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KEEPING IT REAL:

EXPERIMENTAL GAME THEORY AND SOCIAL ONTOLOGY

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This work contains no material that has been accepted for the award of another degree or diploma in any university, and to the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due reference is made in the text of the thesis.

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Introduction

GAME THEORY, EXPERIMENTAL ECONOMICS, AND SOCIAL REALITY

> *To put it bluntly, understanding why game theory does not, in the end, constitute the science of society (even though it comes close) is terribly important in understanding the nature and complexity of social processes*
>
> *– Hargreaves-Heap and Varoufakis 2004: 2*

This thesis will use experimental evidence on the ultimatum and public goods games to spark a discussion on the boundaries of game theory's usefulness. To aid this project, a critical realist perspective on the nature of social reality will be contrasted with the ontological presumptions of mathematical-deductivist methodology. In this way, the divergence between predictions and outcomes in each of these games will be revealed as symptomatic of a fundamental mismatch between the type of reality that is presupposed by the model, and the real nature of the reality to which it is applied. This has significant implications for the use of game theory in the social sciences in general, suggesting in particular that a consideration of ontology is vital for any theorist seeking to understand human strategic action in the real world.

This is not to reject the legitimacy of game theory as a potential tool for social enquiry. In defining its limits, this project seeks also to solidify the domain of game theory's validity. Game theoretic modelling extends utility optimisation models in order to take account of the possibility for another individual's choice making to impact upon one's own, and the contradictions that arise from this – both empirical and theoretical – have the potential to become a starting point for theorising rational choice and human reasonableness outside of the confines of a singular mathematical framework. Drawing on the work of Shaun Hargreaves-Heap and Yanis Varoufakis (2004: 3), this paper argues that game theory has the potential to expose the limited scope of rational agent models, creating a space to bring philosophy and social theory into economics. As the authors note, "…game theory [speaks] to some of the fundamental disputes in social science and as such it should be an aid to all social scientists. Indeed, for those who are suspicious of economic imperialism within the social

sciences, game theory is, somewhat ironically, a potential ally" (Hargreaves-Heap and Varoufakis 2004: 4). Game theory will be used in this way in the chapters that follow, as results from the ultimatum and public goods games guide analysis towards deeper questions on how individuals can form a reasonable choice in accordance with their perceptions of those they are interacting with.

It is therefore of primary concern for this thesis to fill a gap in the critical realist literature in regards to game theory. Critical realism holds most especially to the view that ontological neglect has led to 'the by-now-widely-recognised generalized explanatory failures' and 'lack of realisticness' pervasive in modern economics (Pratten 2014: 2). The school has developed particularly through the *Cambridge Social Ontology Group*, set up in part by Tony Lawson during the early nineties (Pratten 2014: 1). The group's approach derives from the view that reality exists beyond the events and experiences that constitute human perception, and that these unobservable elements of reality must impact our understanding of it (Pratten 2014: 2-3). Take, for example, an extract from a pamphlet circulated to advertise the group's first meeting (then called the *Cambridge Realist Workshop*):

> All that is presupposed is a commitment to the view that there exists a knowable (under some description) social reality and that economics should primarily address such matters as identifying and understanding real world economic structures, mechanisms, processes, and events, etc… The nature of economic reality bears upon both the types of theories we can legitimately entertain, as well as the methods of theory assessment that can be rationally supported (*cited in* Pratten 2014: 2)

Ontological questions therefore exist prior to, and inform, epistemological or methodological ones, the pamphlet continues. The heritage of Roy Bhaskar's philosophy of science shines through particularly strongly in this foundational idea. Bhaskar sought to provide a realist theory of science, by describing what the world would need to look like for scientific knowledge to be possible (Benton and Craib 2011: 124). To do this, he asks himself: "What are the conditions of the plausibility of an account of science?", prioritising the nature of reality from the outset (Bhaskar 2008: xxix). This is because for Bhaskar (1998: 25) the nature of one's object of study must determine how it will be understood: "Thus it is because sticks and stones are solid that they can be picked up and thrown, not because they can be picked up and thrown that they are solid". It follows that humanity is 'contingent', and

knowledge is 'accidental', as experience, research, and enquiry reach towards an understanding of a reality that exists beyond these processes (Bhaskar 1998: 25-6). This is why the pamphlet quoted above stresses the need to realign economic theory to economic reality. Using the foundations laid by Bhaskar, theorists from the *Cambridge Social Ontology Group* have argued that the insistence on mathematical formalism pervasive throughout modern economics has led to the primacy of methodology over ontology. Until this issue is rectified, economics will be prevented from realising its potential to be a truly scientific discipline (Lawson 2003: 22).

In this sense, critical realism has significant potential for unifying heterodox voices that seek to bring pluralistic methodology into economics (Lawson 1994; *see also* Downward and Mearman 2002). Particularly powerful is the concept of open-systems, which argues that reality is "structured, dynamic and highly internally-related system, amongst other things, whilst the conditions for achieving a local closure [of the form 'if *x* then *y*'] are seemingly rare" (Lawson 2003: 21). Using Bhaskar's (1998, 2008, 2011) ideas as a springboard, theorists such as Lawson are able to describe reality as being stratified along various levels of irreducible structures, mechanisms, powers and tendencies, which may 'underlie actual events and govern or produce them', despite not necessarily being observable (Lawson 1994: 514). As these layers of reality are often out of phase with one another, openness of outcomes occurs through their interaction along different ontological levels.

This provides solid foundations for a critique of the trend for modern economics to conceive of mathematics as being both necessary and sufficient for scientific analysis of the social realm. Deductive theorising of this sort requires agents to act as isolated atoms so that given some condition *x*, the same outcome *y* predictably follows (Lawson 2003: 14). Lawson (2003: 17, 22) suggests that without capturing the deeper tendencies or mechanisms underlying outcomes, models presupposing this type of closed-systems ontology require that chains of event correlations are ubiquitous in the real world, and this is causing a gap between the ontology of the model and the reality it is being applied to. "Mathematical-deductive methods have many desirable features", he accepts, "But 'fit' with reality matters too" (Lawson 2003: 22). It is therefore an ontological mismatch at the root of many (if not all) the contradictions arising from modeling in the mathematical mainstream, he argues (Lawson 2003: 11-21). Critical realism has the power to both understand this, and to draw out its implications for social theorising more generally.

Despite these considerable successes in generating sustained critique of the mathematical economics overall, critical realism has neglected a thorough analysis of game theory. The response tends to follow that of Tony Lawson, who – when talking about game theory at all – responds to these models in much the same way as he would for any formal analysis in modern economics:

> As far as I can see [game theory] is a formal modelling approach focusing on typically isolated worlds of optimising atoms "making" decisions in contexts where the anticipated decisions of other optimising atoms are considered. No societal constitution of individuals, and no real time or history [is considered] (Lawson 2009c: 105)

This is certainly an oversight. Game theory is fundamentally different to other branches of formal analysis in economics, because it allows for interaction to occur between optimising agents, and this means that the 'isolated worlds' of these models quickly become less closed off from the rest of social reality when played out in practice. Useful in its fallibility, game theory thus offers critical realism and heterodox economics the power to 'push against the boundaries of orthodox economics' (Stilwell 2011: 184), by revealing the contradictions that arise from the assumption of instrumental rationality in a social context (Varoufakis and Hargreaves-Heap 2004: 291-2, 299). As shall be seen, it therefore has potential to become a rich site of analysis for theorists interested in examining how a model's 'fit' to reality matters. While it is true that the type of reality that game theory is being applied to is fundamentally more open than its deductive structure can capture, as Lawson suggests in the quote above, there is potential for these models to form *a part* of a methodology for an understanding economic action that does take account of time, history, and social forces.

Research from experimental and behavioural economics is used extensively to aid discussion of such issues, as these fields create a direct link between the high theory of pure game theoretic models, and the reality of how these games are played. It is therefore a subsidiary aim of this thesis to highlight the ways that a focus on ontology can enrich experimental methodology, and better inform the behavioural project currently attempting to interpret the results that come from the lab and field. This is important, because the neglect of ontology in the mathematical mainstream of modern economics is leading to confusion over how a model can be either refuted or verified. Take the perspective of Levitt and List (2007: 153), for instance, who argue that, "The allure of the laboratory experimental method in economics is

that, in principle, it provides *ceteris paribus* observations of individual economic agents, which are otherwise difficult to obtain". This would imply that the reality of the experimental laboratory is a closed-system, filled with a collection of mathematically optimising agents, and completely isolated from external influence. Here, there is no mismatch between the ontology presupposed by game theoretic models and the reality they are being applied to, and a breakdown in the predictions of the model therefore says nothing about adequacy of its mathematical methodology. Through a better understanding of the nature of structure and agency, and use of critical realist ideas on openness and closure, this thesis will look at experimental results in a new way. This allows analysis to step outside of the ontological framework of mathematical theorising, in order to view, from afar, the boundaries of its usefulness. In this manner, the divergence between predictions and outcomes in the ultimatum and public goods games is described as being intrinsic to the models themselves.

The path of this thesis will create a narrative around experimental data on these games, using the ontology of critical realism to develop the implications of this for game theory in the social sciences more broadly. The first chapter outlines the two games that will be the point of contrast for game theoretic predictions and outcomes: the ultimatum and public goods games. Particularly emphasised throughout this chapter is the way that divergences from these models are context specific, as this implies that there are emergent social influences that effect strategic interaction in these games. This chapter also examines Matthew Rabin's (1993) *fairness equilibria* approach, as an example of attempts from within game theory to incorporate psychological payoffs into pure game theoretic models. The second chapter outlines the philosophy of critical realism, using this to explain results from the first chapter in ontological terms. Finally, the third chapter builds upon the previous two, in order to bring critical realism and experimental/behavioural economics into a frank conversation with one another. The aim of this chapter is to reveal where and how game theory can become part of a methodological toolkit that allows for ontologically conscious theories of economic behaviour.

Chapter One

THE ULTIMATUM AND PUBLIC GOODS GAMES: THEORY AND EVIDENCE

> *[If] experimental games are to be taken seriously, in that they capture aspects of economic reasoning relevant to real life… then the assumption that humans share the same economic decision-making processes must be reconsidered*
>
> *– Joseph Henrich 2000: 973*

This chapter will delve into the messy business of economics in the making, by closely looking at two famous examples of game theory's predictive failure in experimental settings. The first of these, the ultimatum game, models the strategic behaviour of individuals in a bargaining situation. The second, the public goods game, seeks to predict the outcomes of group cooperation when there are individual level incentives to free ride. Each of these games requires participants to utilize their social knowledge in order to make economic decisions, leading to wide discrepancies between the model and its outcomes. Before turning to a review on this empirical literature, a brief background on the relationship between theoretical economics and experimentation will be outlined.

A Short Introduction to Experimental Economics

The relationship between economic theory and economic experimentation is grounded in a much deeper-running debate on the nature of economics and its distinct role as a science of society. The fathers of game theory, Neumann and Morgenstern (1964: 4), argue that, "It is without doubt reasonable to discover what has lead to progress in other sciences, and investigate whether the application of the same principles may not lead to progress in economics also." They suggest that economics must look to the progress of 'mature' natural sciences such as physics, in order to emulate its methodology and generate objective knowledge on the nature of economic forces. They continue, "[It] would be very unwise to consider anything else than the pursuit of our problems in the manner which has resulted in the establishment of physical science" (Neumann and Morgenstern 1964: 4-5). Yet the objects

of study in economics are intrinsically different to the objects of study in physics, and this creates tensions between a 'scientific' economic method and its social focus. As shall be seen, the desire to create mathematically rigorous models of individual behaviour amongst economists wishing to emulate physics leads to inconsistencies between the reality presupposed by these models, and the reality to which they are being applied.

The role of experimentation in the pursuit of a cohesive science of society is tied up in this, as the link between social theory and social reality remains ambiguous. Some theorists argue that the nature of social reality is such that experimentation is impossible, implying that economics must find other ways to compare between abstracted models and their objects of knowledge. "Economics must be a non-laboratory science", says Richard Lipsey (1995), since "it is rarely, if ever, possible to conduct controlled experiments with the economy" (*cited in* Guala 2005: 2; & Starmer 1999: 3). Similarly, Samuelson and Nordhaus (1985) argue that, "economists … cannot perform the controlled experiments of chemists or biologists because they cannot easily control other important factors" (*cited in* Guala 2005: 3; & List 2011: 3-4). Yet, despite the pessimistic views of some, the groundswell behind economic experimentation has been increasing. "Economics has also been widely considered a non-experimental science, relying on observation of real-world economies rather than controlled laboratory experiments. Nowadays, however, a growing body of research is devoted to modifying and testing basic economic assumptions", stated the Nobel Prize committee in 2002, when awarding the top prize in economics to two experimental theorists (Nobel Prize Committee 2002). Empirical data from laboratory experiments is becoming a vital component of the assessment of the relevance of economic models to actual strategic behaviour across different contexts (Croson 2005: 131; Guala 2005: 3-6; Roth 2015a: 2-3; Samuelson 2005: 65; Starmer 1999: 2).

Views on how to interpret these results tend to vary according to theorists' position on the science question in economics more generally. According to theorists such as Ken Binmore (1999: F16) the aim of this enterprise must be to "settle down to the twofold role of consolidating economic theory in those contexts where it works fairly well, and providing a source of inspiration for revising the theory where it does not work so well." Alvin Roth (2002: 1341-2; 2015b) has a slightly different view, instead emphasising the role for economists to act as engineers, who design institutions for economic interactions and can utilise experimental methods as a tool for this purpose. As will be shown in the following chapters, these differences of opinion especially arise as economic experimenters are forced

to navigate the inconsistencies between the mathematically optimising individual of economic modelling, and its disordered, human counterpart. These contradictions will be explored by focusing upon two well-documented cases where the game theoretic model fails to have its predictions follow through in the lab: the ultimatum game and the public goods game.

The Ultimatum Game: Theory [1]

The ultimatum game examines the strategies of two individuals engaged in a two-stage bargaining process. The first player, the proposer, is provided with an endowment (usually a sum of money), which they must offer a share of to their partner, the responder. The responder is then given the option to either accept or reject the offered share. If it is accepted, the transaction goes ahead, and each player leaves with the amounts offered in the initial round. If it is rejected, the proposer loses their claim to the endowment, and both players receive nothing. Figure 1. (*see Appendix*) shows an example of this game, where the proposer is able to offer the responder a range of shares from zero to ten dollars, and the responder has the two discrete options: to accept, or to reject.

According to strict game theoretic reasoning, the threat of rejection is an empty one, since the responder considers any positive payoff as better than nothing. Using backward induction, the proposer should then be aware that even the smallest positive offer would be accepted. Pursuing their own material self-interest, they will thus offer the share that is the most in their favour, and this will then be accepted. This is called the sub-game perfect equilibrium point, and is a pivotal solution concept for games conducted in stages. For the game shown in Figure 1., the proposer will offer the responder one cent, and this offer will be accepted.

[1] The logic of this section is drawn from Colman (2008). All figures and examples are my own. For more information, see Henrich (2000: 973-4) and Roth (1995).

The Ultimatum Game: Evidence

The theoretical claims of the ultimatum game are not upheld by the experimental literature. In the laboratory, there has been overwhelming evidence to suggest that non-material concerns enter into the minds of individuals engaged in this payoff structure, generating wide discrepancies between the model's predictions and the outcomes of the game as it actually gets played. The first empirical test of this game was performed in Güth et al. (1982), where it was found that 36.7% of the endowment was offered on average by the proposer to the responder. These findings have subsequently been supported in numerous studies on the game, which tend to result in average offers of between 30-40%, a modal offer of 50%, and high rejection rates for offers below 20% of the original endowment (Henrich et al. 2005; Oosterbeek et al. 2004; Roth 1995; Solnick 2001; Thaler 1988). The authors of one meta-analysis on these games found that the behaviour of responders suggests they "care (a lot) about the relative amount they receive" (Oosterbeek 2004: 178).

While the experimental literature shows that the behaviour of individuals engaged in the ultimatum game differs from the predictions of the model, there is still substantial variation in how this divergence manifests. Eckel and Grossman (2001) find that women tend to make more generous offers than do men, and are more accepting of any proposed amount. Responders of any gender also tend to be less willing to accept lower offers from men than from women (Solnick 2001; Solnick and Schweitzer 1999). In one study, gender influences in an American lab also lead proposers to offer female responders shares that were ten percent smaller than those offered to men (Solnick 2001: 193). Men in the group were offered equal splits 82% of the time, while women were only able to gain an even share in 59% of cases (Solnick 2001: 192-4). Along similar lines, Solnick and Schweitzer (1999) found that physical attractiveness has a positive relationship with the level of endowment shared, and attractive proposers are also expected to share higher levels of their endowment in order for their offers to be accepted. High testosterone levels among responders have also been linked to increased rejection rates, suggesting that rejection of low offers derives from innate reputational management strategies (despite this occurring even in one-shot settings) (Burnham 2007).

Research into geographical differences in ultimatum game-play is also widespread, with some indication that these variations can be put down to the influence of culture. Chen and Tang (2009) found lower rates of rejection amongst Tibetan subjects compared to those who were ethnic Han Chinese, for instance. According to the authors, these rates were in keeping with the particular cultural traits of the two different groups (Chen and Tang 2009: 83). In a meta-analysis of ultimatum studies, Oosterbeek et al. (2004) found evidence for differences in responder behaviour across geographical contexts, with participants from Asian backgrounds tending to exhibit higher rejection rates than those from the United States. Similarly, those from the western parts of the US were much more likely to reject offers than those from the east (though in this case the authors couldn't put this down to any particular cultural norm) (Oosterbeek et al. 2004: 181, 184). More recently, analysis of evidence for a 'culture clash' between mixed cultural groups have shown that subjects from different backgrounds can have trouble coordinating their actions. Malaysian and British subjects were tested in homogenous and mixed settings, for instance, to show that between-cultural effects have a significant impact on the proposed shares of individuals in this game (Chuah et al. 2007). The authors reflected that, "Culture clearly matters in an economic context, but the interaction between culture and economic variables is complex and multi-faceted", which is a sentiment that appears to be shared by most theorists working on this issue (Chuah et al. 2007: 46).

In one of the most comprehensive studies conducted on this topic, Joseph Henrich gathered sixteen other experimental theorists to conduct a global investigation into ultimatum game behaviour amongst fifteen small-scale societies (Henrich et al. 2005). Comparing the results between groups, they not only found that the canonical model fails for every population studied, but also that deviations from self-interested choice themselves vary depending upon the particular cultural and economic influences on the individuals involved (Henrich et al. 2005). The authors argue:

> The social relations of daily life may lead individuals to generalize about how others are likely to act in novel situations… if there is a high level of cooperation in work or community, people may expect others to behave in a similarly cooperative manner [in bargaining contexts] (Henrich et al. 2005: 813)

This process of forming expectations in the ultimatum game leads to an integration of the economic and social factors of strategic decision-making, creating a gap between the

predictions this model and the actual behaviour of individuals facing its incentive structure. Another seminal work revealing this particular aspect of ultimatum game-play comes from Roth et al. (1991), who compared the outcomes of this bargaining game to that of a constructed market scenario across four different countries: Japan, Yugoslavia, the US and Israel. Both games had similar payoffs according to game theoretic modelling, yet the ultimatum game sustained significant non-equilibrium behaviour while the market game converged to predicted outcomes rather quickly (Roth et al. 1991: 1070-1). In addition to this, the decisions made by individuals under the market game did not vary much between countries, but in the ultimatum game there was significant variance between what constituted an 'acceptable' offer for responders, and the amount that was offered by the proposers (Roth et al. 1991: 1070). There therefore appears to be an element of sociality that is intrinsic to formulating appropriate action in the ultimatum game, which doesn't have as much of an effect when participants are engaged with market-based scenarios.

Roth et al. (1991: 1092) suggest that the ultimatum game's empirical results could be 'cultural in character', perhaps due to concerns for fairness on behalf of those engaged in bargaining contexts. They argue that the way the experiment was designed, with market scenarios acting as a control, implies that the differences in bargaining behaviour across countries "are not due to differences in languages, currencies, or experiments but may tentatively be attributed to cultural differences" (Roth et al. 1991: 1068). This hypothesis was later supported by the work of Stahl and Haruvy (2008), who found that the way games like the ultimatum game are presented systematically accentuates or mitigates the effects of social norms on behaviour. They suggest that this finding highlights the importance of the social context of decision-making in determining the best responses of individuals facing bargaining games (Stahl and Haruvy 2008: 293). These examples show that the social knowledge of individuals can be invoked with varying strength in different games. For proposers in particular, they are especially important for deciding on how much ought to be shared, in order for an offer to be accepted (Güth et al. 1982: 383-4).

This is most prominently shown where researchers combine experimental and ethnographic methods to gain insight into the way fairness concerns impact upon behaviour in this game. A great example of this comes from Gowdy et al. (2003), who combined economic experiments on bargaining games with survey responses, and anthropological analysis, to explain the cooperative choices made by participants from a rural Nigerian village. To do so, they contrasted results from the ultimatum game to those of the dictator game (where a

responder has no option but to accept any offer, and the proposer need not be concerned for the threat of spiteful rejection). In this case, the researchers found that the mean offers in the ultimatum game were 43% of endowment, which was only slightly higher than the dictator game at 42%. For both games, the modal offer was 50% (Gowdy et al. 2003: 472). In addition to this, out of 73 offers in the ultimatum game, only one was rejected (Gowdy et al. 2003: 472-3). The authors note that this behaviour cannot be explained as being economically rational in the canonical sense, but that the participants' decisions reflected the distinct features of West African society and culture (Gowdy et al. 2003: 470-1).

The importance of acknowledging the impact social norms on the strategic-decisions of individuals in the ultimatum game was supported further in follow-up interviews of participants. "Since the money was freely given, I believe I should give freely to someone else. I have an obligation to be generous", said one proposer. Another reflected, "With a free gift from God, it is necessary to share" (Gowdy et al. 2003: 473). Responders argued for the importance of accepting what they are given, with one person asserting, "a gift is a gift", and another saying, "Whatever is given to you, you must accept" (Gowdy et al. 2003: 474). Anthropological research conducted in the same study showed that the responses of participants genuinely reflected the values of the religious and spiritual beliefs quintessential to a rural, West African context (Gowdy et al.: 2003- 470-1). Individuals from this area subscribe to a belief in an afterlife where one's sins are punished after death, meaning that they might have avoided their sub-game perfect choices due to concerns that there would be costs associated with this later on (Gowdy et al. 2003: 476). Belief in the demi-god *Igwekala* (a mischievous character who brings retributive justice to those who cheat others) may have also impacted upon this (Gowdy et al. 2003: 476). Finally, the authors also point out that, with high levels of illiteracy in the village, significant emphasis is placed upon cooperation, honesty, and trust in order for transactions to take place (Gowdy et al. 2003: 470-1). Taken together, these social factors influenced the outcomes seen in the lab significantly, and led Gowdy and his co-authors to conclude that there was evidence of fairness concerns impacting economic behaviour (Gowdy et al. 2003).

Due to its ability to highlight the importance of these factors, the ultimatum game is one of the most famous examples of the divergence in outcomes that can occur between game theory as a theory, and game theory in practice. Its simplicity allows for a clear contrast between the theoretical predictions of the model, and the outcomes that actually occur when the game is played in different contexts. The substantial evidence shows that in bargaining environments,

the social networks involved in determining choices cannot be extracted and externalized, as there is a multiplicity of social, cultural and economic factors influencing the strategies of individuals involved in this game. This is particularly in determining what constitutes a fair share, as Gowdy et al. (2003: 471) argue: "The economic behaviour of the villagers… cannot be understood without some knowledge of [socially entrenched] institutions". The economic choices of participants must therefore be understood in terms of the particular historical and cultural context of the individuals involved, rather than solely as a function of their material self-interest.

The Public Goods Game: Theory [2]

Another example of how the tension between individual self-interest and social norms can effect game-play comes from the public goods game. This game is interesting because it extends prisoners' dilemma-style reasoning to a group situation, and also because it acts as a game theoretic justification for Hardin's tragedy of the commons (Ostrom 2000: 137). Unlike the ultimatum game, which is to be played in pairs, this model places a number of people together and asks them to work collectively. Each individual is given an initial endowment that they may choose to keep, or to use in order to contribute to a public good. The total of the contributions is then multiplied by a given factor (less than the number of individuals in the group, but more than one), and is then redistributed equally to each person playing the game, without reference to their original contribution levels. Equilibrium in this game occurs when no player contributes. In order to outline the reason for this, the rational choices of each player will be arithmetically deduced from a game theoretic perspective.

[2] Unless otherwise noted, the logic of this section is drawn from the chapter on public goods in Varian (1993: 578-601). All equations and examples are my own. For more information, see Fischbacher et al. (2001: 398-400) and Ledyard (1995).

In this game, the payoff to each player can be represented as follows:

$$\pi_i = x_i - c_i + \frac{w}{n}\sum_{j=1}^{n} c_j$$

Equation 1: Payoff to *Player i* in the public goods game. [3]

Intrinsic to this game is an incentive to free ride. Take the example of a public goods game with four people in the group, an initial endowment of ten dollars, and a multiplication factor of 2. Using game theoretic deductive reasoning, the solution to the model is found by first taking the position of one player facing this payoff function, and determining their rational strategy. Call this player *Player 1*.

If everyone (including *Player 1*) were to contribute their whole endowment, the payoff they receive will be:

$$\pi_1 = 10 - 10 + \frac{2}{4}[10 + 10 + 10 + 10] = 0 + \frac{1}{2}[40]$$

$$= \$20$$

Equation 2: The payoff to *Player 1,* if everyone contributes.

In this case, *Player 1* and the other participants each receive twenty dollars. However, if *Player 1* were to keep their endowment, *given that the others have already chosen to contribute*, they would receive:

[3] Where π_i represents the payoff to player i, x_i is the endowment provided to player i, c_i is the contribution made by player i to the public good, w is the factor the public good is multiplied by, n is the number of players and $\sum_{j=1}^{n} c_j$ is the total amount contributed to the public good. For this game to function, $\frac{w}{n}$ must be less than 1.

$$\pi_1 = 10 - 0 + \frac{2}{4}[10 + 10 + 10] = 10 + \frac{1}{2}[30]$$

$$= \$25$$

Equation 3: The payoff to *Player 1*, if they are the only free rider.

Player 1 would be five dollars better off compared to when they were contributing, since here they receive the gains from the public good whilst retaining their original private endowment. The other three players would receive fifteen dollars in this scenario, which is their share of the public good without any left over private endowment. Following similar reasoning, it is easily shown that *Player 1* is always better off not contributing, given any choice made by the rest of the group. In game theoretic terms, this makes free riding their dominant strategy.

The next step towards finding an equilibrium solution to this problem is to take the position of another player (call them *Player 2*) and find their best response to this game. Since game theory assumes perfect information, *Player 2* knows that it is in *Player 1*'s best interest to free ride. Given this, *Player 2* assumes that a cooperative solution to this game will not be sustainable, and it is therefore in their best interests to also free ride. A similar process of reasoning occurs for *Player 3* and *Player 4*, meaning that the unique solution for this game is complete free riding. The public goods mechanism will never get used, and the players leave with their private endowment only (in the example above, ten dollars). Perhaps counter intuitively, this occurs despite the fact that every individual involved could double their money if the group were to reach a cooperative solution to the dilemma.

The Public Goods Game: Evidence

The data on this game is very heterogeneous. As noted by Elenor Ostrom (2000: 138), "A substantial gap exists between the theoretical prediction that self-interested individuals will have extreme difficulty in coordinating collective action and the reality that such cooperative behavior is widespread, although far from inevitable". Particularly in non-repeated tests of the game, the hypothesis of complete free-riding is conclusively rejected (Chaudhuri 2011; Dawes & Thaler 1988; Ledyard 1995; Ostrom 2000). A survey of the empirical literature found that around 40-60% of the social optimum gets contributed in one-shot settings, with

declining levels of cooperation when the game is repeated (Ledyard 1995: 142). One of the most cited empirical investigations on this game comes from Fischbacher et al. (2001: 398), who used a strategy method to find that 50% of individuals are 'conditional cooperators', who will contribute more to the public good with positive contributions by their peers. However, the actions made by individuals within the group are rather varied, with 30% of individuals choosing their dominant strategy and free riding, 14% engaging in "humped" behaviour (where contributions initially increased in response to a growth in the total public good, only to drop off after a certain point), and the rest seeming to act at random (Fischbacher et al. 2001: 397-404). Contributions also tend to exhibit a 'selfish bias', where individuals will match the contribution levels of their partners by less than one-to-one (Fischbacher et al. 2001: 397-404; *see also* Cheung 2014: 129-153). This could account for declining contribution levels over time, as initially cooperative players become disappointed with the contributions of peers (Fischbacher et al. 2001: 403).

Another significant finding by the experimental literature on this topic has been evidence of a willingness to punish on behalf of the conditional cooperators, even when the cost to punish is high, and will not produce future material benefits for the individual (Chaudhuri 2011: 56-60; Gächter et al. 2008: 1510; Fehr and Gächter 2000; Fehr and Gächter 2002; Nikiforakis and Normann 2008: 363). Fehr and Gächter (2000: 980) suggest that this behaviour comes out of an aversion to being the "sucker" in social dilemma problems. Despite the addition of a punishment mechanism making no difference to the theoretical equilibrium of the game (if it is costly to the punisher, and reaps no material benefits, it should not be utilised), the addition of this function generates sustained contribution levels of between 50-95% of the original endowment (Fehr and Gächter 2000: 980). The authors of this study argue:

> The strong regularities observed in our experiments suggest that powerful motives drive the punishment of free-riders. In our view this motive is likely to play a role in many social interactions, such as industrial disputes, in team production settings, or, quite generally, in the maintenance of social norms. If, for example, striking workers ostracize strike-breakers… or if, under a piece rate system, the violators of production quotas are punished by those who stick to the norm… it seems likely that similar forces are at work as in our experiments (Fehr and Gächter 2000: 993)

Building on these results, Stephen Cheung (2014) extended the reach of this experiment to show that punishment increases not only with decreasing contributions of a target player, but also if the contributions of the other players in the group rise. This implies that the distribution of contributions within the group will have an effect on the decision-making of any individual within that group, perhaps as they indicate the strength of a social norm (Cheung 2014: 140; *see also* Nikiforakis 2010). Supporting the social norm hypothesis, divergences from the model are not consistent across different societal contexts, but manifest in different ways depending on the make-up of the team playing the game. It has been shown, for instance, that the rates of contribution to the public good vary depending upon cultural context (Anderson et al. 2011; Cadsby et al. 2007; Castro 2008; Gächter et al. 2010). Punishment also differs significantly across various social environments, with some groups from traditional, non-Western cultures consistently punishing overly *cooperative* behaviour (Gintis 2008; Herrmann et al. 2008).

The effect of gender is also significant, but difficult to pin down. Many experimental theorists working on the topic of public goods and gender are influenced by the work of Carol Gilligan (1993: 2), a psychologist who used interviews and surveys to suggest that the failure of women to fit into previous visions of human morality was not evidence of "a problem in women's development", but rather "a problem in the representation, a limitation in the conception of [the] human condition, [and] an omission of certain truths about life". Gilligan (1993: 6-8) argues that female voices often represent an alternative mode of thought, one where questions of morality are considered in light of their contextual and relational features rather than in terms of hierarchical individual rights. Her findings are important for understanding public goods provision, as different conceptions of fairness and cooperation generate discrepancies between male and female behaviour within this model.

A relational conception of morality is inherently unbounded and ill defined, and this makes it difficult to test for empirically. Certain authors, such as Brown-Kruse and Hummels (1992), interpret Gilligan (1993) to suggest that all-female groups ought to contribute higher levels to the public good than would an all-male group. To their surprise, they found the opposite to be true; men contributed at much higher rates than women did (Brown-Kruse and Hummels 1992: 257, 264; *see also* Andreoni and Petrie 2008). Other researchers, however, have interpreted Gilligan's (1993) work to imply that participants in all-female groups will be more responsive to the actions of others, which would lead to a faster coordination of behaviour towards equilibrium. Cadsby and Maynes (1996: 616) took this position, arguing that,

"[Gilligan's hypothesis implies] that females are better than males at interpreting and responding to the behavior, altruistic or not, of others in their group", whereas, "men are less likely to be influenced by what others are doing, more often pursuing a strategy seemingly unrelated to their group's dynamics". Later studies that permit a wide range of contribution levels have also led to higher rates of cooperation within all-female groups when compared to all-male, perhaps as this allows for the option of 'partial-defection' amongst less cooperative subjects (Nowell and Tinkler 1994: 33). Further, these discrepancies manifest in various ways depending upon the cultural context of the game, which means that the differences between men and women in public goods scenarios themselves change depending upon the particular gender norms that individuals have been exposed to in daily life (Cadsby et al. 2007).

These effects cannot be understood within the structure of the game, as they do not exist inside the confines of decisions made by isolated individuals acting solely upon self-interest. This is particularly the case since the decision of how likely one's partner is to contribute to a public good must be based upon an individual's understanding of those they are interacting with, and this knowledge often draws upon social norms in order to form expectations of probable outcomes. Externalising social phenomena from these choices makes it impossible for the public goods game – or the ultimatum game – to adequately capture this process as important to economic considerations.

The Slave of the Passions: A First Look at Game Theory and Social Norms

Neumann and Morgenstern (1964: 33) define a game as being an interaction between agents, whose actions are determined by a given set of rules, and whose choices combine to generate particular outcomes. As Hargreaves-Heap and Varoufakis (2004: 3) note, "one is hard put to find an example of social phenomenon that cannot be so described." Accordingly, game theory has often been viewed as a foundational concept for a 'science of society', one that has the ability to uncover the deepest workings of the social realm. Roger Myerson (1999: 1067), for instance, has argued that the formulation of the Nash Equilibrium concept was as 'fundamental and pervasive' to the social sciences as was the discovery of the DNA double helix to biology. Yet, the experimental evidence on the ultimatum and public goods games suggests that these models are still not capturing some essential aspect of economic interaction. The final section of this chapter will look at the underpinnings of game theoretic

reasoning, in order to begin to understand how this gap arises. An example of a mainstream approach to 'socialising' game theoretic models will also be examined.

Models of strategic decision-making in game theory are predicated on traditional utility theory, where individuals are 'instrumentally rational' and therefore make choices that optimize their outcomes, given a set of well-behaved preferences. [4] By extending this model to allow for the effects of another's decision-making on individual level outcomes, game theory creates images of social interaction developed out of purely 'micro' components. Jon Elster (1982: 477) touches on this idea, arguing that, "…game theory provides solid microfoundations for the study of social structure and social change". This feature leads Mark Blaug (2002: 39) to sardonically comment that these models are 'made to order' for modern economists, and that the supposed ability for game theory to explain all interaction through individual-level processes makes it 'the only game in town' for many in the mainstream.

According to Blaug (2002: 40-1), it was Milton Friedman's (1953: 3-43) famous essay on methodology that licensed the assumption of instrumental rationality. Friedman (1953) argued that even if such an assumption is unrealistic, this bares little impact on the validity of the model in question. Indeed, he suggested that reasoning from unrealistic axioms will often lead to more parsimonious or precise conclusions, and will build more robust models that can better abstract from complex reality (Friedman 1953: 14). Here, the legitimacy of a model is derived solely from its ability to 'stand the tests of time', by generating predictive outputs that can be empirically verified. An explanation for this view comes from Friedman's (1953: 19-20) well-known analogy for modelling the distribution of fallen leaves around a tree:

> I suggest the hypothesis that the leaves are positioned as if each leaf deliberately sought to maximize the amount of sunlight it receives, given the position of its neighbors, as if it knew the physical laws determining the amount of sunlight that would be received in various positions and could move rapidly or instantaneously from any one position to any other desired and unoccupied position… The constructed hypothesis is presumably valid, that is, yields "sufficiently" accurate predictions about the density of leaves, only for a particular class of

[4] A description of 'well-behaved' preferences is beyond the scope of this paper. Note, however, that this assumption of ordered preferences is required for any mathematical modelling of individual choice to take place. For more information, see Hargreaves-Heap and Varoufakis (2004: 8).

> circumstances… [Yet] in this example the "assumptions" of the theory will play no part in specifying [these circumstances]: the kind of tree, the character of the soil, etc., are the types of variables that are likely to define its range of validity, not the ability of the leaves to do complicated mathematics or to move from place to place

From this perspective, game theory as a science of social interaction need not hold explanatory power, so long as agents are acting as though they are instrumentally rational. Where this does not occur – as in the ultimatum and public goods games – this is an indication that there is an important piece missing from the model, rather than as definite evidence for a flaw in its structure. Responses to the discrepancy between a game and its empirical outputs therefore tend to work within the structure of game theoretic reasoning in order to refit the model to the data. This will usually involve adjusting a utility function to reflect non-material preferences alongside material ones. Once achieved, this new 'socialised' utility function can be optimised as normal, and strategic behaviour may once again be explained in terms of individuals' instrumentally rational choices.

One example of this comes from Matthew Rabin (1993), who incorporates fairness concerns into an individual's preference ordering. He argues, "Welfare economics should be concerned not only with the efficient allocation of material goods, but also with designing institutions such that people are happy about the way they interact with others. …If a person leaves an exchange in which he was treated unkindly, then his unhappiness at being so treated should be a consideration in evaluating the efficiency of that exchange" (Rabin 1993: 1283). Using the experimental literature on the ultimatum and public goods games to support his case, he suggests that individuals will sacrifice material payoffs in order to punish those they consider to be acting unfairly (Rabin 1993: 1283-4).

To model this, he created a *kindness function* that mathematically represents how much a person is willing to give up in order to respond to the intentions of their partner (Rabin 1993: 1286). In this model, individuals are maximizing their utility when they are balancing their material payoffs with their desire to be kind, or spiteful, to someone they perceive as being kind, or unkind, to them. In cases where the material stakes are small, he argues, this *kindness function* will create new 'fairness equilibria' that may differ from pure Nash equilibrium outcomes. This occurs at 'mutual-max' or 'mutual-min' points, where individuals are either maximising or minimising their partner's payoffs, given their beliefs about their partner's

behaviour (Rabin 1993: 1282). Rabin (1993: 1286) thus argues that the game theoretic model must be complemented with a psychological game, where an individual's expectations about their partner's motivations have implications for the final payoffs of the interaction. Returning to Friedman's (1953) analogy, Rabin (1993) might argue that the reason for the breakdown in a pure game theoretic model's predictions is due to an issue with the circumstances of its application, rather than with the model itself. For this reason, he reconstructs norms of fairness into an individualistic system where individuals act justly, but for purely self-interested reasons. His model need not hold any explanatory power in terms of realistically describing actual nature or source of concerns for fairness, so long as it improves on the predictive power of the original system.

By allowing an individual's rational decision to rely on their perceptions of the partner they are playing against, Rabin's (1993) approach could have serious implications for the use of game theory as a theory of social interaction more generally. As Hargreaves-Heap and Varoufakis (2004: 10-1) note, instrumental rationality derives from the Humean idea that 'reason is the slave of the passions', where reasoning becomes a guide for achievement of particular goals rather than a motivation for action in-of-itself (Cohon 2010). This entails an assumption that the actions available to an individual, and their process of choosing how to act, should not to affect the fundamental ordering of preferences that they're optimising over – the game being played ought not affect what each player desires. Yet, as Rabin (1993) has acknowledged, the intentions behind an action can affect a game's ultimate payoff structure. For the games examined above, this means that what might have been, and therefore the structure of the game being studied, is relevant to what players feel that they want. For Hargreaves-Heap and Varoufakis (2004: 33, 6), this implies that Rabin's (1993) psychological game theory approach should be taken a lot further, to suggest that the institutions of the game are constitutive: "the rules begin to supply the reasons for the action", they argue, and this challenges "even the possibility of describing a game's structure prior to understanding the social norms in which the players are entangled". This implies that the inability for game theory to explain action in the ultimatum and public goods games is indicative of contradictions intrinsic to the rational choice model that it is grounded upon. To break from these foundations, an analysis of the model's ontology will be required.

Chapter Two

CRITICAL REALISM AND MODERN ECONOMICS: LAWSON'S ONTOLOGICAL TURN

Elegant error is often preferred to messy truth.

– Richard Lipsey 2001: 169

This chapter will describe a critical realist perspective on the nature of social reality, in order to set up a new explanation of the gap between predictions and outcomes in the ultimatum and public goods games. It will first be argued that the insistence on using solely mathematical-deductivist models to understand strategic decision-making relies upon an implicit ontological presumption that event regularities are ubiquitous in the social realm. This position is contrasted to the ontology of critical realism, which asserts that reality is both structured and open. Looking at the issue of expectation formation in the ultimatum and public goods games will highlight the importance of the distinction between these two approaches, to show that mixed results on these models derive from a mismatch between the type of reality presupposed by their modelling, and the nature of the real social world.

Hammers and Nails: The Ontological Presumptions of Mathematical-Deductivist Models

Tony Lawson (2003: 22-4) argues that the empirical contradictions faced by mainstream economics derive from the field's insistence that mathematical reasoning must be the basis for all scientific enquiry into the social realm. In this context, he argues, it's difficult for economists to work out exactly where they're going wrong when their predictions fail, and the last place they would look is at the use of mathematics in the first place (Lawson 2003: 11). He points out a range of quotes from theorists of different backgrounds to support this claim, including one from Richard Lipsey (2001: 184):

> To get an article published in most of today's top ranking economics journals, you must provide a mathematical model, even if it adds nothing to your verbal analysis. I have been at

> seminars where the presenter was asked after a few minutes, 'where is your model?'. When [s/]he answered 'I have not got one as I do not need one, or cannot yet develop one, to consider my problem' the response was to turn off figuratively, if not literally, to walk out the door (*cited in* Lawson 2003: 4).

In the same article, Lipsey (2001: 184) goes on to suggest that this emphasis is also reflected in economics teaching, meaning that graduating students are often left with the impression that any problem that cannot be modeled mathematically is outside of the domain of economics. Lawson (2003) also draws on the academic experience of economist Diana Strassmann, who found that acknowledging the deficiencies in an economic model is widely considered 'a minor feat' at best and 'bad manners' at worst (Strassmann 1994: 153-4; *cited in* Lawson 2003: 6-7). To make a valued contribution, one must look to building upon the foundations of what has come before, to create new knowledge out of familiar prototypes: "And so goes the accumulated wisdom of properly taught economists, those who criticize without coming up with better models are only pedestrian snipers. Major scientific triumphs call for a better theory with a better model *in recognizable form"* (Strassmann 1994: 154, *cited in* Lawson 2003: 6, *emphasis added*). Lawson (2003: 8) argues that it is this feature – the insistence on using mathematics in economic theorising – that characterises the mainstream in modern economics. It is often taken for granted that this style of reasoning is always appropriate for, and essential to, developing economic theory he says, and it is this that is causing the explanatory and predictive failures of the orthodoxy (Lawson 2003: 11, 23; *see also* Pratten 2004: 37).

This is because these types of models over-rely on the ability for correlative event patterns to persist into the future (Lawson 2003: 17). An important aspect of Lawson's (1994: 510; 1997a: 17) position is an understanding that methodology and ontology are intrinsically linked, as the methods theorists use necessarily presuppose a particular conception of reality: "Any theory of knowledge… must assume, even if only implicitly, that the nature of reality is such that it could be the object of knowledge of the required or specified sort". He therefore disputes the claim that mathematics is merely an interpretative language that allows theorists to clearly formulate logical arguments (*see for example,* Clower 1995: 309). Mathematics, like any other methodological tool, must emphasise certain aspects of reality, and de-emphasise others, and it is therefore up to the theorist to determine whether its application is appropriate for the domain of reality being investigated. After all, one wouldn't use a hammer

to clean a window, as Lawson (2009b: 104) colourfully explains in an interview with the *Erasmus Journal of Philosophy and Economics*:

> Q: *Does the use of a hammer presuppose a nail? I do not know if all methods presuppose a strict ontology.*
>
> TL: *That is right, they do not. That is why I emphasise the kind of reality presupposed by given methods, and the like. The hammer does not presuppose a nail in particular, but, qua hammer, it does presuppose something that needs to be met with a specific kind of force, and, if the intention is not to break the object, then it presupposes something that can withstand the sort of force that can be exerted with a hammer. Certainly, if I say I urgently need a hammer, you can infer that the immediate task before me, i.e., the task for which I'm intending to use it, is not to write a book, cut a hedge, clean the window, and so forth…*

For deductivist-mathematical economics, Lawson (2003: 5) argues, the kind of reality presupposed is such that closed-systems (where event regularities of the form 'if *x* then *y*' can occur) are pervasive in the social world. This is because deduction works by drawing direct links from circumstances to outcomes, based upon a 'linking-law' [5] that matches a set of initial conditions to specified conclusions (Lawson 1997a: 16-9). To take the example of the ultimatum game, the initial conditions are the rules of the game (where the proposer is provided with an endowment that they must share, and the responder has the power to accept or reject the offer) and the linking-law is that each individual will use all available information to maximise their material payoffs. The conclusion that follows is that the proposer will leave the game with their endowment, minus the smallest amount possible (given to the respondent). Whenever individuals face these initial conditions, deductive reasoning requires that they will wind up with same outcome. We follow a clear path from beginning to end, pressed forward by chains of logical reasoning.

[5] As in the case of Friedman's sunlight maximising leaves, this linking law need not be realistic, so long as the outcomes it predicts do actually arise from the circumstances of interest.

Lawson (1997a: 38-9) argues that this type of ontological grounding forces theorists into shallow moulds that neglect the true nature of the objects of their enquiry. Much of the issue stems from what he sees as an erroneous view of causation, which derives from the position first outlined by David Hume (2007: 46):

> When we look about us towards external objects, and consider the operation of causes, we are never able, in a single instance, to discover any power or necessary connexion; any quality, which binds the effect to the cause, and renders the one an infallible consequence of the other. We only find, that the one does actually, in fact, follow the other

In "denying the possibility of the independent existence of things", Hume "restricts reality to objects of direct experience", Lawson (1994: 510) argues. If all that is real is that which we can sense, Hume's philosophy argues against the existence of underlying causes or mechanisms generating particular outcomes: "When we say, therefore, that one object is connected with another, we mean only that they have acquired a connexion in our thought" (Hume 2007: 55). In line with this, game theoretic reasoning builds knowledge of the world without a search for underlying causes, instead generating predictive models that make claims about the likelihood of a given outcome following a particular circumstance. If further information arises that contradicts our previous understanding, the model is revised, and is hoped to now be a better predictor than before. It is a framework of 'if *this* then *that*' statements, which need not seek deeper causal relationships between circumstances, laws, and outcomes.

In addition to this, Lawson (2003: 14) argues that the mathematics of these models requires individuals to act as isolated atoms that "exercise their own separate, independent and invariable (and so predictable) effects (relative to, or as a function of, initial conditions)". This is in order to ensure that an individual placed in a set of initial conditions will reach a specified conclusion. For game theory, this implies that individuals must optimise their payoffs with reference to their partner's action only in the impact it has on their own final outcomes. For instance, the deduction of equilibrium in the public goods game relied upon each player performing an arithmetic calculation of their monetary payoffs, and acting to maximise them under the assumption that their partners are behaving in the same way. Without regard for the social context of the game, the public goods model asserts that any group of individuals placed within its incentive structure will always reach same outcome.

Under this system of theorising, the nature of reality presupposed is therefore such that event regularities of this sort are ubiquitous, and closed-systems modelling has (at least some) relevance to what actually occurs in the social realm.

Thus despite attempts to characterise mathematical modelling as a neutral tool of analysis, this methodology cannot side-step the ontological foundations of its structure. In fact, mathematical-deductivist reasoning has the strong presupposition of a closed-system, where chains of correlative event patterns of the form 'if *x* then *y*' are pervasive in the social realm. By contrasting this implicit ontology to the true nature of social reality, a new perspective on the reasons for the mixed empirical results on the ultimatum and public goods games can be found.

Issues with Closed-Systems Ontology in an Open-Systems World

According to Lawson (2003: 22), the universal application of models presupposing a closed-system is preventing economics from progressing as a discipline. For one thing, the type of reality they apply to only exists in very rare cases, he argues:

> Thus our best explanation of the widespread failures of economics (as well as the fictions that are abound) is just that the mathematical- deductivist or closed-systems modelling methods are often applied to materials for which they are unsuited. It is conceivable, indeed… that the set of social situations for which they are appropriate is not very large at all (Lawson 2003: 21)

The mismatch between the ontology of mathematical-deductivist models and the reality of the social realm is blocking economic theories from saying anything about what occurs in real world (Lawson 2003: 22-4). Without recognizing the true nature of the objects of study in economics, and designing methodology based upon this knowledge, economic modelling will fail to explain, predict or otherwise illuminate how individual action actually takes place in social reality: "Indeed, I will suggest that the formalistic modelling endeavour mostly gets in the way of understanding", states Lawson (2013: 760).

The philosophy underpinning this claim is that of critical realism, which, in contrast to Hume, directly links an understanding of causality to a non-empiricist ontology. This position was developed particularly through Roy Bhaskar's search for a realist philosophy of science. To do this, Bhaskar (2008) started by asserting that perception, observation and experimentation give access to structures that exist independently of human understanding. It follows from this, he argues, that the nature of causal laws must be such that they are expressions of the tendencies of things, rather than simply patterns of observable events (Bhaskar 2008: xxxi). According to Bhaskhar (2008: 1-2), for scientific knowledge to be possible, causality must exist outside of just being 'a connection in our thought', since without acknowledging the independence of causal mechanisms we cannot sustain the assumption that the laws uncovered through experimentation are universal or enduring beyond their appearance in a laboratory. There is an ontological distinction between events and causal laws, Bhaskar (2008: 2) says, and it is up to the researcher to responsibly utilise observable events in order to discover clues about the true nature of their underlying relationships (Jessop 2005: 43).

Without explaining the deeper mechanisms that create relationships between events at the empirical level, Humean causality lacks the flexibility required for the development of a true understanding of human action in its social context. Instead, Bhaskar's (2008) ontology captures those elements of social reality that are unobservable or unseen, but are nevertheless real (Benton and Craib 2011: 124-5). Using transcendental reasoning (where a given phenomenon is examined to provide insight into the circumstances that allowed it to occur), Bhaskar (2011: 21-4) argues that reality must be stratified over various levels of events, tendencies and mechanisms, in order for scientific enquiry to be able to produce knowledge. In particular, he suggests that there are three levels of ontologically distinct phenomena in the world: the *empirical* level of experience or observation, the *actual* level of events, and the *real* level of mechanisms, powers, and tendencies (Benton and Craib, 2011: 125-6; Bhaskar 2008: 2; Jessop 2005: 41). These stratifications of reality influence and are built out of one another, but each one is irreducible to the next (Bhaskar 2008: 2-3). The nature of reality is therefore inherently open, as interactive causal mechanisms operate over different ontological levels in non-predictable and non-reducible ways (Bhaskar 2008: 3).

Margaret Archer (1995) takes Bhaskar's work on scientific research, and uses it to develop a realist philosophy of social science. She calls this the 'morphogenic approach': "The 'morpho' element is an acknowledgement that society has no pre-set form or preferred state:

the ‘genetic’ part is a recognition that it takes its shape from, and is formed by, agents, originating from the intended and unintendeded consequences of their activities”, she explains (Archer 1995: 5). She suggests that Bhaskar’s conception of stratified reality allows for a picture of human activities that incorporates ‘emergent’ phenomena, where social interaction has the potential to generate structures and mechanisms that exist in Bhaskar’s level of the *real* (Archer 1995: 50-1). Although constituted by individuals, these deeper aspects of reality exist beyond the aggregate of human agency; they are ‘more than the sum of their parts’ and therefore cannot be reduced back to individual action. She gives the example of the division of labour, which produces higher productivity, reflects back upon its component parts (in reproducing monotonous labour) and has causal powers (in the differential wealth of nations), but which cannot be reduced to the productive capabilities of individual workers in isolation (Archer 1995: 9). This is especially the case where social positions develop out of particular combinations of individual interaction, she argues, as these bestow particular powers and capacities onto individuals as a result of their relationship to others (Archer 1995: 51; *see also* Sayer 1992: 119).

Throughout the body of his work, Lawson draws on ideas from Bhaskar (2008; 2011) and Archer (1995) in order to develop a critical realist critique of ontological presumptions of mathematical-deductivist reasoning. The most important implication of this position is that it reveals reality to be fundamentally open, implying that a methodology requiring closed-systems will be unable to identify the true causal relationships underlying outcomes. Social reality, in particular, is highly inter-relational, since (nearly) everything is constituted relative to its position amongst other things (Lawson 2009b: 114). According to Lawson (1997b: 106), “Two objects can be said to be internally related if they are what they are by virtue of their relationship to one another.” In terms of inter-related social positions (such as those between a landlord and a tenant), each individual’s action is constrained and informed by its relation to another’s, and this imparts emergent causal relationships that underlie individual behaviour (Lawson 1994: 521-2; Lawson 1997b: 105-6). Since individuals can simultaneously inhabit multiple positions, Lawson (1994: 522) argues that this conception “renders intelligible the often noted, but reputedly difficult to sustain, sense of a group or collective interest and thus the basis for a theory of collective action”, while allowing “the possibility of a conflict of interest at the level of the individual”. This leads to openness in individual decision-making, as human behaviour becomes situated in a stratified reality, where a multiplicity of interactive social mechanisms generate event-level phenomena in largely non-predictable ways:

> If any agent in the theory could do other than some given y in specific conditions x – either because the agent is intrinsically structured and can just act differently each time x occurs, or because the agent's action possibilities are affected by whatever else is going on – the individuals of the analysis could not be said to be atomic, and deductive inference could never be guaranteed (Lawson 2003: 14)

An ontological stance that exists in the form of chains of events (such as the isolated decisions of atomistic individuals) can therefore sit only on top of social reality, without capturing the important effects of the deeper social mechanisms that are the true causal factors linking correlated outcomes.

In the same interview as the one quoted above, Lawson (2009b: 107) provocatively states, "I believe that an emphasis on prediction, *in a world that is clearly open*, is an aberrant form of behaviour that itself requires explanation, possibly a psychological one" (*emphasis in original*). By relying on prediction for validation, mathematical-deductivist reasoning based upon 'parsimonious', unrealistic assumptions relies upon the ability for systems of correlated events to be remain stable into the future. Yet, as Andrew Sayer (1992: 2-3) notes, "social science has been singularly unsuccessful in discovering law-like regularities", and this is an "inevitable consequence of an erroneous view of causation". Stressing the role of prediction in an open and structured reality can only scratch the surface of what is actually occurring when, for instance, individuals face the payoff structure of the public goods game. The atomistic, closed, and ontologically shallow nature of this model renders its outputs frail, as they cannot adapt to any shift in the underlying mechanisms shaping the way events derive from circumstances to outcomes.

Critical realism thus suggests that the enduring objects of social knowledge exist beyond the empirical level of observation, meaning that the search for stable correlations of events is neither necessary nor sufficient for theoretical progression in economics (Bhaskar 2008: xxxi; Lawson 1994: 518; Sayer 1992: 3). The deductive nature of game theoretic reasoning, relying as it does on atomisation and isolation in order to create statements of the form 'if *x* then *y*', cannot capture the structured openness of social reality, and therefore struggles to adequately account for this. The mixed results emanating from the experimental work on these games is

thus symptomatic of a fundamental mismatch between the ontology of the model, and the reality it is being applied to. This is the reason that experimental economics consistently finds divergences from the theory, and without a break from Humean-positivist ontology, the issue will never be resolved. In short: to justify theorising a relationship between circumstances and outcomes, we must move beyond models of the form "if *this* then *that*", towards explaining the reasons for outcome occurring. Identifying the qualitative nature of social objects, and discovering the relationships that allow particular causal mechanisms to take shape, is an essential part of this process.

A model, under this framework, is no longer judged by its predictive power, but by its ability to adequately explain the causal relationships underlying correlated events (Sayer 1992: 1-4). Unlike the mathematical-deductivist reasoning of game theory, this process seeks to explain why an outcome eventuated, rather than how it came about. In so doing, it has the potential to describe the deeper aspects of social reality that inform and constrict individual agency in scenarios described by the ultimatum and public goods games, and draw out the implications of this for economic action in the social world. It follows that if we wish to better understand the process and outcomes of strategic decision-making in the real world, this question: '*why*?' must take a greater place at the core of economic theory.

Game Theory and Social Expectations: The Ontology of Structure and Agency

As hinted at in the last chapter, there is a tension between game theory's rational choice foundations, and the goal for it to become a universal model of strategic interaction. Having outlined the ontological position of Tony Lawson and the critical realist school, this tension can now be explained in terms of the nature of reality presupposed by the mathematical structure of these models, and the reality to which they are being applied. The mechanics of interaction in the ultimatum and public goods games requires that rational players seek to maximise their own outcomes, with the knowledge that their partners will behave in the same way. In the public goods game, for instance, this meant that the cooperative outcome was logically untenable, as each individual had a dominant strategy to free ride and this was common knowledge. Since group outcomes are reduced back down to atomistic individual-level optimisation processes, acting in the collective interest has no meaning in a game theoretic scenario, and the public goods mechanism is not utilised. Yet, by allowing another's

choices to impact upon the outcomes of participants' decision-making in the experimental lab, the atomisation of individuals breaks down when these games are played out in reality. In particular, beliefs about one's partner must enter into the individual's optimisation process, and this creates openness when choosing a suitable action within these games.

If individuals had entirely material preferences, this process would be straightforward logical deduction based upon quantifiable outcomes. However, as soon as immaterial preferences begin to impact upon individual payoffs, agents must use their social knowledge to make guesses at how their partner will choose to act, and this opens agency to interactive social mechanisms lying at deeper levels of social reality. This is a problem for the ultimatum and public goods games, because it appears that individuals consistently refer to 'socially anchored scripts' as a means of determining the best choice to make – especially in conditions of interactive uncertainty (Beckert 2009: 251; Jagd 2007: 79). This idea comes out of the French economics of convention movement, which suggests that economic action is predicated on socially-based expectation formation, as individuals make guesses about how their partner will behave: "The empirical description of the institutional context of action, [and] the conventions drawn upon by actors, then becomes a crucial element in understanding the conditions of agreement between actors", states one theorist (Jagd 2007: 78; *see also* Diaz-Bone and Salais 2011). In this way, the interaction involved in game theoretic scenarios creates an arena for interactive social mechanisms, meaning that models based on closed-system presumptions are being applied to an open-system reality.

For one thing, this implies that in certain contexts social 'scripts' become vitally important to informing what makes a reasonable decision. To return to Gowdy et al.'s (2003) study in rural Nigeria, for instance, the decisions of individuals operating in this social context were informed by their social knowledge of the individuals they were playing against. In this particular example, high shares coupled with low propensities to reject were unexplainable from a self-interested model, but exhibit exactly the norms and preferences of the group involved. The decision to share high levels of endowment was reasoned for in terms of the particular cultural, religious and social institutions prevalent in the group, rather than a fear of costly rejection (Gowdy et al. 2003: 470-1). In fact, the importance of social structure in shaping rational choice was evident in each of the experiments from last chapter. This is because individuals engaged in the structure of both games must guess at how their partner will react to their own strategy, and impacting their reasoned decision on how much they ought to share or contribute. It can be shown, for instance, that an individual engaged in a

four-person public goods game with a doubled public good would be made no worse off by contributing their whole endowment if they can be sure that at least one other person will too. Their decision on how likely this is to occur must necessarily be based upon their social knowledge of the individuals they are engaging with. Similarly in the ultimatum game, even an entirely self-interested proposer must consider the fairness concerns of their partner, lest they have an overly unequal offer rejected out of spite. The outcomes of the game will thus vitally depend upon the circumstances of its application.

This observation becomes even more significant when combined with a critical realist conception of the relationship between structure and agency. By viewing the nature of reality as quintessentially open and structured, Bhaskar (2008, 2011) is able to describe social relations as being mutually constitutive and transformative. He notes, "Society is both ever-present condition and continually reproduced outcome of human agency: this is the duality of structure" (Bhaskar 2011: 92). It is obvious that if individuals were to disappear, so too would all social structure. Yet, at the moment of each individual act, social structure is given, immutable, and informs rational choice (Jessop 2005: 42). Thus while structure and agency are ontologically distinct, each relies upon the other for its formation; we are, in Archer's (1995: 2) words, both free and constrained. Lawson (1994: 520) describes this idea as follows:

> Because social structure depends upon human agency, it cannot be treated as fixed. At the same time, neither can it be treated as the creation of individuals, for individual intentional action presupposes its prior existence. Structure then can be neither *reified* nor interpreted as a *creation* of individuals. Rather the relevant conception here must be of *reproduction* or *transformation* – individuals reproduce or transform social structure, which, at the moment of any individual act only, can be treated as given (*emphasis in original*).

Just as the grammatical rules of a language are provided prior to each speech act, social structure pre-exists individual choice. At the same time, speakers of a language may transform its rules and expression, and in a similar way, agents have the capacity to rework the structures that their actions are founded upon (Bhaskar 2008: 187-8).

This idea echoes the concept of emergence, and it has significant implications for closed-system models of strategic choice in distinctly interactive contexts. By framing rationality in terms of the self-interested pursuit of one's own goals, game theory is able to retain its ontological closure. Agents in these models act as isolated atoms that bounce off of each other with a singular motivation for every choice they make, which keeps the deductive elegance of 'if *x* than *y*' statements functioning. The cost to this elegance, however, is that the models created cannot adequately capture a sense that individual action is both distinct from, and intertwined with, social context. If game theory provides the 'microfoundations' for an analysis of social phenomena, it does so by disaggregating social processes into distinct parts that can be pieced together through the sum of individual actions. This is a type of explanatory 'upward conflation' (from individuals to social structure), which will necessarily neglect the significance of emergent phenomena in both constraining and informing individual choice (Archer 1995: 8).

As touched upon the previous chapter, Rabin (1993) falls into this trap. Though acknowledging the effect of social norms on economic decision-making, he does so within the same closed-system ontological framework of game theory, and therefore winds up in contradictory loops when the model attempts to account for the relationship between structure and agency. At the very least, subsuming moral action into an individual's utility function – where material and non-material preferences are equally judged according to the positive impact they have upon the individual in isolation – seems to negate the very purpose of acting in an honourable way in the first place (Hargreaves-Heap and Varoufakis 2004: 17). Individuals can, and do, reasonably choose to act in accordance with social norms as a way of "following good behaviour", and as a "self imposed behavioural restraint you accept in your choice of what to do", rather than out of a desire to achieve positive personal outcomes (Sen 2009: 193; *see also* Hargreaves-Heap and Varoufakis 2004: 284). This conception reinforces the idea that individuals have the capacity to engage in socio-economic activity in a purposeful way, while recognizing that just as men 'make their own history' in circumstances already existing, economic actors make economic choices that are constituted by, and also redevelop, their given cultural and societal circumstances.

To take this further, the concept of a psychological game, epitomised in Rabin's (1993) *fairness equilibria* approach, reveals the limited ability for models based upon instrumental rationality to adequately describe the relationship between agents' beliefs, motivations and desires. In Lawson's terminology, Hargreaves-Heap and Varoufakis (2004: 291-2, 299) argue

that the deductive linking-law described by traditional game theory (that players act as if they were instrumentally rational) must give way to a conception of human reasonableness that takes account of the openness of individual decision-making. "Good social theory demands an historical explanation of the source of agents' beliefs and, therefore, of their motivation (including their pay-offs)", they argue, and this requires a better understanding of how the choices individuals make are entwined with the circumstances that they are made in (Hargreaves-Heap and Varoufakis 2004: 284). This gets back to the variability of the data on the ultimatum and public goods games: individuals did not 'deploy the same cognitive machinery' when approaching these tasks, but responded in terms of their knowledge about the structures and relationships within the group (Henrich 2000: 973). Despite being ontologically distinct from emergent structures, the rationality of action is found to be inseparable from the social context in which it is formed.

"The more ambitious game theory becomes", Hargreaves-Heap and Varoufakis (2004: 33) muse, "the less able it is to avoid… philosophical 'complications'". Instrumental rationality is tied to a particular closed-system view of human social interaction, one that is predicated by a Humean conception of reality as being understandable through the mapping of correlative event patterns. As shown throughout this chapter, the mathematical-deductivist reasoning that this licenses requires the nature of social reality to be such that agents act as if they were isolated atoms, without deeper structures affecting the outcome that is generated from any given circumstance. This becomes a particular problem for game theory when the interaction involved requires that individuals are forming beliefs about the motivations of their partner, since this introduces social norms into the process of strategic decision-making and invokes the irreducible relationship between structure and agency. The gap between theory and reality is in the ultimatum and public goods games is thus rooted in the difference between the ontology of these models, and the context that they are played out in.

Chapter Three

GAME THEORY AND SOCIAL ONTOLOGY: SEEKING POINTS OF RECONCILIATION

> *My aim… is not to narrow down the range of methodological options by attempting to prohibit a particular method. Rather it is to widen the range of possibilities through criticising the fact that… the particular method in question is currently and often unthinkingly universalized. The goal… [is] a pluralistic forum where explicitly prosecuted ontology and critical reflection can take their place amongst all the conceivable components of economics as social theorising.*
>
> *– Tony Lawson 2003: 27*

This chapter will argue that critical realism and experimental game theory have the potential to extend and inform one another, leading to richer models of economic decision-making in its social context. It will be shown that this can help behavioural theorists working with experimental data to move beyond an over-focus on the strict replicability of results for establishing the validity of a given model. Instead, the test of a model is to be grounded in its ability to reveal the deeper causal mechanisms underlying observed outcomes. In order to establish whether game theory is capable of being used in this way, the final section of this chapter will return to an analysis of open and closed systems. Moving beyond a dualistic definition of the two, the possibility for a range of open and closed systems will be explored, in order to suggest that the ontological mismatch between a model presupposing closure and open social reality will generate worse symptoms in some cases than others.

The Two 'Souls' of Behavioural Economics

Critical realism can help experimental and behavioural economists to consistently explain, understand and learn from empirical results on the ultimatum and public goods games. This is vitally important, as there is currently significant confusion over how to view the mixed results coming out of experiments from around the world, especially in regards to the way these relate to the rationality principle that game theory models are grounded upon. Part of the issue is that experimental results in economics suffer from the Duhem-Quine problem, where tests of a particular hypothesis must also incorporate auxiliary or background assumptions

that support the idea in question (Blaug 1992: xiv; Dow 2013: 29; Guala 2005: 54; Starmer 1999: 21). This problem means that tests which at first glance dispute the rationality principle could actually be said to have disproved a number of supporting assumptions, such as the stability of preferences, or the assumption that material payoffs override immaterial ones.

In addition to this, the neglect of a consideration of the ontological presumptions of game theoretic modelling is leading to significant confusion over how the formal theory of these models relates to what occurs in the real world. For some theorists, game theoretic models are simply tautologies that outline the logical outcomes arising from a set of given axioms (*see* Binmore 1999; Clower 1995; Hausman 2003; Luce and Raiffa 1957). In this case, the model itself cannot be falsified, but is a normative tool outlining the principles of rational action. Where its predictions do not align with outcomes, the model's axioms need only be 'tweaked' in order to take account of the different preferences informing rational choice. For other theorists, however, the legitimacy of game theoretic models must be established with reference to their practical relevance for researchers and policy makers (*see* Roth 2002; Smith et al. 1994; Tversky and Kahneman 1989). Falsifiability is often claimed to be an important determinant of the validity of a model, in this view. Taking a critical realist position helps theorists to reconcile these inconsistencies, by providing a new perspective on the link between theory, experimentation and reality.

Without engaging in questions of ontology, game theory's link to empirical reality is left unclear. For some theorists, such as Ken Binmore (1994), game theory is an exercise in logical reasoning, and cannot therefore be empirically falsified. He argues, "Mathematical theorems are tautologies. They cannot be false, because they do not say anything substantive. They merely spell out the implications of how things have been defined." The underlying propositions of game theory, he suggests, "have the same character" (*cited in* Guala 2006: 241). Similarly, Bianchi and Moulin (1991: 185) suggest that game theory is a "syntax articulating the vocabulary of interdependent rationality", which implies that the model itself is not refutable: "game theory *per se* is no more empirically verifiable than an alleged translation from English into an unspoken language". It is only in the application of the theory that empirical data can ultimately be used to determine the models applicability (or non-applicability) to particular circumstances, they argue (Bianchi and Moulin 1991: 185). This line of view is similar to that of Milton Friedman's (1953), discussed in the first chapter of this paper. These models can only be validated in terms of formal logical reasoning. Whether

they say something truthful about what occurs in reality is another matter (Colman 2003: 142).

The trouble with this perspective is that, once it is accepted, it is easy for experimental results to retrospectively be rationalised in terms of the parameters of the model. For game theorists in particular, the rationality principle is retained as an essentially unquestionable law, located in the Lakatosian 'hard core' of the theory (Dow 2013: 32-5; *see also* Haussman 2012). Bianchi and Moulin (1991: 187) express this notion, with reference to Aumann's (1988: 1) idea that "game theory without rationality sounds like geology without rocks, or biology without life". From this perspective, the mixed empirical results on the ultimatum and public goods games say nothing about the structure of the models themselves, but rather that they are simply missing key variables or relevant inputs. Binmore (1999: F16) certainly takes this stance, exclaiming that in these types of scenarios "we should not expect economic theory to be predicting well anyway!"

Binmore, and others, have argued that participants in these experiments must have been engaged in a different game to the one that the experimenters thought they were playing (*see* Guala 2006: 247). Following from Rabin's (1993) argument that non-material preferences should be included in an individual's utility function, this school of thought contends that experimental results simply show that material payoffs do not make up the entirety of an individual's preference ordering. In particular, social preferences should be included in the model, if these are what rational agents are truly optimising over. To quote Bianchi and Moulin (1991: 185): "if the theory tells us that outcome A will occur *if that players perceive it in that way*, the burden of verifiability is passed on to the psychologist… to detect in what mood… our players are" (*emphasis added*). With the benefit of hindsight, theorists from this school can explain any outcome by arguing that the purposeful actions of each player were, by definition, in their best interests; all intentional action is necessarily rational.

The danger of this view is that it is easy for mathematical modelling to be pursued for its own sake, without necessary reference to what occurs in the real world. For one thing – despite the claims of economists subscribing to Friedman's brand of positivism – it is rare for economics' tautological models to be abandoned on the basis of poor predictive records (Blaug 1992:

105-6, Dow 2013: 27). Mark Blaug (2002: 36) famously describes this contradiction as being a 'sickness' afflicting the discipline:

> Modern economics is sick. Economics has increasingly become an intellectual game played for its own sake and not for its practical consequences for understanding the economic world. Economists have converted the subject into a sort of social mathematics in which analytical rigour is everything and practical relevance is nothing

He shows that many economists 'pay lip-service' to falsificationism, while actually practicing verificationism in terms of seeking empirical evidence to justify theoretical statements (Blaug 1992: 241; Dow 2013: 28-9). As a result, economics has become a 'normative policy science', he states, that adorns itself with the fig leaf of falsifiability (Blaug 1992: 238). Game theory thus spews forth the "virtually endless conceptual proliferation of fundamental notions of rational behaviour" without ever connecting these notions to what actually occurs when agents make economic decisions in the social realm (Blaug 1992: 240).

In fact, proponents of the tautology thesis tend to push against an over-emphasis on debunking economic theory in experimental economics (*see* Binmore 1999). As Sheila Dow points out, there is a "tension in mainstream economics between empirical testing and formalism" (Dow 2013: 31). Experimental and behavioural theory came out of the realist notion that economic models based upon material self-interest are poor explainers and predictors of actual behaviour. Despite this, Dow (2013: 31, 37-9) says, most are unable to explore the implications of this observation fully, as they are restricted by adherence to the rationality principle that licenses mathematical modelling. Dow (2013) suggests that the mathematical-deductivist framework of mainstream economic models forces experimental and behavioural economics to shield the optimisation framework from critical view, in the Lakatosian 'hard core' of the theory. If only behavioural economics were "to emphasise consistency with their observations of reality over the internal consistency (and universality) of the rational optimising framework, there would be much more scope for theoretical developments which are not *ad hoc* adjustments to existing theory" (Dow 2013: 37). While restricted to a mathematical methodology, the behavioural approaches must either "[define] actual behaviour as rational by redefining the constraints", or else label the behaviour as irrational and therefore non-economic (Dow 2013: 38). The choice is then to treat seemingly non-self interested behaviour as a stochastic, exogenous 'shock' variable to the model, or else

to rework the axioms of rational choice to run the optimization process over a new set of preferences. Neither, Dow (2013: 38) argues, actually challenges the mainstream theory.

This is causing a split in the behavioural project. Luca Zarri (2010) posits that behavioural economics has 'two souls': one that seeks to retain the rationality principle, and one that operates outside of it. Dow (2013: 40-1), similarly, speaks of 'old' and 'new' behavioural economics, with the latter being comprised of a project to incorporate non-material interests into the framework of rationality provided by the mainstream. Guala (2006) provocatively penned a paper entitled, 'Has Game Theory Been Refuted?', and answers that yes, it most certainly has. Against this, Binmore (1999, 2006) suggests that when experiments are run correctly, results do conform to game theoretic outcomes. Plott and Smith (2008: ix), argue in the introduction to their extensive handbook on experimental economics: "while traditional economics produces a sharp and precise theory, experiments may produce results that vary from strong support to little or only 'partial' support of the relevant theory". The cup is often either 'half-empty' (or half-full) in regards to the usefulness of results for theory testing, they continue, "with authors varying as to whether they emphasise the former (or the latter)" (Plott and Smith 2008: ix). These theorists are at the forefront of the tension arising from closure presupposed by these models, and the open reality of the social world. So long as they remain loyal to the strictures of mathematical-deductivist theorising, this tension will never be resolved.

Beyond Correlation: A Critical Realist Perspective on Experimental Results

By approaching reality from a critical realist perspective, the falsifiability question can be side-stepped, with the aim to use experimental data in order to create realistic models that have practical significance for the specific context they are being applied to. In so doing, contradictions in the behavioural project can be reconciled. This is more in line with the goals of Alvin Roth (1991: 113), who argues that, "a measure of the success of microeconomics will be the extent to which it becomes the source of practical advice, solidly grounded in well tested theory, on designing the institutions through which we interact with one another". Experimentation here becomes one way for social theorists to engage with open social reality, and begin to search for potential causal relationships underlying events. This is close to Blaug's (1992) concern for re-establishing a theory's link to reality, but does not rely upon the strict replicability of empirical results to generate validation. Instead, the experimenter

looks towards deeper layers of social reality, with the aim of uncovering the relevant causal mechanisms affecting outcomes.

Integral to this process is the method of retroduction. To do this, economic theorists must echo Bhaskar's process of transcendental reasoning, in order to propose the hypothetical structures or mechanisms that might give rise to certain phenomena of interest. This methodology uses analogy and metaphor to make informed guesses at the potential reasons for observed occurrences. Once the hypothesised mechanism has been developed, further tests and research are conducted in order to determine whether the supposed relationship does actually exist (Benton and Craib 2011: 123; Bhaskar 2008: 4; Jessop 2005; 43; Lawson 1994: 515; Lawson 1997a: 30). Miller and Tsang (2010: 145) describe this concept: "Testing a theory's explanatory power involves going beyond deducing a theory's implications and seeking empirical data regarding those implications; it requires checking whether the proposed theoretical mechanisms account for the data". By seeking to establish causality with reference to deeper levels of reality, the social theorist is thus able to capture effects that are non-measurable and non-empirical. This allows theory and experiment to be linked in a dynamic process of theory construction, without closing one's modelling to the open nature of social reality (Benton and Craib 2011: 123; Price 2005: 88). Instead, Leigh Price (2005: 87) argues that the output of a theoretical model is weighed against its ability to "[do] a good job of accounting for the evidence and… [provide] us with appropriate ways to act". He continues:

> There is a kind of non-vulgar pragmatics at work in [retroduction], because the best explanation is that which 'works for us', that is, we take the evidence available to us and retrospectively suggest non-empirical, antecedent structures and mechanisms to explain that evidence. Like a crossword… (Price 2005: 88)

The mixed empirical results of the ultimatum and public goods games, in this view, are situated in the structured and open context of social reality. When faced with these outcomes, we must engage with retroductive, 'as if' reasoning to begin to understand what factors might be impacting upon the decision-making of individuals facing these payoff structures. Rather than seeking an elegant, closed solution to this question, theorists may need to provide partial explanations, utilize formal and/or non-formal methods, situate empirical results in wider discussion, and let go of the desire to prioritise predictive power.

This may sit uncomfortably with theorists accustomed to the clarity and (apparent) universality of mathematical modelling. As a consolation, however, under this approach the breakdown of correlations is no longer the death knell for a model, but could be suggestive of the existence of countervailing mechanisms operating over the domain of interest. Price (2005: 88) argues that this stance derives from Bhaskar's rejection of the idea of ontological monovalence, where it is asserted that the only objects of interest in reality are those that are positive. Instead, he argues that absence, nothingness, and negative spaces ought to be considered relevant to understanding the social world (Bhaskar 1993: 406, *cited in* Price 2005: 88). In certain circumstances, other influences may block the empirical manifestation of real mechanisms, creating a shadow at the level observable events. Lawson (1994: 517) describes this in terms of the gravitational pull on an autumn leaf that is being held back from falling: "On this transcendental realist view, for example, a leaf is subject to the gravitational tendency even as I hold it in the palm of my hand". In this case, the breakdown of a correlation at Bhaskar's (2008: 2) *empirical* level may not necessarily signify the non-existence of a causal mechanism at the level of the *real*. Further explanation will be required before a conclusion can be drawn.

Empirical results on the ultimatum and public goods games therefore do not refute the existence of a causal mechanism related to self-interested optimisation with certainty, but rather could suggest that it became entwined with other operative mechanisms upon its culmination in open empirical reality. This is an understanding that encapsulates both 'souls' of behavioural theory, because the choices of individuals are understood as the outcome of an interweaving of self interested and non-self interested preferences. The mechanisms that are able to shine through most strongly will depend upon the context of the game, meaning that in some cases the self-interested approach to modelling will be more appropriate than in others. To take the example of the public goods game, recall that contributions displayed a 'selfish bias' that led to the erosion of cooperation when run repeatedly without punishment. The rate of deterioration shifted depending upon the gender make up of the game, with the possibility of this having to do with differences in the way men and women think about morality. Here, self-interested optimisation processes interacted with causal gender mechanisms, leading to discrepancies in the way different groups diverge from the pure self-interested model. This does not imply that individuals are not motivated by self-interest to some degree, but rather that there is a plurality of reasons for action, resulting in the mixed outcomes seen in the experimental lab.

By letting go of the search for strict event regularities and instead looking to establish plausible causal explanations for given phenomena, critical realism is redefining the role for experimentation in the social realm. Nikos Siakantaris (2000: 275) argues that, "Experimental economists attempt to gain control over numerous factors in order to produce a situation of well-defined, measurable and stable event regularities of the form: when event x, then event y". Achieving such closure would undermine the validity of the results outside experimental environments, since the artificial nature of the setting would no longer match that of the outside world (Siakantaris 2000). While this claim might be a little too strong – certainly there are theorists in experimental economics who do not operate in this way – it highlights the need for a consistency of approach that takes account of the nature of the social reality being experimented upon.

This is especially the case since achieving such closure is likely impossible (Archer 1998: 190; Pratten 2004: 39). The creativity and reflexivity of individuals engaging with causal mechanisms in the social world means that the underlying laws of particular social realities can never be truly isolated, and empirical-data gathering in the social realm will need to take account of this, in order to be useful (Archer 1998: 190). Lawson (1997a: 205) argues that 'contrast explanation' is one way of conducting critical realist experiments on open-system reality, as a way of avoiding these issues:

> Experimental control frequently takes the form of comparing two different groups or populations with common or similar histories and shared (if non-constant) conditions, excepting that one group is 'treated' in some definite way that the second *control* group is not. Alternatively put, such experiments consist in observing two (or more) groups of 'participants' experiencing broadly similar conditions excepting (at least) one factor which is varied over the two groups in a controlled way

He gives the example of testing for the effects of a fertiliser over the yield of plots of land in a field (1997a: 205). Given that the background factors affecting yield are relatively similar across the entire field, the fertiliser may be applied to one (or a few) plots, and not the others. The difference in output between the two can then tentatively be attributed to the addition of the fertiliser. As Lawson (1997a: 205) notes, "The aim is to link specific effects to a particular causal factor by having it operate in one of the two sets of situations, but not to the other". Rather than positing 'whenever *x* then *y*' and searching for a contradiction to this, the

question now becomes: 'in situation *x*, why do we get *y* and not *z*?'. This is a process that does not require complete experimental closure, and can operate within an open-system context (Downward & Mearman 2007: 94; Lawson 1997a: 205-8; Lawson 2003: 88; Lawson 2009a: 409; Pratten 2007: 485-6).

In a few cases, experimental theorists are operating in a way similar to this. Joseph Henrich (2000), for instance, uses contrastive results to gain insights into the fairness concerns of individuals across geographical contexts (*see also* Henrich et al. 2005, Henrich et al. 2010b). In a sense, he turns Lawson's approach on its head, by taking a single test and applying it to contexts with different background variables. He then applies ethnographical, anthropological and sociological evidence to explain experimental outputs in terms of cultural and social factors. Experimenting on the ultimatum game in this manner, he has been able to show that results gleaned from an American undergraduate population are not broadly representative of all human strategic choice making, as has been a long-standing assumption in both psychology and experimental economics (Henrich 2000, Henrich et al. 2010a, Henrich et al. 2010b). His findings push theorists to justify any universalist claims, or else establish the boundaries of their models. Recognising the extent of human diversity does not mean abandoning the quest to understand human nature. "To the contrary", Henrich and his colleagues (2010a: 29) note, "this recognition illuminates a journey into human nature that is more exciting, more complex, and ultimately more consequential than has previously been suspected". Grounding behavioural responses to experimental literature in critical realist ontology would help to establish the reasons for variable social influences in different contexts, while guiding theorists to determine the appropriate methodology for the social reality being investigated. This can bring researchers towards a richer understanding of human nature and economic action, as foreseen by these theorists.

Debates on the Nature of Openness and Closure: Formalism's Role in Social Enquiry

In order to draw out the implications of empirical results on the ultimatum and public goods games in ontological terms, this section will return to an analysis of open and closed systems. As was argued in the previous chapter, a central tenet of the critical realist position is the assertion that reality is intrinsically open. From this stance, the mathematical-deductivist theorising of modern economics is critiqued as being mismatched to the reality of the social

world, and the role for prediction in theories of behaviour is minimised. Yet semi-stable correlations do occasionally bubble to the surface of social reality, where patterns of events can be reproduced fairly consistently. Lawson recognises these phenomena as 'demi-regularities', and concedes that they can be a starting point for enquiry into the social realm (Lawson 1997a: 205-8; Lawson 2003: 82-4; Lawson 2009a: 32-33). For theorists such as Andrew Mearman (2005: 65-7), Sheila Dow and Victoria Chick (2011: 371-2), the acknowledgement of these demi-regularities is a reminder that openness and closure are not duals, but that there exists in reality a range of different combinations of the two (*see also* Pratten 2007: 474; Hodgson 2009). By looking at the differences and similarities between Lawson and these theorists, a role for formalism and deductive reasoning in modelling strategic behaviour can be identified.

Following Mearman (2006), Chick and Dow (2011) argue that the *Cambridge Social Ontology Group* over-focuses on event-level outcomes when defining closed-systems. According to these theorists, the Cambridge group identifies closed-systems with the existence of event regularities of the type 'if *x* then *y*'. Whenever these regularities cannot be said to occur, the system is found to be open (Chick and Dow 2011: 370-1, 378; Mearman 2006: 50-2). Mearman (2006: 53) strongly criticises this definition, arguing that:

> This confusion of closure and its evidence is potentially serious. The claim conflates the empirical with the real; this is known as *empirical realism*, a flattening of ontology. It also suggests that the *epistemic fallacy* has been committed: what exists is reduced to what is known. It also suggests *actualism*, defined as the denial of the existence of underlying mechanisms and acknowledges only actual events or experiences. Empirical realism, the epistemic fallacy and actualism are all explicitly denied and rejected by [critical realism]. These contradictions arise here because of the event-level definition of closed systems

According to Chick and Dow (2011: 373), focusing upon the conditions of closure – rather than the empirical outcomes of closure – can help to resolve these apparent contradictions. Here, closed and open-systems are no longer duals, but may blend into one another depending on the nature of the objects of study (Chick and Dow 2011: 346, 366-7). They assert that "While any system that is not closed is therefore open, no system is perfectly open. There is scope for a wide range of types and degrees of openness" (Chick and Dow 2011: 374). Different types of openness will result from the characteristics of the reality being studied,

which may fit into some of the conditions for openness, while not conforming to others. This leads them to describing reality as a 'spectrum' of openness and closure, where some aspects of reality are more open than others (Chick and Dow 2011: 367).

In actual fact, Lawson (and the Cambridge school along with him) would dispute the claim that his definition of closure is based primarily upon the existence of event regularities. As Vinca Bigo (2014: 468) describes, "to identify any thing, including a system, according to one of its features is not *per se* to reduce that thing to its features". She argues that a closed-system, for the Cambridge group, is actually a system in which event regularities are able to be generated (though the existence of event regularities may lead to the diagnosis of a closure) (Bigo 2014: 467, 470-2; *see also* Pratten 2007: 489). Bigo (2014: 476) uses this understanding to describe a picture of openness and closure that is rather similar to Chick and Dow's (2011):

> Just as most of us think of a window or a door as having only one state that corresponds to being closed, but infinitely many that correspond to being open (varying perhaps from slightly open, to wide open), so, for the Cambridge group, a specific domain of reality can assume any numerous states of openness…

Hence on this issue Mearman (2006), Chick and Dow (2011) can be reconciled with the Cambridge group, to emphasize that the relationship between openness and closure in social reality is not binary, but consists of a variety of different combinations of the two. This conception of reality can help to better understand both the limitations and the insights of game theoretic modelling.

If we allow for a multiplicity of types of open-systems to exist in social reality, it must be the case that some of these scenarios allow for demi-regularities to endure more consistently than others. While remaining open in the sense that something else could conceivably happen, these correlations may be strong enough that a deductive, 'if *this* then *that*' -style claim is less likely to break down. In these circumstances, the mismatch between game theory's ontological presumptions and the open nature of social reality may be less severe. This is a point of departure from Lawson's strong claim that the ontology presupposed by a model must *always* match the reality it is being applied to (Chick and Dow 2011: 375-6). Instead, it can be argued alongside Chick and Dow (2011: 378) that theorists can legitimately 'cut up'

social reality to render it understandable: "In order to construct models, restrictions are necessary. These are bound to be 'distorting'. But the important issue is how this is done; reality has to be 'cut up' in some way for analysis, and some cuts make more sense than others". They suggest that a model presupposing closure might be useful for understanding open social reality if it is embedded in a theory that allows openness to be held 'at the back of one's head' (Chick and Dow 2011: 369). The problem with mathematical economic modelling thus becomes less about formalism itself, but rather the absolutist stance that formalism is both necessary and sufficient for creating 'scientific' or 'objective' models.

For Chick and Dow (2011: 372-4), a single model is no longer given universal explanatory status, but is just one piece in a wider schema that acknowledges the openness of social reality, while allowing for permeable boundaries to be established around particular areas of interest. These models are different from those traditionally used in rational choice schemas, as they allow the underlying axioms deductive analysis to shift, without this fundamentally changing the thrust of the wider theory: "The distinction is between ignoring for the time being aspects of reality, on the one hand… and actively assuming something known to be false which precludes later relaxation, on the other" (Chick and Dow 2011: 369). The implication of this is that the boundaries framing a particular model are able to shift depending upon what aspect of reality is being examined. Here, a mathematical-deductivist model's outputs might be interpreted and used in an open context when the nature of the objects of interest forms an open-system that allows for demi-regularities to persist with a fair degree of stability. It's therefore in the interpretation of results, and in their becoming situated in a wider context of theory creation, that theorists can begin to blend outputs from the various models composing a theory in order to create a picture of what is happening in the open social world.

While Lawson disputes the use of the term 'boundary', the process described by Chick and Dow (2011: 373) is actually quite similar to his concept of abstraction, as he explains it: "To abstract is to focus on aspects of something whilst not assuming the non-existence, or non-impact, of features not focussed explicitly upon…" (Lawson 2009a: 21). Differences of opinion regarding this issue can also be resolved to show that open-systems theorists agree that it is legitimate for theories of behaviour to focus upon a particular point of interest, so long as this is not at the expense of assuming the non-existence of other interesting or relevant phenomena. The question for economists – and social theorists more generally – is whether

game theoretic models might be capable of being utilised in this way. To answer this, it is worth returning to the empirical results outlined in Chapter One.

Although the ultimatum and public goods games do not achieve predictive success, the break down of the theoretical model in laboratory provides interesting information on the groups involved in the game. As noted previously, when played out these games invoke social norms in expectation formation, and this creates a crack in the closure of the system under study. The deductive ontology of the formal theory cannot capture the openness that this brings. What these experiments do show, however, is the various ways in which this openness can manifest. They become a litmus test for the strength of interactive or emergent social mechanisms in the context they are being applied to, and can provide insight into how these impact upon the choices of individuals from the groups being tested. To take this further, letting go of the insistence on maintaining the self-interested optimisation principle in the 'hard core' of the theory, these mathematical models become one of a set of tools for abstractive enquiry (Dow 2013: 32, 39). Their empirical and predictive outputs must be brought into a wider discussion extending beyond the models themselves, in order to take account of the openness involved in socialised understandings of strategic economic action.

Take the work of Joseph Henrich, for instance. He and his wife, Natalie Henrich, write that they aim to "breathe life into the deductive logic and equations that buttress [their] theoretical presentation" (Henrich and Henrich 2007: 3). They explicitly manipulate the relative openness and closure of the reality they are investigating, by utilising a range of different methodologies (Henrich and Henrich 2007: 4). In this way, they are able to search for the existence of underlying causal relationships with an explicitly ontological focus. They abstract from messy social reality by honing in on a particular area of interest, running experiments to test for the existence of underlying tendencies or mechanisms, and then using these to retroductively build upon previous understandings. Since they are 'holding openness in the back of their heads', they may use formal or deductive models that presuppose closure in a manner that does not assume the non-existence of other relevant mechanisms. They then apply the knowledge they have gathered to economic scenarios that require cooperation, and use their developed knowledge to better understand how individuals might behave in these contexts. Many other researchers looked at throughout this paper have started on the road to engaging with experimentation and theory-building in a similar manner. Gowdy et al. (2003) are another prime example, as are the researchers using Gilligan's work on gender and

morality to examine variances in cooperation levels in the public goods games (Andreoni and Petrie 2008; Brown-Kruse and Hummels 1992; Cadsby and Maynes 1996).

Lawson's conclusion that mathematical-deductivist models are useful only in very rare cases of complete closure is thus found to be too strong (Hodgson 2009: 176, Lawson 2009b: 112). A model's 'fit' to reality matters, but by consciously engaging with the relationship between methodology and ontology theorists may responsibly abstract, form permeable boundaries, or generate interesting breakdowns in the model through experimental control. The findings from these methods can then be utilised in a retroductive manner, in order to uncover the real tendencies or mechanisms that are operating over the objects of study – both inside and outside of the laboratory (Pratten 2007: 481). Game theory can be an element of this process, so long as the formalism it entails is not assumed to be a universal explanation of the intricacies involved with socially entwined action.

Conclusion

IS GAME THEORY USEFUL?

> *An ontology without a methodology is deaf and dumb; a methodology without an ontology is blind. Only if the two go hand-in-hand can we avoid a discipline in which the deaf and the blind lead in different directions, both of which end in cul-de-sacs*
>
> *– Margaret Archer 1995: 28*

This thesis argues that the disagreements over game theory's usefulness have ontological roots; the way that a theory is linked to the reality it is being applied to will determine how and when it is considered useful. Following a critical realist perspective allows analysis to look beyond methodology, in order to assess how the model's fit to reality is determining the relationship between its outputs and what actually occurs in the real world. This stance creates grounding for an explanation of the divergence between predictions and outcomes in the ultimatum and public goods games in terms of the ontological presuppositions of game theory, and the reality to which these particular games are applied. In Chapter Three the implications of this interpretation were drawn out, to suggest that a consciousness of ontology could resolve the theoretical and empirical contradictions of game theory, by revealing both its powers and its limitations.

A consequence of this approach is that the over-emphasis on mathematics and prediction must be abandoned. By assessing a model's usefulness solely in terms of its capacity to deduce novel predictions from simple assumptions, this approach allows model-building to be purposefully disjointed from complex reality. In this view, understanding of the world comes from the ability of a model to adequately guess which outcome will arise from a given set of circumstances. Here, instrumental rationality is a valid characterisation of economic behaviour, so long as agents act as though they were optimising a well-behaved set of preferences. Problems for this approach arise when previously accurate predictions break down, as a result of a dynamic and transforming social reality. In the case of the ultimatum and public goods games, for instance, the divergences from the game theoretic predictions were context specific and highly reliant upon the particular cultural and historical background

of the group playing the game. Rabin's (1993) *fairness equilibria* approach, an attempt to 'patch the gap' in game theoretic outputs from within, revealed the theoretical contradictions that arise when the link between methodology and ontology is not recognised. This approach assumed that the nature of social phenomena is such that individual moral action can be reduced to a universal optimisation problem, where humans everywhere (at least act as though they) "deploy the same cognitive machinery for making economic decisions and, consequently, will respond similarly when faced with comparable economic circumstances" (Henrich 2000: 973).

Instead, it needs to be remembered that (whether implicitly or explicitly) all social researchers 'do' social ontology. This simple idea has the strong implication that ontology and methodology ought to inform one another, in order to guide enquiry and aid understanding of the real world. Critical realism recognises this, and seeks to find a reasonable conception of the nature of reality that can inform methodologies that reach towards real causal relationships in social reality. It is therefore uniquely placed to explain results on the ultimatum and public goods games as being indicative of a mismatch between ontology and reality, rather than an issue that can be 'patched' within the same methodological framework. This allows theorists to finally see the boundaries of game theory's usefulness, in ontological terms.

As was shown in Chapter Two, Tony Lawson would be unsurprised by the failure of pure game theory to have its predictions follow through in the laboratory. In his eyes, the isolated, atomistic nature of this model renders its outputs frail in the context of an open and structured social reality. Further, the deductive, 'if *x* then *y*' system of theorising forces this framework into an ontology that presupposes ubiquitous event regularities, where correlations that have been observed in the past can be relied upon to play out in the future. Since event regularities of this sort are unlikely to persist in an open social realm, models of this caliber will inevitably break down when shifting mechanisms at deeper layers of social reality change empirical outcomes. This explains the reasons why divergences from the model manifested themselves differently depending upon the social context of the lab, since underlying tendencies and mechanisms interact in variable and non-predictable ways. Archer's (1995: 51) idea of emergent effects also implies that structure and agency are mutually constituted while being ontologically distinct, suggesting that one's environment informs and constrains action. Without capturing the deeper causal links between outcomes, critical realism is able to

explain the fragility of game theoretic predictions in terms of its vulnerability to the interactive and emergent phenomena that exist in the social realm.

An analysis of the ontological presumptions of game theory allows the results on these models to be situated in terms of the usefulness of this methodology more broadly. This is important, because outside of the ultimatum and public goods games, there are situations where game theoretic models actually do have consistent (predictive) success. Recall from Chapter One that in Roth et al.'s (1991) study of ultimatum game-play across four continents, a market game was also played. Here, the choices of individuals converged quickly to equilibrium, despite significant divergences in the ultimatum game amongst the same group of participants. Similarly, Vernon Smith (1962) famously designed a market scenario in an experimental context, and proved that buyers with given utility functions will interact with suppliers who have given cost functions in stable and predictable ways. Game theory has also been a significant component of auction market design and creating institutions for matching markets (Klemperer 2002; Nobel Prize Committee 2012; Roth 2008). Goeree and Holt (2001) provide an interesting example of this contrast, by showing that in ten basic game theoretic models, the payoffs offered to participants can either sustain or block out equilibrium play. In each of the games, equilibrium is achieved when the payoffs offered are fairly symmetric. However, if there are large discrepancies in payoffs, or if the costs to carrying out 'empty' threats are small, the behaviour of participants can vary greatly from the predictions of the model. "The observed contradictions are typically somewhat intuitive", the authors note, "even though they are not explained by standard game theory" (Goeree and Holt 2001: 1403). This implies that certain payoff structures invoke social norms that are outside of the realm of game theory, while others do not. Depending upon the nature of the game being played, human behaviour can exhibit fuzziness to a greater or less degree.

It is thus an interesting implication of this thesis that models presupposing closure will have greater predictive success when utilised in certain types of open-systems. For the ultimatum and public goods games, the openness of social reality has significant consequences to the predictive power of the model, since agents are ultilising their social knowledge in order to determine their best response to the game's payoff matrix. However, in other cases, the game being played may be insulated against the effects of higher order social mechanisms, and their interactive or emergent properties. In cases where event regularities are able to remain semi-stable, the application of game theoretic models is less likely to produce divergences between predictions and outcomes, because there is less of a gap between the ontology of the model

and the reality to which it is being applied. Even if predictive power were the only test of the validity of a model, an ontological focus can help theorists to determine when predictions are more likely to remain stable. The usefulness of game theoretic models as predictors of behaviour can therefore be positioned in terms of the relative openness or closure of their objects of interest.

Understanding game theory's implicit ontology through this lens would allow theorists to examine to the assumption of instrumental rationality from a new perspective. Rather than needing to work around the principle in order to develop behavioural theory within the confines of the model, or to label non-self interested choice as irrational (and out of the domain of economics), this approach allows instrumental rationality to be treated as one causal mechanism amongst many. Depending upon the nature of the game being played out, the operation of this mechanism may be evident at an empirical level to a greater or a lesser degree. This means that the application of any particular methodology must be justified in terms of the nature of the context under scrutiny. There is some circularity here: methods used to discover things about reality must be defensible in terms of previous understandings of what that reality looks like. As theorists build knowledge within this cycle, however, the goal is sharpen methodological tools and deepen ontological understanding, in order to get at the true causal mechanisms affecting empirical outcomes. Using contrast explanation, abstraction, and retroduction, critical realism can inform methodology to create perspectives on instrumental rationality that do not rely on strict correlation or predictive power for validation. Game theory could also aid this project, by highlighting the different contradictions arising from rational agent models in interactive contexts. Gowdy et al. (2003) used experimental results on the ultimatum game in this way, for instance, to become a point of further social enquiry into the motivations behind participant's action. From this perspective, any paradoxes and inconsistencies evident in models that presuppose ontological closure are viewed as an interesting starting point for further enquiry into the nature of the open-system they are being applied to.

Underlying debate over game theory's usefulness is a much deeper one about the relationship between the natural and social sciences. The over-use of mathematics in economics has been a consequence of a shallow view of scientific methodology, based upon the Humean conception of causality as existing only in patterns of empirical events. "There seems to be a quiet confidence in the profession that we are moving, if only slowly, towards a more scientific basis for economics", argues Alan Kirman (1989: 126), a basis where the only

criterion for a theory to be scientific is in its ability to generate empirically falsifiable propositions. The heritage of Friedman's (1953) methodology exists here, as well as in the idea that positive economics can be an 'objective' science by using exactly the same methods as a natural science such as physics.

Yet there is a fundamental difference between the nature of the objects of study in the 'hard' sciences, and the human component of economics as a science of choice. Since social phenomena rely upon human agency for existence, the laws and causal relationships underlying patterns of human action cannot be isolated and examined in the same way that natural laws can. As Siakantaris (2000: 278) argues, "The internal-relationality of [social] positions, structures and systems means that economy and society must be perceived as totalities", which stands in stark contrast to the subject of the natural sciences. Critical realism instead asserts that the scientific credence of a theory derives from its ability to find and use modes of reasoning that are appropriate to the nature of what is being studied (Fullbrook 2009: 1). Given that there are differences in the nature of the objects of study in the natural and social sciences, it follows that the successful methods of one cannot necessarily be imported into the other. This implies that formal methods such as game theory will be granted scientific legitimacy only in their ability to aid in the search for underlying causal relationships, rather than in the precision of the model's predictions or elegance of its mathematics.

This thesis fills a gap in the critical realist literature in regards to game theory, in order to explain the divergence between predictions and outcomes in the ultimatum and public goods games. From here, broader implications on game theory's role in social enquiry can be explored, with the aim of outlining the boundaries of the space for formal analysis within open-systems ontology. It is hoped that this approach to combining game theory and social ontology will provide the foundations for an understanding of economic choice-making that accounts for the open and structured nature of social reality, while allowing for a range of experimental, formal, and non-formal methods to be used. As Archer (1995) notes in the quote above, ontology without methodology is rendered both deaf and dumb, just as methodology requires solid ontological foundations in order to see. This thesis provides insight into the ways in which the two together can lead theorists through an analysis of individual action in an open context. By encouraging the development of ontologically conscious models of human behaviour, economic enquiry has the potential to uncover a great deal about strategic action in the real social world.

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Appendix

The Ultimatum Game: Strategy Sets and Extensive Form

Strategy Sets for Player 1 and Player 2:

$S_1 = [0; 10]$ $S_2 = \{f : [0; 1] \rightarrow \{\text{Accept offer of } x; \text{ Reject offer of } x\}\}$

Extensive Form:

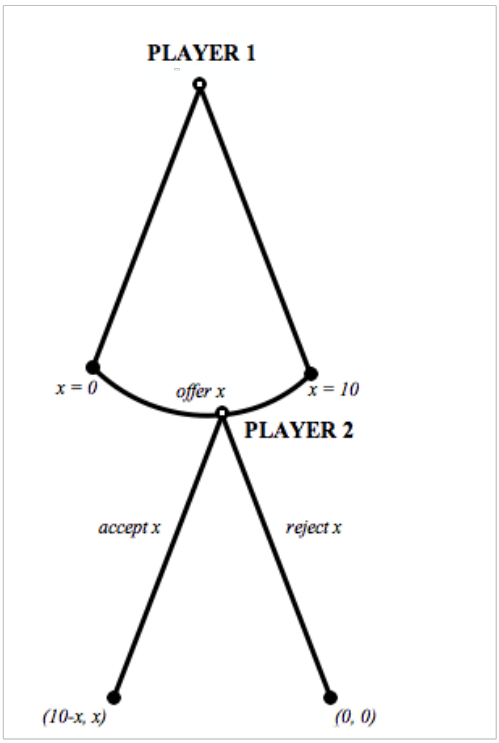

Figure 1. The Ultimatum Game In Extensive Form

Description:

Player 1 may choose any value of $x \in [0 , 10]$. (It's traditional to place Player 2's decision node asymmetrically between 0 and 10, in order to represent this).

Once x has been selected by Player 1, Player 2 has two discrete options: accept, or reject. If the offer is accepted, the payoffs are: $\pi_1 = (10 - x)$, $\pi_2 = x$.