

LEGAL EVOLUTION: INTEGRATING ECONOMIC AND SYSTEMIC APPROACHES

Centre for Business Research, University of Cambridge
Working Paper No.424

by

Simon Deakin

Centre for Business Research,
University of Cambridge
s.deakin@cbr.cam.ac.uk

June 2011

This working paper forms part of the CBR Research Programme on Corporate Governance

Abstract

This paper explores the scope for synthesis between economic and systemic approaches to the understanding of legal evolution. The evolutionary and epistemic branches of game theory predict that stable norms will emerge when agents share common beliefs concerning future states of the world. Systems theory see the legal order as a social system which reproduces itself by recursive acts of legal communication, thereby giving rise to self-reference and operational closure. At the same time, the legal system is cognitively open, that is to say, indirectly influenced by other social systems in its environment. This gives rise to the possibility of coevolution of law and the economy. It will be argued that systems theory, by developing the idea of law as an adaptive system with cognitive properties, provides a missing link in the evolutionary theory of norms. Recent game theoretical models imply that common knowledge is not entirely endogenous to agents' interactions, but depends to a certain extent on emergent normative structures. These include the public representations of common knowledge which are provided by the legal system. The paper will explore the implications of this idea, argue for an integrated economic and systemic analysis of legal evolution, and consider some of the theoretical and methodological implications of such a step.

JEL Codes: C72, C73, K12, K22.

Keywords: Legal evolution, game theory, correlated equilibrium, social norms, systems theory, contract theory, legal origins.

Acknowledgements. I am grateful for comments received on earlier drafts of this paper at the Seminar on Evolutionary Approaches to Comparative Law, Ghent University, April 2010, and the Comparative Law and Economics Forum, University of Oxford, June 2011.

Further information about the Centre for Business Research can be found at the following address: www.cbr.cam.ac.uk

1. Introduction

This paper develops and defends an evolutionary conception of law which integrates economic and systemic approaches to the analysis of institutions. Influenced by game theory, economics increasingly sees institutions in terms of the stable states or equilibria which arise from agents' strategic interactions. Coordination of this kind depends on the presence of beliefs which are widely shared among a given population of actors. Institutions function as public representations of these beliefs, in such a way that they both reflect and influence behavior. This approach accordingly stresses the cognitive foundations of economic institutions. There is, however, a gap in the analysis when it comes to specifying the origins of the shared beliefs on which coordination depends. These cannot be derived from the axioms of rational behavior underlying game-theoretical models. They depend, rather, on more open-ended analytical categories, such as 'culture', 'history' or 'precedent'; in other words, on an explicitly evolutionary conception of institutional forms (Gintis, 2009: 223; Aoki, 2010: 131). The missing piece of the jigsaw is the idea of institutions as adaptive systems, which receive, store and transmit information about their environments while coevolving with them. The insights of systems theory are of direct relevance here.

Systems theory is a body of thought which draws on biological theories and analogies to explain social institutions, while stressing the distinctiveness of human evolution in its societal context. It sees institutional forms, including those of the legal and economic systems, as mechanisms for facilitating coordination through the organization and reduction of complexity. Legal forms encode information about coordination strategies which have proved more or less successful in particular social settings, including the economic domains of the market and the business enterprise. The cognitive dimension of legal and other institutions is therefore at the core of this approach, as it is in evolutionary and institutional economics. At the same time, systems theory, in its focus on the communicative and interpretive dimensions of human action, provides a more complete account of the evolution of institutions than the hypothetico-deductive models used in game theory are capable of providing. It therefore has the potential to deepen and enrich a research project which aims to articulate the 'analytical linkages between individually rational behavior and the social institutions that align the beliefs and expectations of individuals' (Gintis, 2009: 162).

To develop this argument, section 2 below provides an outline of the theory of institutions which is implied by recent developments in evolutionary and epistemic game theory. The account provided here focuses on the notion of correlated equilibrium as proposed by Aumann (Aumann, 1976, 1987; Aumann

and Brandenburger, 1995) and developed in an institutional and evolutionary setting by Gintis (2009) and Aoki (2010). Section 3 then explores links between this emerging body of thought and the account of legal institutions in systems theory. The focus here is on the idea of the legal system as a cognitive order which, while attaining stability on the basis of its own self-reference or *autopoiesis*, nevertheless evolves alongside economic forms. This gives rise to institutional complementarities between law and the economy and to their mutually constitutive coevolution (Luhmann, 2004). Systems theory thereby provides an evolutionary conception of law which can help to explain the dynamics of legal and economic change. Throughout the discussion, concrete examples are given, drawn from contract and corporate law, of the implications of game-theoretical and systemic approaches. Section 4 concludes.

2. Evolutionary and Epistemic Game Theory: From Individual Rationality to the Cognitive Foundations of Institutions

2.1 Institutions as parameters for social action

Game theoretical models analyze the interactions of individual agents in settings of various kinds. In classical game theory the rules of the game are fixed by the ‘game form’, which consists of the set of players, the set of their admissible strategies, and the payoffs which result from their decisions. The game form, so defined, is clearly distinguishable from the set of equilibrium outcomes of the game, that is to say, the equilibria or stable states that the players arrive at having made and acted on their decision choices (Aoki, 2007). So-called non-cooperative games, such as the prisoner’s dilemma, hawk-dove and stag hunt games, have been intensively studied because they pose the question of whether stable states can emerge in contexts where there is no external mechanism, such as a legal rule, social norm or private contract, guaranteeing cooperative behavior. In a non-cooperative game, players acting solely according to their own self-interest will generally arrive at a particular kind of stable state, a ‘Nash equilibrium’, from which they have no reason to deviate if they have full knowledge of the structure of the game, including the strategy that each of them will follow (Nash, 1951).

When the prisoner’s dilemma game is played only once, or for a finite number of rounds known to the players in advance, the outcome of the game is a unique equilibrium in which both players defect. In other words, they pursue a strategy which, for each of them, is individually rational, but which fails to maximize their joint product. This outcome is generated by the parameters of the game form. It is assumed that each party acts exclusively with regard to their own well-being and with knowledge of the other player’s strategy. Under these

conditions, mutual defection is assured by the structure of pay-offs inherent in the form of the game. Each player knows that, whatever strategy the other one adopts, it is always better for them to defect, regardless of the impact this has on their collective well being. The result is a Nash equilibrium in the sense that neither player has an incentive to change their strategy in the light of what they have good reason to expect the other player to do.

The fixed parameters implied by the form of a non-cooperative game can be understood as capturing certain features of institutional environments which shape the behavior of actors engaged in economic exchange or other types of social interaction. In this approach, institutions are presented as exogenous constraints on the parties' behavior. The models can be used to show how changing the parameters of the game can alter outcomes in a way which improves the parties' overall well being, as the following example demonstrates.

2.2 Modeling different legal regimes: the 'battle of forms' and 'good faith' games

Figures 1 and 2 illustrate different versions of a 'contract negotiation' game played under different legal rules. The aim of negotiation is to arrive at the contract which best reflects the interests of the parties, who in this case are a manufacturer making components to order and its client. An optimal contract, for this purpose, is one that maximizes their joint product. This can be taken to be a contract which contains the particular mix of terms governing price, delivery, quality, liability and so on which maximizes the sum of the gains to be made from exchange, and which provides for the optimal level of legal enforcement taking into account the costs to the court and to the parties themselves, in the form of litigation and other process costs, of verifying the terms of the contract and of sanctioning any breach. 'Cooperation' is defined here in terms of behavior which involves a good-faith effort to negotiate a mutually accommodating agreement in the sense just described. This need not necessarily take the form of a contract which is 'fair'; the issue here is simply whether the contract maximizes the parties' joint gains within the ex ante constraints of endowments and resources that they are operating under. 'Defection' takes the form of behavior which amounts to an attempt by one side to impose its terms upon the other. This is modeled as an outcome under which, because one side benefits to some degree directly at the expense of the other and so reduces their incentives for cooperation, their joint product is not maximized.

Figure 1 represents a version of this game that can be called 'the battle of forms'.¹ This is a situation in which it is always in the interests of each side to try to impose their standard contract terms on the other. They will always be

better off by doing so than if they seek to negotiate in good faith. The two parties can be referred to as ‘offeror’ and ‘offeree’. If the offeror bargains in good faith but the offeree defects by seeking to impose his terms without negotiation, the offeree earns a high pay off, and vice versa (these are the pay-offs in the top right-hand and bottom left-hand boxes, respectively). If both sides defect, their individual pay-offs are reduced and the joint product is lower than in the case of unilateral defection (the bottom right-hand box). If they both cooperate (the top left-hand box), their joint product is higher than in any of the other cases, but the individual pay-offs to each player are lower than if they defect. Individual defection is always better than cooperation, whatever the other party chooses. On the assumption that each party knows what the other will do in all states of play, mutual defection is unavoidable.

4, 4	0, 6
6, 0	2, 2

Figure 1. The Battle of Forms

The ‘battle of forms’ is a version of the prisoner’s dilemma game. The assumptions built into the game form reflect a context within which the prevailing legal rule governing contract formation is one based on classical principles of offer and acceptance as developed by the common law courts in the course of the nineteenth century. According to this approach, the contract is formed once both parties are in complete agreement as to its terms. A contract comes into being when the offeree gives his full assent to the terms set out in the final offer made by the offeror. Offer and acceptance precisely ‘mirror’ each other. The court’s task is, by and large, confined to identifying the agreement that has been made and enforcing it; it has limited powers to supply missing contract terms on the basis of trade custom or assumed mutual understandings of the parties. This approach is intended to aid commercial certainty and minimize verification and enforcement costs. It runs into difficulty in the context where both parties negotiate on the basis of divergent written standard terms. For example, the seller’s terms may contain a price escalation clause, allowing it to raise prices if the costs of raw materials go up; or the buyer’s terms may allow it to defer payment as a way of obtaining credit. The ‘mirror image’ rule gives each party an incentive to try to force their terms on the other under circumstances where they know that they would otherwise be unlikely to agree to them, or would not otherwise be viewed by the court as doing so. They can do this by ensuring that they make the last offer, the so-

called last shot, prior to the commencement of performance. As the court is likely to construe part performance by one or other party as equivalent to acceptance by conduct, the party who ‘fires the last shot’ will win the battle of forms.

If just one side follows this strategy, the outcome will be sub-optimal but it will at least be clear: the contract will be based on the terms of the party who fires the last shot. If both parties play the game this way, not only will there be no attempt to arrive at a mutual accommodation on matters of price, delivery and payment; the court will find it difficult in practice to determine which side fired the last shot and what the contract terms therefore are. The court’s interpretation of the contract will therefore be to some degree ad hoc. To this element of uncertainty, other losses must be added in terms of the deadweight costs of unduly protracted and unclear negotiations, and arbitration and litigation costs in settling disputes.

These problems are illustrated by one of the leading cases on the battle of forms in the English law of contract of the late twentieth century, *Butler Machine Tools Ltd. v. Ex-Cell-O Corp.*² The Court of Appeal, by a majority, took the view that the classical analysis of offer, counter-offer and acceptance applied to the battle of forms. The majority judges were then faced with the problem that the last communication prior to performance, which had apparently been made by the seller, contained a highly unusual price escalation clause, which buyers in this situation would not normally agree to. The majority, notwithstanding their decision to stick with the nineteenth century approach to contract formation, held that the true final offer had in fact been made by the buyer, and that the seller’s last communication was merely a notification of receipt of terms. Lord Denning, in the minority, reached the same result by a less orthodox route. Rejecting the mirror image rule, he argued that neither of the putative offers should be regarded as containing all the contract terms. The court should, he thought, step in to construct a contract from the sum total of the communications passing between the parties, drawing where necessary on trade custom. On this basis he too rejected the seller’s price escalation clause. The upshot of *Butler* was that the ‘last shot’ rule survived, but in an attenuated and, from the point of view commercial certainty, less efficient form. Contracting parties would continue to have good reason to act with a view to imposing their terms by the tactic of delaying agreement until the last minute, but, in the light of the outcome in *Butler*, would now be less sure than before that the final communication would be construed as an offer by the court.

Figure 2 represents the game played according to a legal rule based on the principle of ‘good faith’. The facts are as before: the parties are engaged in a negotiation involving divergent standard terms in circumstances where the

inchoate agreement is at least partially performed, giving rise to litigation as to its effects. Here, the court will refuse to give legal effect to either party's standard terms simply because they were the last shot to be fired, and will penalize bad faith during the negotiation process. If either side defects in the sense of refusing to engage in genuine negotiation, they can prevent the formation of the contract, but the court will penalize the defecting party by requiring him to pay compensation for any loss suffered by the other as a result of the abortive negotiations (hence the negative pay-offs in the bottom left-hand and top right-hand boxes). If both sides defect, the court again refuses to enforce the contract. Each party suffers some loss as the effect of the court ruling is that there is no legal protection for their expectations. The seller cannot sue for full payment (beyond the value of any property actually transferred to the buyer) and the buyer cannot sue for late delivery or for defects in the goods supplied. Here, then, the penalties for defection are stronger than in the 'battle of forms' game, so that both sides have incentives to bargain towards a contract which accommodates their mutual interests (the top left-hand box).

4, 4	3, -3
-3, 3	-1, -1

Figure 2. Good Faith

This outcome models elements of the approach taken by the court in another English contract law case, *British Steel Corp. v. Cleveland Bridge & Engineering Co. Ltd.*,³ a decision of Robert Goff J at first instance in the Queen's Bench Division. The judge, faced with a battle of forms, refused to recognise the contract asserted by the buyer, so preventing it claiming damages for delivery out of sequence and non-delivery of some components. He also rejected the seller's claim for damages for loss of profit, limiting it to a restitutionary claim for the value of the components received and used by the buyer. Neither party lost out completely, but they were both worse off than they would have been had a fully enforceable contract been agreed, because in neither case were their expectations fully protected. The buyer was unable to sue for defective performance and the seller was limited to a claim for the benefit it conferred, through performance, on the buyer, not a claim for its lost profits. In effect, Robert Goff J's judgment penalized both parties for their unwillingness to negotiate in good faith.

In Figure 2, the addition of the ‘good faith’ norm alters the parameters of the game and moves the potential outcome to a more socially advantageous equilibrium. Parties aware of the ruling in the *Cleveland Bridge* case would have a powerful incentive in future to negotiate towards a more mutually beneficial agreement. The game-theoretical model therefore helps to explain how a shift in the institutional framework can avoid the problem of mutual defection. However, the game theoretical model does not explain how or from where the norm of good faith is derived. Nor does it explain how it operates to shape behavioral outcomes. It is simply assumed that the norm exists, that the parties can interpret correctly the signal given by it, that they have full confidence in the capacity of the legal system to enforce it, and that the court can indeed do so. If we want to understand the origins and effects of the norm, something more is needed.

2.3 Institutions as correlated equilibria

A starting point in understanding the origin and mode of operation of legal norms is to shift the focus in formal models from the game form to the outcome of the game. In this approach, institutions are understood, not as exogenous constraints on the player’s strategies, but as the endogenously generated states of play which emerge from their interactions (Aoki, 2007). In evolutionary game theory, cooperation can emerge endogenously on the basis of repeated play involving observation-based learning, without disturbing the assumption of individual rationality (Young, 1998). If the prisoner’s dilemma, for example, is played over multiple rounds without a fixed end point, an equilibrium of mutual cooperation can be achieved given the possibility each player has of punishing any defection by the other (Axelrod, 1984). Thus in the example just given, if the parties are engaged in repeated trade, the threat of retaliation in future rounds reduces the potential gains from a strategy of defection. In this way, a norm of good-faith bargaining could become spontaneously established.

Even in a repeated game, as soon as the end point is known to both parties, through ‘backwards induction’ they have an immediate incentive to defect (Aumann, 1995). Cooperation can be maintained if the trading relationship is not just long-term, but indeterminate in its duration. This insight is of value for understanding the incentive properties of certain legal institutions which seek to instantiate open-ended exchange relations. In the context of corporate governance, shareholders investing equity capital in common stock make open-ended commitments to the firm. It is normal for firms to offer ‘career workers’ indeterminate-duration employment contracts as opposed to fixed-term agreements. More generally, the foundational legal concept of the corporation as a ‘permanent’ entity with an enduring legal personality distinct from that of

its members at any given time can be seen to be one with an inbuilt tendency to support complex exchange relations (Aoki, 2010).

Evolutionary models have other implications for legal institutions. These models show that multiple outcomes to repeated games are possible, depending on how far the parties play ‘mixed strategies’, altering their approaches in different rounds of the game. The modeling of multiple equilibria is significant for its prediction of institutional variety within a range of different environmental settings. It also points to the role of contingency in shaping outcomes. The selection of one equilibrium over another may depend on an arbitrary feature of the local environment, which serves as a behavioral cue or focal point for interactions: ‘meet at Grand Central Station’ (Schelling, 1960), ‘drive on the right’ (Young, 1998), and so on. This point underscores some of the foundational observations of comparative law scholarship, namely the idea that formal differences across legal institutions may mask underlying functional continuities, and, relatedly, that the function performed by a particular legal rule depends on its context, that is to say, on how it relates to other norms and to commercial practice (Zweigert and Kötz, 1998).

Evolutionary game theory is nevertheless only capable of providing a limited explanation for the structure of legal and other institutions. In the prisoner’s dilemma, agents will play the game in such a way as to arrive at a Nash equilibrium only if they play with common knowledge of rationality – that is, with a common understanding of each other’s strategies. They must also have a complete understanding of the structure of the game, that is, of the permissible choices, and of the resulting pay-offs. These are not trivial assumptions (Gintis, 2009: 162). Similarly, the so-called ‘folk theorem’ predicts cooperation where individuals act with common knowledge of rationality, have long-term time horizons, and play the game with public information on whether other agents have cooperated in the past. The folk theorem thereby sets out certain conditions under which cooperation will emerge. However, it does not tell us how these conditions are brought about in the first place. Since the conditions are stringent and not necessarily typical, this limits the applicability of the model in concrete societal settings (Gintis, 2009: 195).

One way forward is more formally to model the role played by the focal points or cues around which behavioral regularities can coalesce. The idea of *correlated equilibrium* is a step in this direction (Aumann, 1976, 1987; Aumann and Brandenburger, 1995). Here, the parties’ behavior is conditioned on a commonly observable event, which is variously referred to as a ‘correlating device’ or ‘choreographer’. A correlated equilibrium is a stable state (a Nash equilibrium) in which ‘each party chooses a best response to the move of the other, assuming the other carries out the choreographer’s directive’ (Gintis,

2009: 41). In other words, the correlating device signals to each player the strategy that they should follow in a given environment, in circumstances where they can ascertain with a given probability the strategy that the other players will adopt. More formally, a correlated equilibrium of a given game G is a Nash equilibrium of the game generated from G by adding a correlating device ‘whose move at the beginning of the game is to observe the state of the world E and to indicate a move $f_i(Y)$ to each player i such that no player has an incentive to do other than to comply with [the correlating device’s] recommendation, provided that the other players comply as well’ (Gintis, 2009: 138). The good faith game in Figure 2 above can be understood as a correlated equilibrium, in this sense, of the original contract negotiation game which leads to the battle of forms.

The formal properties of correlated equilibrium are such that it is not necessary to invoke the model of indeterminate play to explain cooperative outcomes. The correlating device works even in the context of a finitely-played prisoner’s dilemma or other non-cooperative game. This is not to suggest that models of indeterminate play are not relevant to understanding social structure, simply that they do not exclusively describe the conditions for stable cooperation. In addition, the preconditions for establishing a correlated equilibrium are less strict (and hence more generally applicable) than those required for a stable state Nash equilibrium under conditions of repeated play. It is not necessary to assume that the players have common knowledge of each other’s rationality, or full knowledge of the structure of the game. Instead, they can be modeled as having bounded rationality, that is to say, as acting instrumentally but with imperfect information with respect to an uncertain and complex external environment. More specifically, players can be said to act with *Bayesian rationality*: they assign weighted probabilities to outcomes on the basis of a learning process through which knowledge of states of the world is incorporated into their preference functions (Aumann, 1987).

In correlated equilibrium models, to say that players act with bounded rationality does not involve abandoning the axioms of individual rationality which underlie the game-theoretical approach, but it does involve some modifications to the approach taken in classical game theory. Players can still be assumed to act in a way which is preference-consistent, that is to say, to make decisions which are consistent with the subjective valuations they place on particular sets of outcomes. On the other hand, it is unnecessary to assign to the actors the capacity for hyper-rational decision-making of the kind they would need to bring their choices into perfect alignment with the environment. The actors can be thought of as aiming to maximize their individual well being subject to the constraints of the environment, which for this purpose include the limits on their knowledge of it. They act with Bayesian rationality when their

decision choices are conditioned by the subjective probabilities they assign to their being in one or more of a set of given states of the world (Gintis, 2009: 138-9).

This focus on the iteration between knowledge, beliefs, preferences and outcomes marks the shift from evolutionary to epistemic game theory. Societal coordination depends on the possibility of a concordance of beliefs among a population of actors. Actors are in a state of correlated equilibrium when they share common beliefs on the basis of cues that they take from their environment. These cues can be represented by events or conduct of a particular kind or by norms of varying degrees of formality. These can range from tacit conventions based on common knowledge (Lewis, 1969) to social norms based on an inherent moral or 'normative predisposition' on the part of actors (Gintis, 2009) and highly formal public indicators contained in laws or regulations (Aoki, 2001, 2010). A convention, norm or legal rule N acts as a correlating device if it is taken as specifying to all agents that they are in a given environment E . If each agent associates N with E , and each of the others knows this, following the strategy S associated with N becomes the common best response to the environment they are in. Thus $N(E)$ represents the shared beliefs that form the basis for coordination (Gintis, 2009: 141).

At the core of correlated equilibrium is the idea that the correlating device gives an instruction of some kind to the actors. The instruction can take a physical form. Thus the meaning of a green light at a traffic intersection or a table set for dinner in a restaurant will be conveyed, to those who encounter them on a regular basis, by the arrangement of the physical objects concerned. In the presence of physical signifiers of this kind, it is not necessary for each individual actor to know in detail the strategies or preferences of other actors encountering them. The strong assumption of the common knowledge of rationality which underlies the concept of Nash equilibrium is not needed. Rather, in a correlated equilibrium all that each agent needs to know in order to act is that there is a certain probability that the correlating device means the same to others as it does to her. The device acts as a symbolic representation of agents' *common priors*, that is, common assumptions which form a basis for assigning probabilities to states of the world.

Many correlating devices take a visual, physical or behavioral form which aids their communication. Equally, there are many such devices which are expressed in conceptual or abstract form, without any obvious physical manifestation. Norms, for example, can take the form of linguistic expressions or formulae which function as shorthand for physical or behavioral manifestations of common knowledge (Aoki, 2010: 128). Legal formulae,

which frequently express complex, higher-order concepts, are at one end of the spectrum running from the concrete to the abstract.

In whatever precise form it is expressed, a correlating device serves as a public representation of knowledge and beliefs which are widely shared in a given societal setting. More precisely, the correlating device is based on the ‘probability distribution given by the players’ (common) beliefs’ (Gintis, 2009: 242). How does an object, symbol or linguistic concept come to embody information which can be used as a basis for action in this way?

This is the point at which we come up against the limits of an account based entirely on axioms of individual rationality. Game theory can explain how agents with common priors will act according to the social structure implied by the idea of a correlated equilibrium. Indeed, in a formal sense, a correlated equilibrium *is the same thing* as the parties’ common priors (Aumann, 1987). This statement is a tautology, but an informative one. It implies that indicators such as rules and norms have a dual aspect: they embody information about the past as well as directing future conduct. Indicators serve as signals where they contain mechanisms for receiving information about the states of play on which societal coordination is based, storing it, and filtering it back to society to form the basis for cognitive beliefs (Aoki, 2010: 143). These mechanisms possess an institutional or systemic dimension which, while evolving alongside and often aligned with individual rationality, is more than the sum of all strategic individual acts.

3. Systems Theory: The Evolution of Social Structure

3.1 Gene-culture coevolution and the origins of social institutions

Game theory has been successful in highlighting the role played by the diffusion of knowledge in generating the conditions for societal coordination and in analyzing the formal properties of strategic decision making in the presence of shared beliefs. It has been less successful in identifying the processes through which knowledge is accumulated in such a way that it can form the basis for individual decision-making and action. There is no single ‘meta-game’ informing the structure of all others, or at least, none that has been convincingly suggested so far (Gintis, 2009: 223; Aoki, 2010: 121). Under these circumstances the definition of common knowledge, as something that everyone knows, that everyone knows that everyone knows, and so on, faces the problem of infinite regress (Aoki, 2010: 123). This can be avoided in a number of ways, all of which involve moving beyond the rationality axioms of classical game theory and the related assumption of methodological individualism (Gintis,

2009: 162). Methodological individualism does not necessarily deny that collective entities or structures exist within society, but it does deny that they can be explained in any other terms than those of the beliefs, motivations and actions of individuals. To reject this version of methodological individualism is not to take the view that individual behavior does not matter, or that the rationality axioms of game theory are irrelevant. Rather, it means taking the position that individual agency and social structure are mutually interdependent. Individual rationality is *situated* within the cognitive frames set by enduring institutional structures. Causal flows run both ways, so that individual interactions both influence and are influenced by these structures.

One of the moves made by behavioral and social scientists interested in developing an evolutionary theory of social structure is to posit the existence of shared psychological traits among human agents. These traits can be understood as the outcome of a process of *gene-culture coevolution* (Cavalli-Sforza and Feldman, 1981; Boyd and Richerson, 1985; Richerson and Boyd, 2004). Genetic structures respond, albeit with some lags and misalignments, to the conditions of the natural and physical environments within which the organisms carrying those genes subsist. Genes encode information about strategies which are more or less successful in ensuring the survival of individual organisms and of the wider species of which, in biological terms, they are a part. Through *niche construction*, part of the environment is formed by those same strategies, that is, behavioral routines or patterns which form the basis for the members of a given species' subsistence and survival (Laland et al., 2000). This phenomenon is not confined to human organisms, but it may have particular significance for explaining human evolution and specifically the emergence of complex forms of societal cooperation. It is a prime example of the way in which agency and structure interact in the biological sphere. Enduring genetic structures inform behavioral routines which, by reshaping the physical environment, loop back to influence (over time) the genetic composition of the group. It is plausible to assume that gene-culture coevolution, that is, the mutual constitution of genetic structure and social institutions, has, over the very long run of human existence, played a role in shaping human evolution in both its physical and societal aspects.

In this approach, the inherited psychological predispositions of human agents provide a fixed parameter for interaction, at least as far as any one or a certain finite number of generations is concerned. Evidence from the behavioral sciences suggests that human beings possess certain inherent capacities for social or collective action, including a bias towards pro-social behavior, which derive from some of the original conditions of human evolution. Pro-social attitudes which transcend kin relations can be understood as the consequence of gene-culture coevolution in the environments, stable over many successive

generations, in which human interaction mostly took place within small-scale, largely self-sufficient communities (Gintis, 2009: 196). Pro-sociality implies that human agents are, in varying degrees, other-regarding, and that their behavior will reflect a bias towards altruism at least in certain contexts. This inherited trait does not violate the rationality assumption because it can be modeled as endogenous to individuals' preference functions, a position for which there is also some empirical evidence based on behavioral and social-psychological studies (Gintis, 2009: ch. 3). Other cognitive biases which are present in contemporary human society, such as loss aversion and the endowment effect, can also be explained as rational best responses to this environmental context which, through the path-dependent effect of genetic inheritance, have influenced the subsequent evolution of societal institutions. Thus it is suggested that 'modern notions of property are built on human behavioral propensities' (Gintis, 2009: 220) which have combined biological and social roots.

This is a promising research field which can be pursued within the frames of several of the behavioral sciences, including evolutionary biology, anthropology, social psychology, sociology and economics, and may in due course lead to some kind of fusion between them (Gintis, 2009). Its implications for the study of legal evolution are less clear. This is in part a question of the focus of the research question. If the aim is to uncover certain foundational elements of legal structure which all societies have in common, an approach based on gene-culture coevolution may be appropriate (Du Laing, 2011). Even so, the difficulty inherent in such a project is to identify the elements of legal institutions, if any, which can properly be said to have a proximate genetic cause, as opposed to one arising from evolutionary processes which are specific to cultural forms.

An alternative way to use insights from the theory of gene-culture coevolution is to employ evolutionary concepts to explain not simply the common elements within but also the extent of diversity across national legal systems, both in historical terms and in contemporary societies. The common genetic inheritance of human agents might explain some of the features of foundational concepts such as property and contract and the practices associated with them, but it may be less helpful when it comes explaining the widespread institutional diversity that we also observe across contemporary legal systems. Nor can it very well explain those features of legal systems which have undergone rapid change over time periods during which the composition of the human genetic code has changed very little, if at all. This observation is not so much a criticism of gene-culture coevolution theory, as an observation on the limited value of evolutionary-psychology based approaches in seeking to understand the range of cultural phenomena observed in contemporary human societies (see

Gintis, 2009: ch. 12). More generally, it points to the need for caution in ascribing genetic origins to legal phenomena.

There is a further, methodological reason for being cautious in the use of findings from the biological and related behavioural sciences directly to inform legal research. There is no doubt that insights can be gained by viewing legal phenomena through the prism of another discipline, such as economics or biology. There are, however, costs to imposing an external frame of reference on legal data. The inverse approach is to look at the study of legal systems using an evolutionary logic, but from the inside: to identify the salient features of legal phenomena through a micro-institutional focus on their internal workings. The legal system then becomes one of a number of cases of institutional evolution, which can be used to throw light on the broader properties of evolutionary systems, informing a more general theory of evolution (Luhmann, 2004: 231).

3.2 The autopoiesis of social and legal systems

A social system, for present purposes, can be thought of as a linked set of discursive and behavioral practices through which social action is coordinated. Systems arise from the iteration between agency and structure, and thereby display the feature of *emergence* which implies that ‘complex’ orders cannot be reduced to, or explained entirely in terms of, their constituent parts (Morowitz, 2002). Social systems are cognitive orders which store and retain information drawn from their environment and transmit it back in such a way as to shape the environment’s structure. Thus social systems are adaptive: they coevolve with their environment or, more precisely, with each other. The process of cultural transmission takes a number of forms but is evident above all in social phenomena such as behavioral routines, public symbols and linguistic formulae, rather than taking a neurological or physical form as suggested by the idea of memetic ‘brain to brain’ transmission (Dawkins, 1976). The idea of a meme as a cultural unit of transmission is directly relevant here, but legal memes assume a social or institutional form (Deakin, 2003; Carvalho and Deakin, 2011), which is one possible manifestation of the phenomenon of associational or group cognition (Aoki, 2010: 22).

In its empirical dimension, social systems theory takes a broad view of the scope of the social sciences, which can embrace behavioral studies but also extends to the interpretive analysis of linguistic forms. Behavioral analysis is not irrelevant, but systems theory rejects the idea that social structure is equivalent to the sum of the actions of individuals. Because writing ‘operates as social memory’ (Luhmann, 2004; 234), the structure of texts is indicative of social structure more generally.

Systems theory provides an evolutionary account of the legal system, and of other, related social systems, which takes a combined ‘external’ and ‘internal’ approach. A number of external points of reference, derived from general theory of biological and social systems (Maturana and Varela, 1992; Luhmann, 1995), are used to frame an interpretive account of the legal system which views legal phenomena from within the system itself, that is to say, through the internal processes, symbols and linguistic structures of the law (Teubner, 1993; Luhmann, 2004). The first step in the analysis is to reconstruct the internal dynamics of the legal system which form the basis for its *autopoiesis* or self-referential closure. The ‘closure’ of the system signifies its autonomy from other social systems and the distinctiveness of its internal operations. Closure does not imply that systems operate in isolation from each other or that there are no causal interdependencies between them (Luhmann, 2004: 80). Instead, the autopoiesis of social systems is the precondition of their mutual constitution, or coevolution.

System closure, in this sense, is the result of the complexity of modern society and of its fragmentation or functional differentiation into a number of separate discursive spheres (law, economy, politics, religion, science). This follows from a more fundamental separation, that of societal evolution in general from its biological base. Societal evolution is distinguished by the emergence of *meaning* as a feature of human communication. Meaning implies that human agents do not act solely on the basis of common knowledge of their environment; they do so, more specifically, on the basis of *commonly accepted modes of interpretation*. Social systems, such as the legal system, represent particular types of discursive practice, through which the interpretive process is organized. Systemic differentiation provides the basis for the variety of forms of human action found in modern society and, more generally, for the coordination of complex social relations.

Thanks to their autopoiesis, social systems are *operationally closed* but *cognitively open*. This means that, notwithstanding their mutual differentiation and separation, they have the capacity to process information from the external environment in such a way as to make it meaningful in the context of their internal processes. The legal system receives information from the social context in which its rules are applied – for example, the economy or the political system – through the points at which it comes into contact with relevant forms of social interaction, such as litigation, adjudication and the legislative process. For this information to be meaningful within the legal system, however, it has to be ‘coded’ into juridical form. This is achieved through the use of a distinctively legal form of language – legal ‘dogmatics’ – based on higher order concepts or abstractions which inform the content of

rules. Concepts like ‘property’ or ‘contract’ *condense* or *compound* the information flowing into the legal system from dispute resolution and political deliberation. In turn, they form an informational store or *cognitive resource* which can be mobilized by the practice of legal interpretation: ‘concepts store experiences and keep them on call, even though the concept does not formulate these experiences... but only reactualizes them in a given instance (Luhmann, 2004: 341). Interpretation forms the basis for the formulation of legal rules which are then transmitted back to social actors in the form of rulings, statutes, codes, and so forth.

However, the legal system does not simply produce rules for consumption by social actors, in the sense of responding to the demands of the economy or polity. The legal system organizes the information it receives in such a way as to formulate rules which are linked to each other and to the higher-level conceptual abstractions which inform them. Legal norms acquire stability through the internal, systemic inter-linking of rules and concepts: ‘only through complex legal dogmatics can the stabilization and restabilization of norms be shifted from the simple... validity of assigned norms to their consistency’ (Luhmann, 2004: 257). It is, moreover, the need for consistency in its internal operations, and not its alignment with the economy or the political system, that above all drives the workings of the legal system and defines its ‘efficiency’. It follows that some degree of misalignment of systems is unavoidable. The removal of system boundaries would not, however, bring them more closely into equilibrium. By undermining the autonomy of systems, and allowing some to dominate others, it would diminish the capacity of human society (the sum total of social systems) to organise the innate complexity of its environment, which is the precondition for societal coordination.

While stable, the legal system is also adaptive. Its evolutionary properties are the combined result of the closure or autonomy of the system, on the one hand, and the possibility of its *structural coupling* with related social systems, including the economy, on the other (Teubner, 1993: ch. 5). Through its operational closure, the legal system internalizes the mechanisms of inheritance, variation, and selection. Legal reasoning, which is guided by the principle of internal consistency, supplies a basis upon which normative phenomena are stabilized (inheritance), while also providing for the adjustment of rules in the light of changing external circumstances. A legal device such as the doctrine of precedent, which is aimed at achieving consistency, simultaneously contains the basis for the modification of rules when new cases arise (variation). Precedent implies that like cases will be treated alike, and unlike cases differently from each other. Under these circumstances, ‘evolutionary selection achieves a very specific form’, one in which new rules emerge from the matching of rules to cases and the scope for the modification of rules which arises when two cases

are not alike (Luhmann, 2004: 255). It would be misleading here to think of variation as the random result of, for example, errors in the copying or replication of rules. Rather, variations are channeled by the twin pressures on legal interpretation: to maintain the internal order of the system, on the one hand, while finding a way to process and translate the information received from the environment, for example through litigation over individual cases, on the other. The result is the apparent paradox of legal rules which are simultaneously stable and mutable.

We are now in a position to reconsider the role played by legal rules as public indicators or representations of the recursive states of play which represent the outcomes of societal interaction (Aoki, 2010). Legal rules are indicators of a particular kind. They cannot be equated with the social norms observed by economic actors engaged in repeated trade or the common priors shared by a given set of agents, but they may be linked to them, responding to them as well as informing their development. Thus to some degree, legal norms will reflect external environmental conditions. In that sense, legal rules can be said to be endogenous to particular social and economic contexts. The development of modern concepts of property and contract has been, over the long run, coterminous with the rise of market-based economic relations (Luhmann, 2004: 250). A change in the economic environment of the kind represented by the rise of industrial, market-based economies will give rise to selective pressures on the legal system, arising from incentives that parties have to challenge what are, for them, inefficient rules, that is to say, those which impose a private cost on them. This can result in litigation challenging establishing rules or legislation arising from attempts to alter them through the political process. However, the result will not be a perfect alignment of legal rules to economic needs, or of social to private costs. Nor can the legal system simply adopt the contours of a social norm or convention that is generally respected in society. The scope for legal variation is constrained by the need to maintain the legal system's autonomy and internal consistency. Selective pressures of the kinds identified in the evolutionary law and economics literature (Rubin, 1977; Priest, 1977) can only act on a strictly finite set of rules. The effect is misalignment between public indicators and evolving states of play (Aoki, 2010: 143).

If the legal system is only imperfectly matched with its environment, its capacity to shape social outcomes through the production of norms is also constrained by its autopoiesis. In the first instance, legal communications are just internal directions within the legal system, addressed to legal actors. The text of a statute embodying economic legislation, in itself, has no implications at all for the market exchanges which it purports to regulate (Teubner, 1993). The effectiveness of such legislation depends on the norm it contains being transmitted to the social actors concerned and on their own capacity to receive

and act upon it (Aoki, 2010: 136). A law is likely to be more effective the greater the extent to which it gives expression to an already existing practice. Because the fit between formal laws, social norms and behavioral practices is imperfect, this cannot be guaranteed.

The emergence of legal systems, which implies their separation from the economy and the political system, is nevertheless a process with the potential to extend the possibilities of societal coordination. A legal system is a highly specialized kind of information storage device. Through legal ‘coding’, it transforms and then preserves socially useful knowledge that would otherwise be dissipated or lost. The coevolution of law, economy and polity implies the existence of institutional complementarities across different domains of interaction. Legal notions such as ‘contract’ or ‘corporation’ will not bear the same meaning as, for example, ‘exchange’ or ‘organization’ in an economic context, but they will be related to them in various ways. Changes in one system or domain, while not implying a parallel shift in another, may nevertheless have an impact on complementary institutional structures in other domains, and hence on the interactions of agents. Thus the parameters of social interaction in a given domain should be thought of as only *quasi-fixed*, that is, as open to external influence which is expressed through a coevolutionary logic (Aoki, 2010: 134).

3.3 A systemic interpretation of the good faith game

A reconsideration of the case of the good faith game illustrates the relevance of the systemic approach to legal evolution. It was argued in section 2.2 above that when the contract negotiation game is played according to a norm of good faith, the original battle of the forms is transformed into a game which is more likely to produce a contract which accommodates the mutual interests of the parties. The approach taken by Lord Goff when he was a first instance judge in the *Cleveland Bridge* case achieved this result by declining to find a contract in a situation where there was no convincing evidence, as he saw of it, of mutual assent to the contract terms. By denying the buyer a remedy for non-performance and limiting the seller to a claim in restitution for the value of part performance, the *Cleveland Bridge* case penalized defection and thereby created a legal regime that should have reduced parties’ incentives to engage in a battle of forms in future.

In practice, it does not seem to have had this effect. Battle of forms cases have continued to come before the English courts on a regular basis. The highest appellate court, the UK Supreme Court, recently distinguished *Cleveland Bridge* in a case of this kind, *RTS Flexible Systems Ltd. v. Molkerei Alois Müller GmbH & Co. KG*,⁴ declining to follow Lord Goff’s approach. The

Supreme Court in this case reached a different result from both the first instance judge and the Court of Appeal, suggesting that this was a case in which the nature of the supposed agreement made by the parties was open to multiple interpretations.

The English case law on the battle of forms illustrates the tension between the doctrine of precedent and the pressure to adjust settled legal rules to new commercial circumstances. Lords Denning and Goff recognized and publicly articulated the problems in applying nineteenth century contract law doctrine to late twentieth century conditions. In *Butler*, however, Lord Denning's attack on the last shot doctrine was too openly confrontational to succeed. A few references to isolated earlier dicta aside, he did not attempt to fit his new analysis into an existing conceptual category. As a result his minority opinion in *Butler* has left virtually no trace in the law. Lord Goff's approach was different. He invoked a well recognized, if (then) somewhat neglected restitutionary remedy, the *quantum meruit*, as an alternative to the normal contract claim. Some courts have followed his lead,⁵ but the Supreme Court has failed to endorse it when it had the opportunity, preferring to regard *Cleveland Bridge* as a case that 'depends on its own facts'.⁶

The case law on the battle of forms illustrates the point that judges do not, on the whole, decide cases in an openly instrumental way. Whatever the arguments for and against the view that common law judges tend to discover efficient (that is, social cost minimizing) private law rules (Rubin, 1977), they hardly ever invoke efficiency as a justification for their decisions. This does not mean that they are unaware of the consequences of their rulings. Rather, it illustrates the overriding importance of what might be called system consistency. Even incremental innovations in the law, and certainly more radical ones, depend for their validity in the internal legal order on being presented in terms which describe them as a development from the existing stock of precedents.

The case of the battle of forms also illustrates the complex and indirect relationship that legal concepts have to commercial practice. 'Good faith' is not a rule directed to commercial parties, but a higher-order concept which informs the interpretation and evolution of more specific legal norms. Its principal function is to organize legal information within the legal order. Such a concept is open to multiple interpretations. Neither Denning nor Goff used the expression in their judgments in the battle of forms cases they decided. When the relevance of the concept of good faith to English contract law was put squarely before the House of Lords (the forerunner of the UK Supreme Court as the highest appellate court) in the early 1990s, the court held that the concept had no application in the context of the formation of commercial contracts,

taking the view that the parties could be expected to bargain at arm's length and with a robust view of their own self-interest.⁷ Thus the concept of good faith in commercial (business to business) dealings is simply not recognized by the English common law. It has made a limited entry into the English law of contract only via a European Union directive regulating terms in consumer contracts (business to consumer dealings).⁸

The Directive on Unfair Terms in Consumer Contracts incorporates a version of the good faith concept which is drawn from the civil law tradition and specifically from the German law notion of *Treu und Glauben*. Why have the English courts been resistant to a concept which appears to work well in the context of another market-based economy? The answer only partly turns on the civil law roots of the German rule, and has nothing to do with its 'legal origin' in the sense recently developed in parts of the law and economics literature, which draws a distinction between common law and civil law systems according to the role played by the courts, as opposed to legislatures, in developing the law (La Porta et al., 2008). Although references to *Treu und Glauben* can be found in the late nineteenth century German civil code, its modern form, in which it operates as a general norm of reciprocal fairness in commercial and not just consumer contracts, it was the result of judicial innovations in the 1920s (Dawson, 1983). The presence of good faith as a general principle of the German law of contracts, and its absence from the equivalent English law, owes more to the economic context of the two systems. In Germany, the principle of good faith stands at the apex of a system of more specific legal rules giving concrete effect to the principle of reciprocal fairness, the terms of industry-level standard form agreements setting out generally-accepted terms of dealing for particular types of contract, and, at a further level closer to that of the economic exchanges themselves, a widely observed social norm of flexibility in contractual dealing which is reflected in the widespread use of 'hardship' clauses and other explicit contractual devices for adjusting long-term contracts (Arrighetti et al., 1997; Casper, 2001).

Thus the good faith norm does not directly inform contractual dealing, but it indirectly influences it through its role in stabilizing the structure of subsidiary norms and practices to which it is linked. When commercial parties negotiate a manufacturing and supply contract in a German context, their common priors originate in a range of normative sources. The most immediate will take the form of prevailing practice in the industry concerned and general expectations of appropriate behavior in the context of contract negotiations. More specifically, these parties will know that they can rely on industry-level standard terms which cannot straightforwardly be customized to suit either party's advantage. They are unlikely to have, or to need to have, a detailed knowledge of the legal doctrines informing the practice of industry-level standard terms, or

of the jurisprudence underlying the principle of good faith. The legal principle nevertheless provides indirect support for the stabilization of the social norms which more directly shape commercial practice. It is, conversely, the product of those other norms and practices: ‘good faith’ represents the coding, in juridical form, of practices and beliefs which have resonance within the economic environment.⁹

In British contractual practice, it is less usual to find industry-level standard term contracts which are regarded as generally binding on commercial parties. In sectors where they exist, one or both parties will often try to customize them to their own advantage (as in the *RTS* case). While practice varies from industry to industry, hardship clauses are rarely used, in part because it is unclear whether they can be legally enforced,¹⁰ and contractual flexibility more often takes the form of disregarding contracts altogether in favour of informal dealing (Arrighetti et al., 1997). Thus the endogenous pressures which helped to instantiate the social norm of reciprocal dealing and in due course shaped the evolution of the principle of good faith in the German context, do not exist, or at least not to the same extent, in Britain. Even the limited introduction of the concept of good faith into English contract law through the consumer contract terms directive has had, in this unpromising environment, more the effect of an ‘irritant’ than the anticipated ‘transplant’: while not without some significant impacts on law and practice, these, by and large, have turned out in a way which is distinct from the way the norm operates in its home system (Teubner, 1998).

This is consistent with a systemic view of legal evolution. There is no inbuilt tendency for the legal system to arrive at rules which in an abstract, context-independent way can be modeled as ‘optimal’. Rather, legal interpretations evolve in the specific context of the industrial and commercial practices of their home environments. The resulting normative orders are often good enough for local practice, without being precisely aligned with them. Institutional complementarities ensure diversity across different industrial and national contexts, even within the larger family of market-based economic systems, and in the face of efforts to establish common standards through transnational harmonization initiatives.

4. Conclusion: Legal Evolution Reconsidered

This paper has sought to contribute to the debate over the nature and effects of legal evolution. It has argued for a methodological approach based on the distinctiveness of legal evolution, that is, its separation both from societal evolution more generally and also from biological evolution. Examining legal evolution ‘from within’ reveals structural features of evolutionary processes which have wider implications for model building and for empirical analysis in

the social and behavioral sciences. For game theory, it provides a missing link in models of social interaction under conditions of shared beliefs, by explaining the institutional origins of the common priors which form the basis for correlated equilibria. For the behavioral sciences more generally, it opens up new perspectives on the origins of social structure, which can be drawn from study of the lineage of legal concepts and their coevolution with economic forms.

Legal evolution ‘does not mean that the level of happiness of social life generally has been raised effectively, let alone that law correctly reflects the factual state of a given society’ (Luhmann, 2004: 141). Legal evolution has brought about autonomy for the legal system from the economic and political domains, a development with decidedly mixed results. The autonomy of law qualifies the effectiveness of legal reform as an instrument of economic and social policy, while insulating the legal system from wider pressures for social change. At the same time, legal autonomy is the precondition for the impersonal and impartial application of the coercive power of the state, the ‘rule of law’ which is understood to be part of the bedrock of a market economy and democratic society. In such societies, the legal system informs and supports the web of beliefs and expectations through which societal coordination is combined with protection for the individual and private sphere. This is hardly a negligible achievement. It is also a contingent and precarious one, under threat from the politicization of legal decision making and from intellectual currents arguing for the economization of the legal system. It will be important to understand more fully what is at stake in legal evolution.

Notes

¹ In Figures 1 and 2, the choices of the offeror are represented in the rows and those of the offeree in the columns. The offeror plays cooperate in the top row and defect in the bottom row. The offeree plays cooperate in the left-hand column and defect in the right-hand column. The payoffs are expressed as (row, column), that is, (offeror, offeree).

² [1979] 1 WLR 401.

³ [1984] 1 All ER 504.

⁴ [2010] 1 WLR 753.

⁵ Including the Court of Appeal in the *RTS* case ([2009] EWCA Civ 26) and another recent decision, *Whittle Movers Ltd. v. Hollywood Express Ltd.* [2009] EWCA Civ 1189.

⁶ [2010] 1 WLR 753 at [54].

⁷ *Walford v. Miles* [1992] 2 AC 198.

⁸ Directive 93/13/EC on unfair terms in consumer contracts; Unfair Terms in Consumer Contracts Regulations, SI 1999/2083 (replacing SI 1994/3159).

⁹ In the specific context of the battle of forms, German commercial law protects each party against attempts by the other to impose their own terms. The courts moved away from the equivalent of the ‘last shot’ approach in the 1980s, ruling that the standard terms of one party would only become part of the contract if the other expressly agreed or, in the absence of such agreement, to the extent that they were consistent with or overlapped with those of the other (BGH, NJW 1985, 1838, 1839; BGH, NJW 1991, 1604, 1606). I am grateful to Georg Ringe for clarification of the German law on this point.

¹⁰ This is the consequence of *Walford v. Miles* [1992] 2 AC 198.

References

- Aoki, M. (2001) *Toward a Comparative Institutional Analysis* (Cambridge, MA: MIT Press).
- Aoki, M. (2007) 'Endogenizing institutions and institutional change' *Journal of Institutional Economics*, 3: 1-31.
- Aoki, M. (2010) *Corporations in Evolving Diversity. Cognition, Governance and Institutions* (Oxford: Oxford University Press).
- Arrighetti, A., Bachmann, R. and Deakin, S. (1997) 'Contract law, social norms and inter-firm cooperation' *Cambridge Journal of Economics*, 21: 171-96.
- Aumann, R. (1976) 'Agreeing to disagree' *Annals of Statistics*, 4: 1236-1239.
- Aumann, R. (1987) 'Correlated equilibrium as an expression of Bayesian rationality' *Econometrica*, 55: 1-18.
- Aumann, R. (1995) 'Backward induction and common knowledge of rationality' *Games and Economic Behavior*, 8: 6-19.
- Aumann, R. and Brandenburger, A. (1995) 'Epistemic conditions for Nash equilibrium' *Econometrica*, 65: 1161-80.
- Axelrod, R. (1984) *The Evolution of Cooperation* (New York, NY: Basic Books).
- Boyd, R., and Richerson, P. (1985) *Culture and the Evolutionary Process* (Chicago, IL: University of Chicago Press).
- Casper, S. (2001) 'The legal framework for corporate governance: the influence of contract law on company strategies in Germany and the United States', in P. Hall and D. Soskice (eds.) *Varieties of Capitalism. The Institutional Foundations of Comparative Advantage* (Oxford: Oxford University Press).
- Cavalli-Sforza, L., and Feldman, M. (1981) *Cultural Transmission and Evolution* (Princeton, NJ: Princeton University Press).
- Dawkins, Richard. 1976. *The Selfish Gene* (Oxford: Oxford University Press).
- Dawson, J. (1983) 'Judicial revision of frustrated contracts: Germany' *Boston University Law Review*, 63: 1039-98.

- Deakin, S. (2003) 'Evolution for our time: a theory of legal memetics' *Current Legal Problems*, 55: 1-42.
- Deakin, S. and Carvalho, F. (2011) 'System and evolution in corporate governance,' in P. Zumbansen and G.-P. Callies (eds.), *Law, Economics and Evolutionary Theory* (Cheltenham: Edward Elgar).
- Du Laing, B. (2011) 'Bio-legal history, dual inheritance theory, and naturalistic comparative law: on context and content biases in legal evolution' *Review of Law and Economics*, forthcoming.
- Gintis, H. (2009) *The Bounds of Reason. Game Theory and the Unification of the Behavioral Sciences* (Princeton, NJ: Princeton University Press).
- La Porta, R., Lopez-de-Silanes, F. and Shleifer, A. (2008) 'The economic consequences of legal origins' *Journal of Economic Literature*, 46: 285-332.
- Laland, K., Feldman, M. and Odling-Smee, J. (2000) 'Niche construction, biological evolution, and cultural change' *Behavioral and Brain Sciences*, 23: 131-175.
- Lewis, D. (1969) *Convention: A Philosophical Study*. (Cambridge, MA: Harvard University Press).
- Luhmann, N. [1984] (1995). *Social Systems*. J. Bednarz Jr. with D. Baecker (trans.). (Stanford, CA: Stanford University Press).
- Luhmann, N. [1993] 2004. *Law as a Social System*. K. Ziegert (trans.), F. Kastner, R. Nobles, D. Schiff and R. Ziegert (eds.) (Oxford: Oxford University Press).
- Nash, J. 1951. 'Non-cooperative games' *Annals of Mathematics*. 54: 286-295.
- Maturana, H, and Varela, F. (1992) *The Tree of Knowledge. Biological Roots of Human Understanding* (London and Boston, MA: Shambhala).
- Morowitz, H. (2002) *The Emergence of Everything: How the World Became Complex* (Oxford: Oxford University Press).
- Priest, G. (1977) 'The common law process and the selection of efficient rules' *Journal of Legal Studies*, 6: 65-82.

- Richerson, P., and Boyd, R. (2004) *Not by Genes Alone* (Chicago: University of Chicago Press).
- Rubin, P. (1977) 'Why is the common law efficient?' *Journal of Legal Studies*, 6: 51-64.
- Schelling, T. (1960) *The Strategy of Conflict* (Cambridge, MA: Harvard University Press).
- Teubner, G. (1993) *Law as an Autopoietic System*. Z. Bankowski and R. Bankowska (trans.) (Oxford: Blackwell).
- Teubner, G. (1998) 'Legal irritants: good faith in British law, or how unifying law ends up in new divergences' *Modern Law Review*, 61: 11-32.
- Young, H.P. (1998) *Individual Strategy and Social Structure: An Evolutionary Theory of Institutions* (Princeton, NJ: Princeton University Press).
- Zweigert, K, and Kötz, H. (1998) *Introduction to Comparative Law*. T. Weir (trans.) (Oxford: Oxford University Press).
