnl
The error or difference when the sum of all frequences does not
equal 1.

(068) Ec2=
          0.55
Units: Dmnl
The coefficient defining the relative efficacy (power) of
          sanctioning of defectors at the Second Level.

(069) Eo2=
          0.3
Units: Dmnl
The coefficient defining the relative efficacy (power) of
          weakening or neutralising sanctioning of defectors at the Second
          Level.

(070) F=
          0.6
Units: Dmnl
The coefficienct in the production function, used in this model
          when the coefficient is a constant.

(071) F2= INTEG (
          Change in F2,
                    F)
Units: Dmnl
Coefficient in the production functions, used in this model when
          the coefficient is a variable.

(072) FINAL TIME = 2000
Units: Iteration
The final time for the simulation.

(073) "Full Contribution (CC)"= INTEG (
          Change in CC,
                    Initial CC)
Units: Dmnl
Relative frequency of practices of Full Contribution (Full
          Cooperation) as a proportion of Total Frequency (= 1).

(074) Fx=
          IF THEN ELSE(Switch=0, F, F2)
Units: Dmnl
Coefficient in the production function, determined by either F
          (Switch = 0) or F2 (Switch = 1).

(075) Initial CC=
          ZIDZ(Num CC, Denominator)
Units: Dmnl

(076) Initial CD=
          ZIDZ(Num CD, Denominator)
Units: Dmnl
Initial frequency of voluntary Contribution.

(077) Initial CO=
          ZIDZ(Num CO, Denominator)

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Units: Dmnl
Initial frequency of Acquiescence.

(078)   Initial DC=
          ZIDZ(Num DC, Denominator)
    Units: Dmnl
    Initial frequency of Dominance

(079)   Initial DD=
          ZIDZ(Num DD, Denominator)
    Units: Dmnl
    Initial frequency of Defection.

(080)   Initial DO=
          ZIDZ(Num DO, Denominator)
    Units: Dmnl
    Initial frequency of Resistance.

(081)   Initial TFT=
          ZIDZ(Num TFT, Denominator)
    Units: Dmnl
    Initial frequency of Reciprocity.

(082)   INITIAL TIME = 0
    Units: Iteration
    The initial time for the simulation.

(083)   Kc1=
          1
    Units: Value
    Cost of contributing at the First Level

(084)   Kc2=
          0.3
    Units: Value
    Cost of contributing at the Second Level.

(085)   Ko2=
          0.3
    Units: Value
    Cost of opposing at the Second Level.

(086)   Koc=
          0
    Units: Value
    Cost of information required to coordinate action at the Second
          Level.

(087)   Level of Collective Good=
          $1 - (\text{Defection})^{Fx}$
    Units: Proportion of Total
    Level of Public Good Production, or proportion of the total
          value of the collective good that could be produced by full
          contribution.

(088)   Maximum F2=
                1.2
         Units: Dmnl [0,10,0.01]
         Maximum value of the exponent in the production function.

(089)   Mean Yield=
                "Contribution (CD)"*CDyield + "Defection (DD)"*DDyield + "Reciprocity

(TfT)"
         *TFTyield + "Full Contribution (CC)"*CCyield + "Dominance (DC)"*DCyield +
         "Acquiescence (CO)"*COyield + "Resistance (DO)"*DOyield
         Units: Value
         The weighted sum of the yield of all strategies multiplied by
                         the relative frequency of each strategy.

(090)   N=
                2
         Units: Actor [0,10,1]
         Number of actors in the local coalition.

(091)   Num CC=
                8
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of Full Contribution.

(092)   Num CD=
                5
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of voluntary Contribution.

(093)   Num CO=
                5
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of Acquiescence.

(094)   Num DC=
                8
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of Dominance.

(095)   Num DD=
                8
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of Defection.

(096)   Num DO=
                16
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of Resistance.

(097)   Num TFT=
                0
         Units: Dmnl [0,25,1]
         Numerator in the initial frequency of Resistance.

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(098)   P=

        0

Units: Value

First-Level or Structural influences on the replication of rates
of practices of Defection (Full Defection) interacting with
Defection (Full Defection). Following Runciman the outcome is
regarded as the net effect of inherent replication rates and
social selection pressures distributed as power by institutions
of production and distribution, coercion and persuasion. 'P' is
taken from the standard practice of referring to this cell as
Punishment in representations of the Prisoners Dilemma. That is
not applicable to other Games.

(099)   R=

        V-Kc1

Units: Value

First-Level or Structural influences on the replication of rates
of practices of voluntary Contribution (Private Cooperation)
interacting with voluntary Contribution (Private Cooperation).
Following Runciman the outcome is regarded as the net effect of
inherent replication rates and social selection pressures
distributed as power by institutions of production and
distribution, coercion and persuasion. 'R' is taken from the
standard practice of referring to this cell as Reward in
representations of the Prisoners Dilemma. That association is
not applicable to other Games.

(100)   "Reciprocity (TfT)"= INTEG (
        Change in TfT,
           Initial TFT)

Units: Dmnl

Relative frequency of practices of Reciprocity (Tit-for-Tat) as
a proportion of Total Frequency (= 1).

(101)   "Resistance (DO)"= INTEG (
        Change in DO,
           Initial DO)

Units: Dmnl

Relative frequency of practices of Resistance (Full Opposition)
as a proportion of Total Frequency (= 1).

(102)   S=

        (V*(1-("D/N"^Fx))) - Kc1

Units: Value

First-Level or Structural influences on the replication of rates
of practices of voluntary Contribution (Private Cooperation)
interacting with Defection (Full Defection). Following Runciman
the outcome is regarded as the net effect of inherent
replication rates and social selection pressures distributed as
power by institutions of production and distribution, coercion
and persuasion. 'S' is taken from the standard practice of
referring to this cell as Sucker in representations of the
Prisoners Dilemma. That association is not applicable to other

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Games.

(103) SAVEPER =
        TIME STEP
Units: Iteration [0,?]
The frequency with which output is stored.

(104) Switch=
        0
Units: Dmnl [0,1,1]
An on-off option to determine whether the exponent in the
        production function is constant or variable.

(105) T=
        $V*(1 - ("D/N"^{Fx}))$
Units: Value
First-Level or Structural influences on the replication of rates
        of practices of Defection (Full Defection) interacting with
        voluntary Contribution (Private Cooperation). Following Runciman
        the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures distributed as
        power by institutions of production and distribution, coercion
        and persuasion. 'T' is taken from the standard practice of
        referring to this cell as Temptation in representations of the
        Prisoners Dilemma. That is not applicable to other Games.

(106) "TFT-CC"=
        R - Koc
Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
        interacting with Full Contribution (Full Cooperation). Following
        Runciman the outcome is regarded as the net effect of inherent
        replication rates and social selection pressures, which,
        following Coleman include sanctions, distributed as power by
        institutions of production and distribution, coercion and
        persuasion.

(107) "TFT-CD"=
        R-Koc
Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
        interacting with voluntary Contribution (Private Cooperation).
        Following Runciman the outcome is regarded as the net effect of
        inherent replication rates and social selection pressures,
        which, following Coleman include sanctions, distributed as power
        by institutions of production and distribution, coercion and
        persuasion.

(108) "TFT-CO"=
        R - Koc
Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
        interacting with Acquiscence (Compliant Opposition). Following
        Runciman the outcome is regarded as the net effect of inherent

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replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(109)   "TFT-DC"=

$$Ec2*S + (1-Ec2)*P - Koc$$

Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
    interacting with Dominance (Hypocritical Cooperation). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(110)   "TFT-DD"=

$$P-Koc$$

Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
    interacting with Defection (Full Defection). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(111)   "TFT-DO"=

$$P-Koc$$

Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
    interacting with Resistance (Full Opposition). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(112)   "TFT-TFT"=

$$R-Koc$$

Units: Value
Second-Level replication of Reciprocity (Tit-for-Tat)
    interacting with Reciprocity (Tit-for-Tat). Following Runciman the outcome is regarded as the net effect of inherent replication rates and social selection pressures, which, following Coleman include sanctions, distributed as power by institutions of production and distribution, coercion and persuasion.

(113)   TFTyield=

    "Contribution (CD)"*"TFT-CD" + "Defection (DD)"*"TFT-DD" + "Reciprocity (TfT)"
    "TFT-TFT" + "Full Contribution (CC)""TFT-CC" + "Dominance (DC)"*"TFT-DC"
     + "Acquiescence (CO)"*"TFT-CO" + "Resistance (DO)"*"TFT-DO"

Units: Value

Weighted sum of the replication of Reciprocity (Tit-for-Tat)
when Reciprocity (Tit-for-Tat) interacts with each of the other
strategies. The outcome can be attributed to selection
pressures, payoffs or learned responses .

(114)   TIME STEP = 1
Units: Iteration [0,?]
The time step for the simulation.

(115)   V=
1.4
Units: Value
Full value of the collective, public or common good.
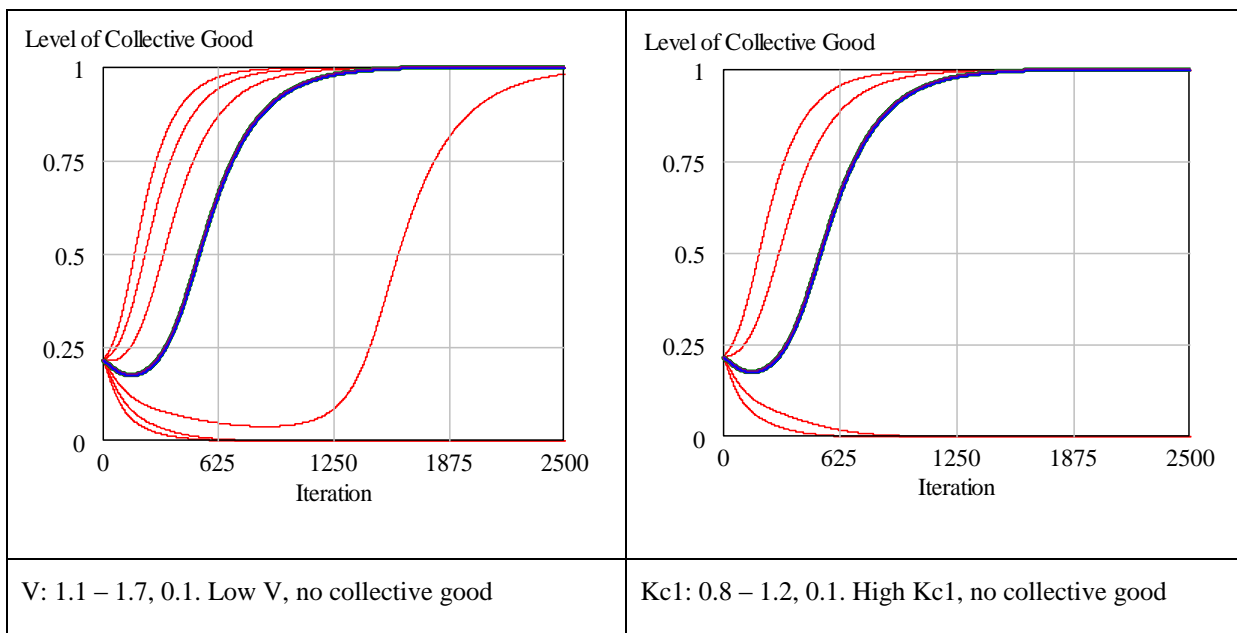
(116)   Z=
0.05
Units: Dmnl
Z is a sensitivity parameter representing the speed with which
population distributions change in response to different
pressures or payoffs.

Appendix 4: Marginal sensitivity in three regimes

Authoritarian

The reference mode is shown in the figure below and as a blue line in the charts. In each chart only the one parameter was changed across the range that is noted.

V: 1.1 – 1.7, 0.1. Low V, no collective good	Kc1: 0.8 – 1.2, 0.1. High Kc1, no collective good

Koc: 0.01 – 0.09, 0.01. Limit of cost increase

Kc2: 0.05 – 0.15, 0.01, Low cost, slower increase

Ko2: 0 – 1, 0.2. High cost, faster increase

Ec2: 0.3 – 0.7, 0.1. Upper limit for collective good

Eo2: 0 – 1, 0.2. Increase slows increase

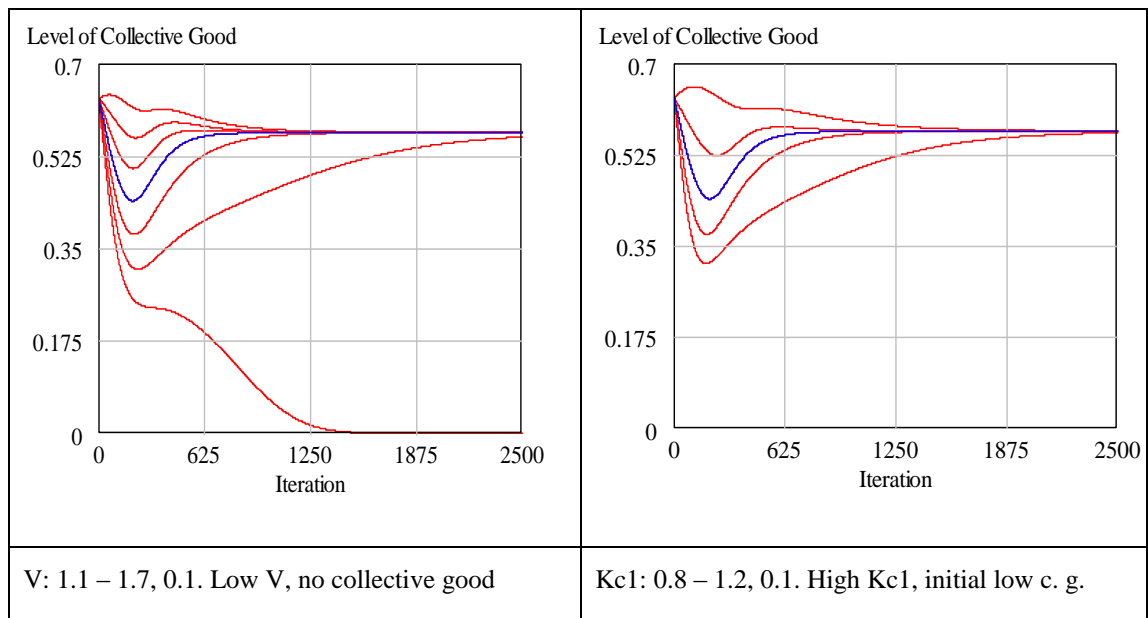F: 0.2 – 0.4, 0.05. High F slower increase in mid range
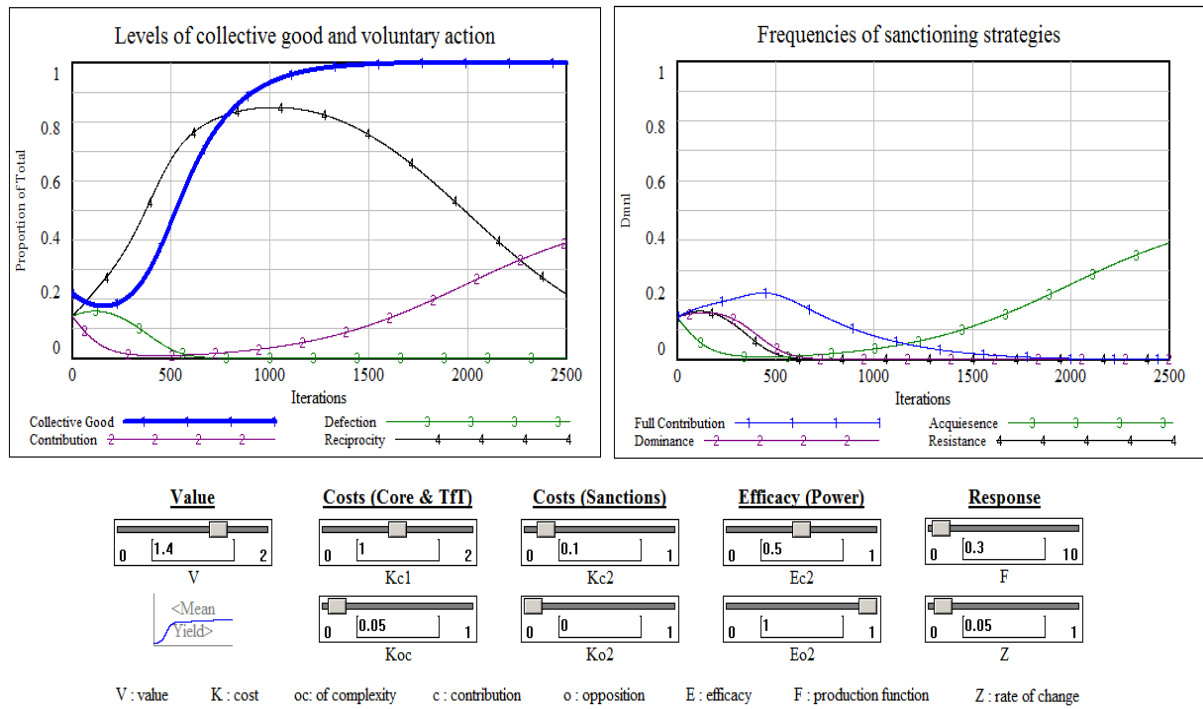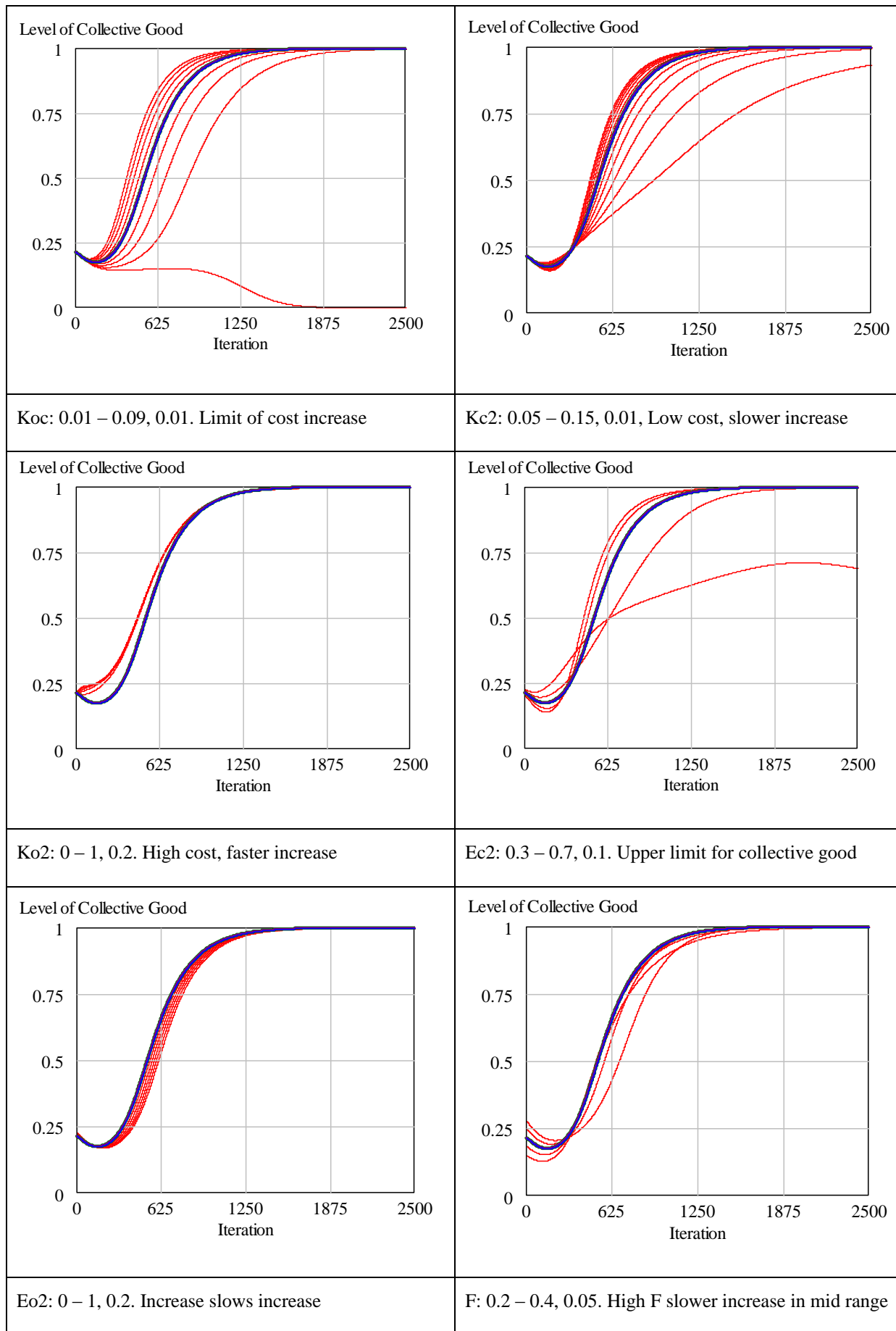
Liberal

The reference mode is shown in the figure below and as a blue line in the charts. In each chart only the one parameter was changed across the range that is noted. (c.g. = collective good, equil. = equilibrium)

Level of Collective Good	Level of Collective Good
V: 1.1 – 1.7, 0.1. Low V, no collective good	Kc1: 0.8 – 1.2, 0.1. High Kc1, initial low c. g.

Koc: 0.01 − 0.09, 0.01. Insensitive at margin

Kc2: 0.05 − 0.15, 0.01, High Kc2, initial low c.g.

Ko2: 0 − 1, 0.2. High cost, higher collective good

Liberal

Ec2: 0.3 − 0.7, 0.1. High efficacy, higher c. g.

Eo2: 0 − 1, 0.2. Lower efficacy, sooner to equil.

F: 1.12 − 1.32, 0.05. Low F, low collective good
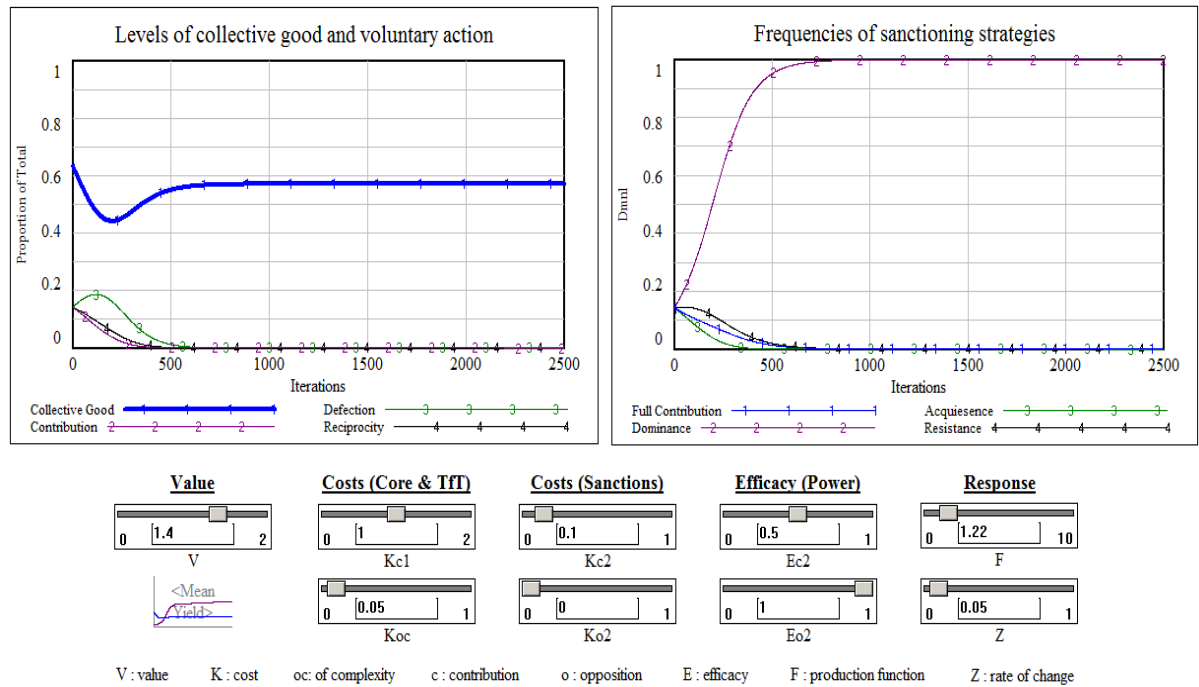
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Plural

The reference mode is shown in the figure below and as a blue line in the charts. In each chart only the one parameter was changed across the range that is noted.
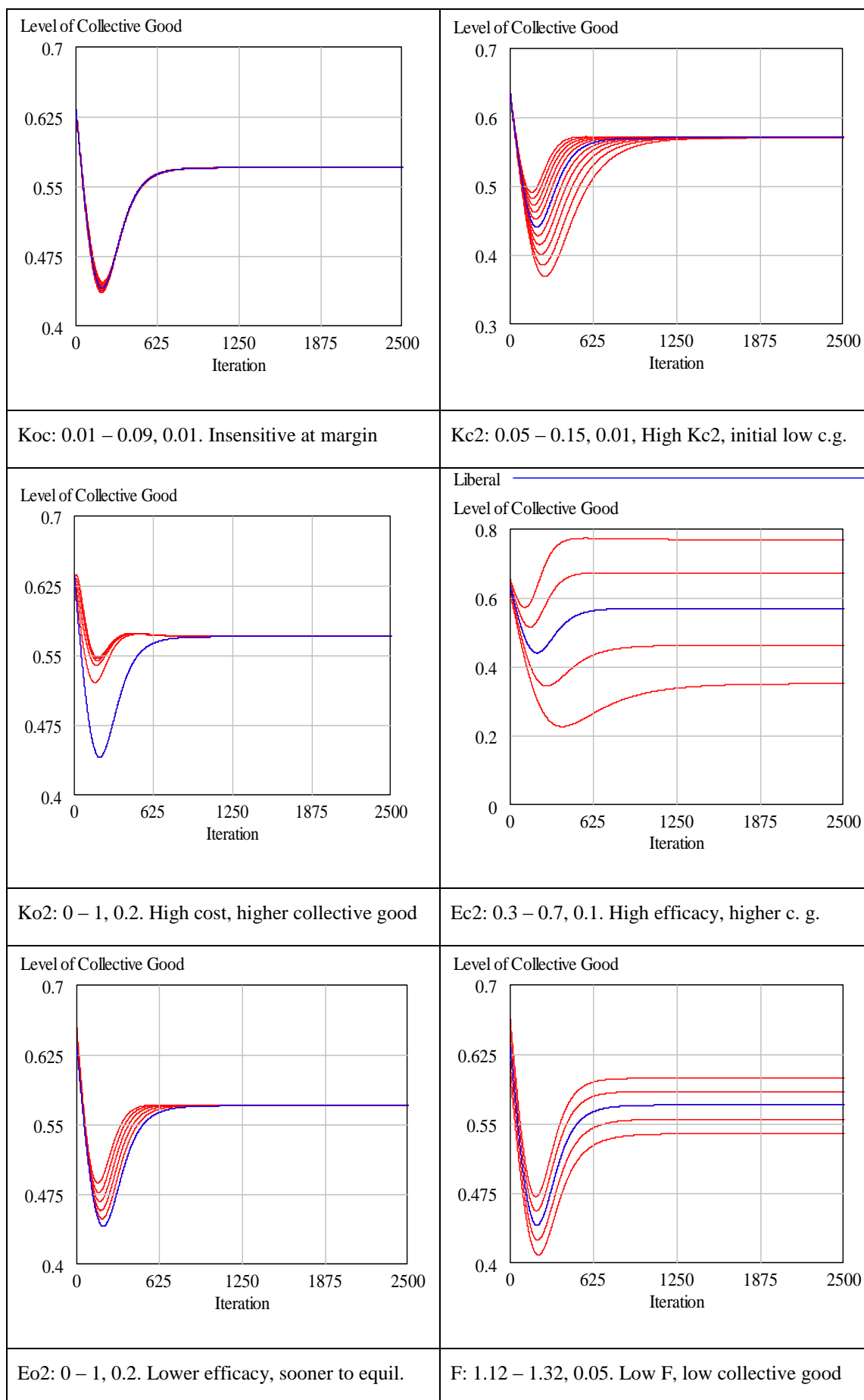

V: 1.1 – 1.7, 0.1. Low V, slower to equilibrium	Kc1: 0.8 – 1.2, 0.1. Lower value, higher trajectory

Koc: 0.01 – 0.09, 0.01. Insensitive at margin

Kc2: 0.05 – 0.15, 0.01. Lower cost, higher trajectory

Ko2: 0 – 1, 0.2. Higher cost, higher trajectory

Ec2: 0.3 – 0.7, 0.1. Low cost, low trajectory

Eo2: 0 – 1, 0.2. Higher cost, higher trajectory

F: 2.9 – 3.1, 0.05. Lower value, lower trajectory