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The Vital Role of Norms and Rules in Maintaining Open Public and Private Economies

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by

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Introduction

After the fall of the Berlin Wall, the presumption of many policy analysts was that rapid development in the former Soviet Union would result from the creation of effective market institutions and the privatization of land and productive enterprises. Achieving the long-term goals of economic growth and prosperity for citizens has proved to be far more difficult than initially presumed by many (Kikeri and Nellis, 2004; Shivakumar, 2005). Building systems of law and order is more complex and takes substantially more time and effort than simple text book examples illustrate or policy analysts thought when confronting post-colonial and post-Soviet political-economic systems (World Bank, 2001; 2002).

In this chapter, we will draw on systematic methods for analyzing strategies, norms, and rules developed by colleagues at the Workshop in Political Theory and Policy Analysis. With these methods, it is possible to dig under casual assumptions of "law and order" in a slow and methodological manner to illuminate the diverse challenges of establishing effective law and order and trust among citizens in any society. Establishing a high level of trust after massive failure of governance systems is even more difficult.

We begin this chapter with a very simple model: the game of Snatch. This simple game has been used in past work (Plott and Meyer, 1975) to illustrate that non-

simultaneous exchange in the absence of "law and order" leads to inefficient outcomes. We do not present this game to illustrate all exchange settings that occur informally in many settings. Rather, we start with a simple model in order to illustrate the basic dilemma of non-simultaneous exchange prior to a more complex analysis. The two-person Prisoners' Dilemma is frequently used in this fashion. Then, we demonstrate that while reciprocity norms can overcome the inefficient outcome of the game of Snatch, these norms depend on contextual factors such as community integration and stability.

The plan of the chapter is as follows: first, we present and analyze the game of Snatch and explore alternative models which lead to different equilibria. Next, we examine how the opportunity to gain a reputation can lead to trustworthy behavior, and how trust-enhancing institutions help people acquire reputations by disseminating information about who is trustworthy and who is not. Third, we describe three of these trust-enhancing institutions, and emphasize how they evolve in order to make reputation management less costly, more stable, and more effective. Finally, we point to some problems that occur when these institutions are designed without understanding the context of relationships they are to manage.

The Game of Snatch in a "Hobbesian State of Nature"

Consider the following situation: you own a farm in an isolated area. Another farmer has recently arrived in the area. To keep things simple, assume that all you grow is corn, and all that the other farmer grows is beans. Eating corn all the time has lost its appeal for you, and your neighbor is tired of bean soup, so you propose to trade him a bag of your corn for an equal amount of his beans. He agrees and suggests that since he passes your place to go to work on another plot this Friday, you leave a bag of corn out

front for him, and he'll exchange it for a bag of beans. You think about this and realize that you'll be in the field when he stops by, so it is possible for him to take your corn and not leave anything in return. Assume for argument's sake that there are no police to whom you can complain, and that you and the other farmer are unlikely to see each other again. Do you leave the corn out or not?[1]

Classical game theory—predicated on purely self-interested, economically maximizing players—advises against leaving the corn for your neighbor: he gets more utility from taking the corn and leaving you nothing than taking the corn and leaving behind some beans[2]. Let us solve the game in Figure 1 through backwards induction. Clearly, the other farmer receives more utility from playing Snatch than playing Exchange. Yet the form of the game is common knowledge, so you know the other farmer's payoffs and can predict that he will choose Snatch. Thus, you choose not to leave the corn out for him, leading to a Nash Equilibrium of (Don't Offer, Snatch). In this way, you avoid being a sucker. Unfortunately, you also forego any gains from trade: both you and the other farmer would benefit by trading corn for beans, but because you can't be guaranteed he won't steal your corn and leave you nothing, you decide not to take the risk.

[Figure 1 about here]

While backwards induction is an accepted solution concept for a finite extensive-form game, is it not without its problems. Like all static solution concepts, it assumes hyper-rational players who never make mistakes and have perfect recall. Furthermore,

[1] The game of snatch has a similar structure to the Choice game developed by Carl Bergstrom in this volume. Dating and market exchanges both rely on the development of reputations, norms and sometimes rules as we discuss in more depth in this chapter.

[2] This assumes utility corresponds only with individual economic gain. Many economists now question this assumption: for examples, see Rabin (1993), Cain (1998), and Fehr and Schmidt (2001).

experimental evidence from Centipede and Dictator games conflicts with the predictions of backwards induction (Camerer 2003). For this reason, it is valuable to explore a dynamic solution concept to the game of Snatch.

Replicator dynamics, which measure the fitness of a given population relative to the average fitness of its members, are commonly used to do this (Samuelson 1997). We let x equal the percentage of Farmer 1's who play Don't Offer, and y equal the percentage of Farmer 2's who player Snatch. Then the evolution of x and y over time t is given by the following replicator equations[3]:

$$dx/dt = 5x\,(1 - x)(2y - 1)$$

$$dy/dt = -5y\,(y - 1)(1 - x)$$

Since this game has asymmetrical payoffs, its behavior can be quite complex and counterintuitive. While space considerations prevent a full evolutionary analysis, we can make the following observations of interest:

By examining the second replicator equation, we see that it is always increasing for $y < 1$ and $x < 1$. This means that regardless of the strategy chosen by the initial population of Farmer 2's, this population will always end up all playing Snatch. This is not surprising, as the strategy of Snatch strictly dominates the strategy of Exchange for Farmer 2.

However, while the population of Farmer 2's playing Snatch is always increasing towards 1, its rate of increase varies inversely with the size of the population of Farmer 1's playing Don't Offer. In other words, as more Farmer 1's play Don't Offer, the rate of increase of Farmer 2's playing Snatch slows down. Thus, while the population of Farmer

[3] See the appendix to this chapter for the derivation of these equations.

2's always converges to playing all Snatch, how long this convergence takes depends on the growth rate of the population of Farmer 1's playing Don't Offer.

What can we say about this growth rate? Examining the first replicator equation, we see that dx/dt is increasing provided $x > 0$ and $y > 1/2$. However, when $x > 0$ and $y < 1/2$, dx/dt is decreasing. Thus, the proportion of Farmer 2's playing Snatch has to reach a certain threshold ($y = ½$) before the population of Farmer 1's begin to respond. So long as fewer than ½ the population of Farmer 2's are playing Snatch, they can get away with their malfeasance. However, since this population is increasing for all values of x and y, eventually the Farmer 1's begin to adapt and play Don't Offer instead of Offer.

In fact, since the population of Farmer 2's playing Snatch converges to 1, and the population of Farmer 1's playing Don't Offer is increasing for $y > ½$, then they eventually converge to 1 as well. We say that the point $x = y = 1$, where everyone is playing (Don't Offer, Snatch), is a fixed point of this system because $dx/dt = dy/dt = 0$. This means that once both strategy sets converge to this point, they will stay there provided everyone in both populations continues to play only these strategies. However, if players from either population make mistakes—that is, play Offer or Exchange—then the strategy sets may diverge from the fixed point $x = y = 1$. In particular, since the strategy (Don't Offer, Exchange) is only weakly dominated by (Don't Offer, Snatch), it cannot be eliminated from the strategy set of Farmer 1 by evolutionary pressure (Samuelson 1997).

Does this mean that the strategy (Don't Offer, Snatch) is evolutionary stable? The answer depends on one's definition of stability. In accordanance with Selten's theorem, it is not an evolutionarily stable strategy (ESS), because the weakly dominated strategy

(Don't Offer, Exchange) is not completely eliminated by the evolutionary process. However, as Samuelson (1997) notes, the criteria for a strategy to be an ESS are quite strong and eliminate some strategies which are for all intents and purposes evolutionarily stable. The question we need to answer is whether the failure to completely eliminate the weakly dominated strategy of (Don't Offer, Exchange) affects the evolutionary dynamics of this game in an important way. At first glance it does not seem to, although a more complete evolutionary analysis is needed to fully answer this question.

We have seen that non-simultaneous exchange is not a Nash Equilibrium of the game of Snatch. Furthermore, while the strategy (Don't Offer, Snatch) is not an ESS, it is fixed-point stable. Yet, we observe and participate in numerous exchanges of this sort every day, which leads us to believe that something more must be at work. Indeed, numerous explanations have been offered which make (Offer, Exchange) an equilibrium of this game. We will detail one of these explanations—that of trust-enhancing institutions—below. The point of the game of Snatch is that it is contrived: by abstracting from the shared strategies, norms, and rules which operate in the world we live in, we can more clearly see the necessity of having them in order for exchange to occur.

In this chapter, we argue that that many trust-enhancing institutions may evolve through the efforts of participants in long-term, repeated market exchange environments or when they are linked together as providers and consumers of public goods or common-pool resources. These trust-enhancing institutions make it easier to establish a reputation as a trustworthy participant as well as making exchange less costly, more stable, and more effective than possible without such institutions. Furthermore, efforts to design

such institutions without understanding the context of relationships can sometimes crowd out trust rather than enhancing it.

Trust in the "State of Nature": The Need for Institutions

The Game of Snatch illustrates that without any norms or rules related to the private exchange of goods, a Hobbesian state of nature exists. Hobbes, like modern game theorists, carefully laid out his assumptions. First, he set aside "the arts grounded upon words" (Hobbes: 1960) [original 1651] p. 80). Second, he examined a setting when "men live without a common power to keep them all in awe" (*Ibid*). Then, he presumed that in such a state where every man is against every other man:

> . . . there is no place for industry; because the fruit thereof is uncertain: and consequently no culture of the earth; no navigation, nor use of the commodities that may be imported by sea; no commodious building; no instruments of moving, and removing, such things as require much force; no knowledge of the face of the earth; no account of time; no arts; no letters; no society; and which is worst of all, continual fear, and the danger of violent death; and the life of man, solitary, poor, nasty, brutish, and short (*Ibid.*)

In such a state of nature, a game theoretic analysis predicts that households will not engage in exchange due to lack of trust. This contradicts not only our intuition derived from our own everyday experience in open, democratic societies, but empirical evidence that people do trust one another in many social dilemma situations far more than is theoretically predicted (Camerer 2003; E. Ostrom and Walker 2003). And, political theorists have shown that a "common power that keeps them all in awe" is not the only way that "law and order" is achieved (V. Ostrom, 1987; 1997). Accounting for this contradiction will lay the groundwork for the remainder of this chapter.

In game theory, equilibria are mathematically determined. Yet these equilibria are initially determined by the structure of the game assumed by the theorist. Alternative

models often have different equilibria, and the question of which model best represents a particular puzzle or problem in field settings can be difficult to answer. Below, we consider alternative models of the Game of Snatch which lead to different equilibria than the one determined by our initial model.

Trust in a World With Norms and Warm Glows

One possibility is that players adopt norms that lead them to derive utility from self-consciously refraining from snatching the goods. As Lynn Stout argues elsewhere in this volume, we often overestimate how selfish people are, because selfish behaviors stand out from everyday observations. Andreoni (1989) has suggested that people receive a "warm glow" from performing good deeds and adhering to social norms. Following Crawford and E. Ostrom (1995), we can model this "warm glow" as a delta (δ) parameter that is added to the utility of the player who follows a norm to refrain from snatching goods and thus, exchanges rather than snatches goods. The game of Snatch with Warm Glow is illustrated below:

[Figure 2 about here]

Examination shows that (Offer, Exchange) is now the Nash equilibrium, provided that the value of δ is large enough to offset the advantage gained from snatching the goods. Paul Zak and others offer evidence in this volume that the δ may indeed be large enough in many cases. This makes the "warm glow" hypothesis compelling: however, much research demonstrates that social norms are needed to instantiate and maintain high-enough δ's to sustain a stable free-market society (Arce, 1994; Axelrod, 1986; Barner-Barry, 1986; Basu, 1995; Brooks, 2001). Thus, even if most players refrain from snatching due to a "warm glow," social norms are necessary to cultivate and sustain this

level of cooperation. The game of Snatch with Warm Glow could be an appropriate way to model close-knit settings with repeated interactions among members of a community, and where the individuals do have strong δ's. While there is no single external force to keep all participants "in awe," the setting allows for the establishment of norms so long as stability of population and shared commitment to the norms are maintained.

Trust in a World With Law and Order

A second alternative is the establishment of "law and order" by creating a new position in the community and adding the power of sanctioning to that actor's authority to be used when goods owned by one member of the community are taken illegally. Now, if your neighbor snatched your goods, you would be motivated – so long as you could get your commodities returned – to go to the judge, ask for your commodities back, and request the judge to sanction your neighbor by taking his commodities away. Once a position of judge is created with authority to sanction someone who took someone else's goods, your neighbor would face a new set of alternatives if he snatched, or better phrased now, stole your goods[4] Now, your neighbor knows that you would be motivated to call in the judge who would confiscate his goods and return yours to you. We call this the Game of Snatch with Property Rights and Sanctions (see Figure 3).

[Figure 3 about here]

Examination shows that (Offer, Exchange) is the Nash Equilibrium of this game, so long as the sanction involves a loss of utility from being sanctioned than is greater than

[4] Creating a system of "law and order" however, is just one change in the context and structure of a game. As Ostrom (2005; 211-14) illustrates, at least four rules– position, boundary, choice, and aggregation rules -- need to be changed to move from the "state of nature" game of Figure 1 to a game with property rights, and sanctions. These rules do not need to be changed by a single center of authority for an entire country, however, as Hobbes posited. In many countries, local communities have established their own rules related to diverse transactions taking place within their boundaries for centuries (Berman, 1983).

the expected gain from snatching the goods. Yet, in order for sanction to be effective, you must be willing to go to the judge and the judge must punish infractions. In the game in Figure 3, you have a real incentive to go to the judge, but the judge is represented as a player without a choice.

At a more general level, passing rules and enforcing them involves costs, which leads to a second-order collective action problem: what would be the incentives for players to monitor and sanction others when they receive no direct benefit from this action? Furthermore, the game in Figure 3 assumes that monitoring and sanctioning are both done perfectly: the guilty are always caught and the innocent never punished. Our more general point is that "assuming law and order," is not a simple process that can be imposed by some strong central authority. Those who participate in on-going transactions must be committed to following the rules and incentives to do so need to be in place. If the judge wanted a large share of your goods as well as confiscating those of your neighbor, you might never go to the judge.

A third possibility is that players can develop reputations for trustworthiness through their behavior. Players can then choose who to trade with based on their reputation, even in a one-shot game (provided the game itself is repeated with enough other players to generate reputations). Substantial evidence shows that people do rely on reputation information in determining who they will trust (Colson, 1974; Sally, 2002; Wedekind and Milinski, 2000). We believe that reputation provides a plausible explanation for one of the key mechanisms enabling sustainable free trade in a society. However, reputations cannot lead to an increased level of trust without institutions that enhance knowledge about and reliability of reputations. In the next section, we explore

these institutions in greater detail. We then argue that they evolve partly in order to make reputation management less costly, more effective, and more stable.

Trust-Enhancing Institutions and Reputation Management

We stated above that there is substantial evidence that people rely on information about other's reputations in deciding whom to trust. Yet reputations only provide a partial solution to the dilemma of whom to trust, because learning about these reputations is costly in a world of imperfect information. If this cost is too high, even perfectly accurate reputation information will not be disseminated at an effective level. In this section, we argue that one effect of trust-enhancing institutions is to help people manage reputations by disseminating information about who is trustworthy and who is not.

Strong evidence exists that people examine the reputations of others to decide if they are trustworthy. E. Ostrom (1998) and E. Ostrom and Walker (2003, Chapter 2) develop a behavior theory linking the interaction of trust, reputation, and reciprocity to success in solving collective action problems. Strong empirical support exists for this theory. For example, Fafchamps and Minten (1999) describe how agricultural traders in Madagascar rely upon personal networks in order to procure goods and manage risk. Clay (1997) examined the question of how, in the absence of formal legal systems in California during the early 1800s, merchants were able to engage in active trading. Drawing on evidence from the merchant's business correspondence, Clay examines the coalitions that merchants formed to mitigate the commitment problem involved when many actors handle goods, and the punishment that merchants imposed on cheaters. She also examined the expansion of the coalitions toward mid-century and their eventual

collapse at the time of the gold rush when coalitions were overwhelmed with many new participants without reputations.

Milgrom, North, and Weingast (1990) take this work a step further by analyzing the development of exchange markets in Champagne, France. Michele Fratianni (forthcoming) provides a fascinating history of the evolution of a formal association – San Giorgio – aimed at protecting creditors' rights and reducing the risk of the monarch repudiating debt. Reputation, norms, and rules are all involved in this historical evolution. Eric Feldman (2005) analyzes a dynamic market in modern Tokyo which has developed a highly formal, legal system backed by extensive norms to cope with the contentious problems related to the quality of tuna and who is responsible for spoiled fish.

Formal models also demonstrate the importance of this interaction: Annen (2003) uses an infinitely-repeated Prisoner's Dilemma game to show how the inclusiveness, communication capacity, and complexity of an exchange setting affects individual's ability to manage social capital. Bravo and Tamburino (2006) use an agent-based model to delimit the initial conditions which lead to the development of a "sense of trust" among a population. They speculate that:

> A system where trust, reputation and reciprocity are strictly linked in a positive feedback relationship is likely to assume only two states, one where the cooperation level is high and one where it is low. . .If this idea is right, a relatively thin threshold should mark the transition between high and low cooperation equilibria, and even close initial configurations may therefore end in fully different states (8).

The above sections demonstrate that reputations can, under certain circumstances, resolve the trust dilemma that is at the heart of the game of Snatch. Yet if Bravo and Tamburino are correct, it is vitally important to determine what these circumstances are.

As a first step, we consider the difference between perfect and imperfect information for developing a stable interaction between trust, reputation, and reciprocity. It is well known in game theory that in an infinitely repeated trust game, cooperation can be maintained if players do not switch partners and have perfect information and recall about one another's past actions (Fudenberg and Tirole (1991). Kandori (1992) shows that this result holds even if players switch partners every period, provided that the conditions of perfect information and recall are maintained. In this case, perfect information leads to indirect reciprocity. Further, players are willing to punish defectors even at a cost to themselves in order to maintain the stability of the system. In effect, perfect information resolves the second-order collective action problem of punishing defecting players. This leads to an equilibrium where snatching the goods is more costly than exchange, because no one will trade with you in the future if you have a reputation for snatching goods.

Fudenberg and Tirole and Kandori provide valuable insight into the conditions necessary for developing and maintaining a stable interaction between trust, reputation, and reciprocity. They do not go far enough, however, since in the real world, acquiring and disseminating reliable information is costly for all involved. People can only directly observe the decisions of a small fraction of those they may have to trust; for the rest, they must rely on information from other sources, such as the reports of others or heuristics such as group membership or likeability.

Of these substitutes, we focus our analysis on the reports that others provide about a given reputation, because this best illustrates the differences that arise in a world of imperfect information. Recall that perfect information can sustain trust in a society of

one-shot trust exchanges, even when players switch their partner every turn. This is because all players know the reputation of their exchange partners prior to every exchange game. Imperfect information removes this certainty about the reputation of one's partner. There is now a temptation to cheat—to snatch the goods—because doing so improves one's utility and does not necessarily decrease one's future utility. If reputation is not common knowledge, it does not have the same deterrent effect.

One way to overcome this problem is for people to tell one another when they have been cheated. In this way, one can approximate a world of perfect information and exclude untrustworthy people from exchange relationships. This could lead to the creation of a "sense of trust" in a society, especially given recent evidence that many people are predisposed to trust one another (de Waal, 1996; Kurzban, 2003). Yet, there remains the problem that people may not have an incentive to report to others that they have been cheated unless they already exist in tight networks of relationships. Reporting that one has been cheated is a costly action. These costs grow as the size of the society increases. This creates a second-order collective action problem: everyone would benefit if people did report that they had been cheated, but no one individual has an incentive to do so. For this reason, we must investigate the interaction of trust, reputation, and reciprocity under conditions of imperfect information. In doing so, we will see that one function of institutions is to help people manage reputations by disseminating information about who is trustworthy and who is not.

Before doing so, it is necessary to clarify what we mean by "institution." We draw on the framework presented in E. Ostrom (2005) which is based on more than two decades of theoretical and empirical study. We define institutions as the prescriptions

that humans use to organize all forms of repetitive and structured interactions. Institutions are present in families, neighborhoods, markets, firms, sports leagues, churches, private associations, and government at all scales. They do not have to written down or codified, and frequently are not. A farmers' market, a rotation system developed on a farmer managed irrigation system, and a legal code are all examples of institutions.

In studying institutions, it is useful to distinguish between three mechanisms that help players coordinate their behavior. Crawford and E. Ostrom (2005) develop an institutional grammar for this purpose. We will use this grammar to describe the coordinative mechanisms of shared strategies, norms, and rules, and to delimit the similarities and differences between them.

In the institutional grammar, all three mechanisms are expressed in the following syntax. This syntax includes five components: ATTRIBUTES, DEONTIC, A*I*M, CONDITIONS, and OR ELSE. Each mechanism is composed of different groupings of these components. The following descriptions will make this clear.

A *shared strategy* is defined as ATTRIBUTES of players with a specific A*I*M that may be performed under certain CONDITIONS. For example, in the game of trust, the players have the ATTRIBUTES of Trustor and Trustee. The A*I*M of the Trustor is to decide how much (if any) of his or her endowment to give to the Trustee, while the A*I*M of the Trustee is to decide how much (if any) of this money to return to the Trustor. The CONDITIONS for the Trustor delimit how he or she will behave based upon the actions of the Trustee. For example, the CONDITIONS for a "grim trigger" strategy would be "cooperate in each round of the game unless the Trustee defects, in which case defect for the rest of the game." CONDITIONS for the Trustee follow a similar logic.

A shared strategy depends solely upon players' expectations about each other's future behavior and prudential decision making. It noticeably lacks a DEONTIC component specifying what players must, may, or may not do. Instead, it is entirely the strategic interaction of each player's strategies that determines the equilibrium of a game.

A *norm* is defined as ATTRIBUTES of players who, according to certain DEONTIC conditions, must, may, or may not perform a specific A*I*M under certain CONDITIONS. Thus, a norm differs from a shared strategy in that it specifies that players must, may, or may not do certain actions. In the trust game with norms, the DEONTIC may state that the Trustee must return a certain portion of the money sent by him or her to the Trustor.

A *rule* is defined as ATTRIBUTES of players who, according to certain DEONTIC conditions, must, may, or may not perform a specific A*I*M under certain CONDITIONS, OR ELSE. Thus, the difference between a norm and a rule is the presence of a sanction: the OR ELSE condition. In the trust game, this condition may define what sanctions the Trustee is subject to if he or she does not follow the condition specified in the DEONTIC. This has necessarily been a brief overview of the institutional grammar. Interested readers are referred to Chapter 5 in E. Ostrom (2005) for a more complete treatment.

Having outlined the above grammar, we can utilize it to describe three interactions of trust, reputation, and reciprocity of increasing complexity. In doing so, we will see the problems that arise from simple solutions to trust generation; how more complex institutions arise to resolve these problems; and how these solutions lead in turn

to different problems which in turn require a careful understanding of their complexity to mediate and resolve.

Three Examples of Trust-Enhancing Institutions

We begin with a game illustrating how shared strategies can lead to a general "sense of trust" in a society. In a forthcoming article, Bravo and Tamburino describe an agent-based model based on a repeated sequential Prisoner's Dilemma. The following Figure illustrates this game:

[Figure 4 about here]

Examination shows that this game places the first mover in the role of Trustor, and the second mover in the role of Trustee. This is because if the first player chooses to Cooperate, this increases the possible payoffs of both players, but also requires the first player to trust the second player not to Defect and take a higher payoff. As with our game of Snatch, backward induction shows that the Trustor should choose to Opt-Out—that is, refuse to trust the Trustee. The Nash equilibrium of the one-shot game is therefore (Opt-Out, Defect), resulting in no gains from trust for either player.

How does adding reputation change the dynamics of this game? Bravo and Tamburino use an agent-based model to answer this question. In this model, each of 1000 agents plays the above game with other randomly selected agents for 10000 generations. Each generation consists of 24 periods. The role of each agent is randomly selected for each pairing: that is, sometimes the agent is the Trustor, while other times it is the Trustee.

Each agent is defined by two parameters: the probability (p) that the agent will choose to Cooperate when it is the Trustor, and the probability (q) that the agent will

choose to Cooperate when it is the Trustee. Values of p and q are randomly assigned at the beginning of the first generation and evolve throughout the simulation. At the end of every generation, each agent generates a number of offspring proportional to the sum of the payoffs earned during the 24 periods forming the generation. Each offspring inherits the characteristics of its parent, with a 0.005 percent probability of a random mutation in one of its two parameters. At the end of the reproduction process, 1000 offspring are randomly selected to form the next generation.

Bravo and Tamburino model six different states. The ones of interest to us involve imperfect information. In these states, every time a Trustee moves, only a randomly selected number of agents are allowed to observe its behavior and use this information in subsequent periods. Each of these states was tested under two different conditions: stranger matching, where agents switch partners every round, and partner matching, where agents play six periods before being re-matched.

What do Bravo and Tamburino observe in these two conditions under imperfect information? First, they note that the results obtained in both conditions depend heavily on the proportion of agents who can observe a given exchange. In turn, these results are different in the stranger matching condition than in the partner matching condition: in the latter, high cooperation levels are sustainable with about half as many observers as are needed in the former. Bravo and Tamburino attribute this to the ability of agents in the partner matching condition to rely on direct reciprocity, as well as indirect reciprocity. As agents must rely on indirect reciprocity in the stranger matching condition, a higher proportion of observer agents are needed to maintain high cooperation levels.

Bravo and Tamburino's second finding is that, in a world of incomplete information, something akin to a general "sense of trust" emerges because agents cannot consistently base their decision on the reputation of their opponents since they lack full information regarding this. They summarize this "sense of trust" as follows:

> By emergence of a general trust, we mean that the micro-level effect of trust is independent from the corresponding effect of reputation. First-players are more likely to be trustful even if second-players have a "cheater" reputation or if they do not know anything about their opponent's past behaviors. . .Most agents will therefore start cooperatively any interaction with an "unknown" opponent and only subsequently adapt their moves as a function of its behavior, a clear example of direct reciprocity strategy (13-14).

Finally, Bravo and Tamburino note that in both conditions, the system under incomplete information seems to be able to reach only two states: one close to the noncooperative equilibrium and one close to the cooperative optimum. Through parameter analysis, they note that when the effect of reputation is weakened and the number of observers is proportionally low, the system rapidly closes in on the noncooperative equilibrium.

What lessons can we learn from this analysis? First, it is important to note that using the institutional grammar outlined above, the agents are relying on shared strategies rather than norms or rules. Bravo and Tamburino demonstrate that under conditions of incomplete information, these shared strategies can generate a "sense of trust" to a degree independent of reputation effects. However, this "sense of trust" is highly dependent upon the initial parameters of the model: in particular, on the number of agents who are able to observe a given exchange. Furthermore, when these parameters are not sufficiently high, the model rapidly closes in on the noncooperative equilibrium. This demonstrates that shared strategies can lead to high levels of cooperation, but that

achieving this result is highly dependent on the initial levels of trust and trustworthiness present in a population. It is unlikely that many large and mobile populations will be able to achieve high levels of cooperation based on shared strategies alone. Furthermore, even those populations with the right initial conditions have a strong incentive to look for ways to bolster their initial "sense of trust" against internal and external shocks.

One way to do this is by switching from shared strategies to norms. Norms differ from shared strategies in that they have a DEONTIC component which specifies actions the player may, must, or must not take. E. Ostrom (2005) describes them thus:

> Norms can be represented in formal analyses as a delta parameter that represents the intrinsic benefits or costs of obeying a normative prescription in a particular setting. The changes may occur as a result of intrinsic motivation such as pride when keeping a norm or guilt when breaking a norm. The delta parameter may also occur as a result of the action being observed by others leading to esteem for following a norm or shame for breaking it (121-122).

We observed an example of this type of modeling in Figure 2 above, the Game of Snatch with Warm Glow. Here, the second player has an internal norm against snatching the goods from the first player. This norm is modeled as a delta (δ) parameter that is added to the payoff of the second player if he or she does not snatch the goods. If the value of δ is greater than the marginal gain from snatching the goods, then the second player gains more utility from not exchanging goods than from snatching them.

Do norms in fact influence behavior in this way? There is strong evidence that they do. Gouldner (1960) theorizes a norm of reciprocity present in most societies. This norm is present even in children, and likely learned by children from their parents (Harbaugh, et al., 2003). Further evidence comes from Kerr and Kaufman-Gilliland's (1994) meta-analysis of social dilemma experiments. After examining competing explanations for how groups manage to resolve social dilemmas, the authors conclude

that successful groups rely on explicit or implicit promises to abide by a group agreement which, if followed, will resolve the dilemma. In most cases, this agreement is made during face-to-face communication with other group members, while in almost all cases, defection cannot be punished by the group (this is certainly true when the players only communicate once). Yet in a majority of cases, players in groups which used face-to-face communication to arrive at successful agreements did abide by them (Sally, 1995; see also Bochet, Page and Putterman, 2006). Since each player in a social dilemma has an incentive to defect from the group agreement (particularly if the other group members abide by it), this is strong evidence that norms do alter individual behavior.

At a macro-social level, norms can stabilize the initial "sense of trust" generated by shared strategies. There is strong evidence that humans have both an innate propensity to learn norms, and a keen ability to recognize violations of norms in others (Pinker 1994; Manktelow and Over 1991; Price, forthcoming). This could make untrustworthy behavior more costly, even under conditions of imperfect information.

Certainly, the norms that one learns are highly dependent upon the culture he or she grows up in. However, some norms are nearly universal, such as the norm of reciprocity (Gouldner 1960). In addition, there is evidence for a norm of strong reciprocity, where people are willing not only to reciprocate trustworthy behavior, but to punish untrustworthy behavior even at a cost to themselves (Gintis, this volume). In this way, norms can resolve the second-order collective action problem associated with costly punishment.

One way to observe norms in action is to examine the behavior of non-human primates such as chimpanzees and capuchins. As Brosnan demonstrates in this volume,

these non-human primates exhibit behavior consistent with the possession of internal and external norms of in-group reciprocity and inequity aversion. For example, Brosnan found that the willingness of capuchins to accept a food reward depended on whether their reward was equal to or less satisfying than the reward of another member of their in-group. Using the institutional grammar, we can define this norm as:

> A capuchin who receives a food reward that is less satisfying than the reward of another in-group member must not accept this food reward.

The advantage of this methodology is that one can separate behavior motivated solely by norms from behavior motivated by a combination of norms and rules or rules alone. While the social relations of non-human primates are not simple, non-human primates are less likely to be intentionally deceptive about their purposes than human primates. In other words, the social and dominance hierarchies which mark all primate societies, including those of humans, are more visible to the trained observer than those of human societies typically are. Furthermore, the absence of a differentiated, abstract language capability lessens the complexity of analysis: where rules are present, the sanctions are immediately observable behaviors, which leads to strong predictions about the motivation for this behavior. In sum, we join with Brosnan and the other colleagues in this volume in calling for further study of non-human primates as a way to isolate the fundamental norms which affect pro-social behavior from the confounding effects of an abstract, differentiated social structure.

As the above analysis shows, norms can stabilize the initial "sense of trust" generated by shared strategies. Yet norms are not a complete solution. Because they lack an explicit sanction (the OR ELSE statement in our institutional grammar), societies

which rely solely on norms are subject to invasion by purely self-interested actors. Furthermore, norms must be transmitted within a cultural framework, making them vulnerable to the weakening of this framework. This makes norms ill-equipped to handle the expansion and specialization necessitated by economic growth. Thus, while norms can stabilize the "sense of trust" in a society, the need to impose specific, graduated sanctions eventually leads societies which experience this growth to develop institutions relying on not just norms, but rules as well.

One example of this development is the rise of the medieval Law Merchant described by Milgrom, North, and Weingast (1990). The Law Merchant was a set of legal codes governing commercial transactions and administered by private judges drawn from the commercial ranks. The purpose of these codes was to enforce contracts between merchants from different localities. A merchant who felt that he or she had been cheated by another merchant could file a grievance with the local private judge, who would then conduct a trial and, if the grievance was justified, enter a judgment on behalf of the aggrieved merchant. As Milgrom, North, and Weingast (1990) note, the development of the Law Merchant code was vital to reducing the uncertainty of trade associated with varying local practices and limiting the ability of localities to discriminate against alien merchants. This in turn led to increasing economic differentiation and specialization, which helped make early modern Europe a center of economic exchange.

What is surprising about this development is that the judges had little or no power either to force parties to abide by the terms of their contract, or to sanction those who did not comply. This lack of sanctioning power was due to the prevalence of foreign merchants trading in Europe, against whom the judges had no legal jurisdiction. Thus,

while judges could enter judgments on behalf of an aggrieved merchant, they lacked the legal and political power to enforce these judgments. This creates the following paradox, nicely summarized by Milgrom, North, and Weingast (1990):

> . . .it is not clear why such a system would be effective. What prevents a merchant from cheating by supplying lower quality goods than promised, and then leaving the Fairs before being detected? In these circumstances the cheated merchant might be able to get a judgment against his supplier, but what good would it do if the supplier never returned to the Fairs? Perhaps ostracism by the other merchants might be an effective way to enforce the payment of judgments. However, if that is so, why was a legal system needed at all? (6).

Their resolution of this paradox ties in nicely with our previous discussion of the interaction between trust, reputation, and reciprocity. Recall that with perfect information, a high level of cooperation is sustainable even if players switch partners every turn. Bravo and Tamburino demonstrated that this level of cooperation was possible even given imperfect information, although achieving cooperation rather than the uncooperative equilibrium was heavily dependent upon how much information players had about one another's reputations. As our analysis demonstrates, one function of norms is to stabilize the system of cooperative exchange against internal and external shocks. Yet norms become increasingly unworkable as the society becomes more economically differentiated. Societies must then switch from norms to rules such as the Law Merchant. In doing so, they do not switch from one set of problems to another: rather, as Milgrom, North, and Weingast demonstrate, the Law Merchant makes possible the system of increasingly anonymous exchange by providing accurate information about the reputation of merchants to other merchants at a low cost. Thus, the core problem of maintaining a reputation system under imperfect information still exists, while the function of the Law Merchant is not to harness state power to enforce contracts, but

rather to disseminate reputation information at a low cost to all merchants trading at a specific locale. Merchants then use this information to choose whom to trade with, and can effectively ostracize untrustworthy merchants, even without direct observation of their untrustworthy actions.[5]

Yet for the Law Merchant to perform this function, it must provide an incentive for merchants to register grievances when they feel they have been cheated. As we have demonstrated, it is costly for merchants to register these grievances, and given the judges' lack of formal enforcement powers, little benefit for an individual merchant to do so. In other words, the Law Merchant runs into the second-order collective action outlined above. Its solution to this problem is ingenious: judges only allow merchants to use the system to resolve disputes if they make the appropriate queries prior to engaging in trade. This allows the judge to collect payments simply for providing information. In this way, both judges and merchants have an interest to use the Law Merchant courts, which in turn resolves the collective action problem and leads to the dissemination of low cost information. We can represent this solution by the following rules:

1. Merchants must make queries prior to engaging in trade, OR ELSE they cannot use the Law Merchant courts to register grievances.
2. Judges must provide accurate information to merchants in response to these queries, OR ELSE they cannot collect a fee for their services.

[5] Merchants throughout the world have faced similar problems to those described by Milgrom, North and Weingast. Gracia Clark has studied the evolution of market rules in Kumasi, Ghana and the important role that Asante women traders and their leaders play in both resolving everyday disputes among traders, building reputations, and increasing the returns that traders can obtain from use g this market as well as the rules and norms that have evolved in these arenas (See Clark, 2000; 2002; 2004)

Milgrom, North, and Weingast (1990) show that this system is sustainable provided the costs of making queries and adjudicating disputes is not too high relative to the frequency and profitability of trade.

The Law Merchant courts are one example of how rules can structure complex and differentiated exchange relationships. They also demonstrate one way that rules evolve from norms in order to fix problems that norms are not capable of resolving. However, rules are not a panacea. To see this, note that the Law Merchant system does not have to work exactly as described above. In particular, merchants who have bad reputations may bribe judges to conceal this fact from other merchants. Because judges have an information advantage in their relationship with the merchants, there is a real possibility for this type of corruption to occur. Not all judges will be honest, and as Milgrom, North, and Weingast demonstrate, this can lead to perverse outcomes and ultimately to the system's collapse.

A first reaction to this problem is frequently to create more rules: perhaps a rule sanctioning judges if they are caught taking bribes. Yet this may lead to further problems. Rules are never costless. All rules are potentially subject to manipulation by political actors (Riker 1982). Furthermore, each additional layer of rules creates not only additional governance costs, but increased complexity in the system. This complexity can lead to perverse outcomes and make the detection of corruption more difficult, both of which can cause the system to lose its legitimacy in the eyes of those who must rely on it.

Two Principles of Effective Institutional Design

The dilemma we have outlined is as old as politics: who will guard the guardians? In this section, we argue that a slight rephrasing is in order: how should the guardians be guarded, and what are the consequences of guarding them incorrectly?

We begin with the second question, because the consequences of incorrect institutional design are so well-known in contemporary society. In the private market, the Enron scandal demonstrates the potential for harm when powerful actors manipulate rules for their own gain at the expense of the weak. There are also devastating consequences in public economies when institutions fail, including environmental destruction and paralyzing government corruption. This leads not only to economic inefficiency, but to a pervasive distrust of private and public institutions by the public. At the extreme this distrust turns to cynicism and erodes the social capital necessary for both public and private economies to function efficiently.

It is not our purpose to speculate on the extent to which this is happening in the world today. Nor are we claiming that the Enron scandal or government corruption are solely the result of poor institutional design: both are complex phenomena, of which institutions compose only one part. Yet it is a vitally important part, and if we are to prevent future economic disasters, we must understand the basic principles of successful institutional design. There are many such principles. Here we want to focus on the following two.

First, it is vital to understand that the shared strategies, norms, and rules of an institutional arrangement are context-sensitive. There is no one perfect institutional solution to all problems, or even all problems of a certain type. To take a well-known example involving common-pool resource management: for many years, it was thought

that there were only two solutions to the "tragedy of the commons" outlined by Hardin (1968). These solutions were, on the one hand, instituting private property among resource users; and alternatively, instituting a sanctioning apparatus to punish users who over-utilize the resource. Both solutions had their partisans, who advocated their solution as the solution to all common-pool resource dilemmas and explained contrary results as anomalies.

What went largely unnoticed prior to a National Research Council study in 1986 and empirical research that was stimulated by it (e.g. Berkes, 1987; E. Ostrom, 1990; Acheson, 2003) was that the common-pool resource dilemma is not a single problem, but rather an abstract way of describing a large class of problems with certain similarities. These similarities provided a theoretical model with which to think about these problems. Yet some scholars reified the dilemma as existing everywhere when multiple users harvest from the same resource and recommended either privatization or government ownership as a panacea. Using only one way of thinking about CPR problems obscured important differences between different common-pool resource situations. These differences are more likely now to be recognized; yet many precious resources were destroyed in learning this lesson.

Thus, our first principle of successful institutional design is to pay attention to context-specific differences among similar classes of institutional problems. Selling commodities in a farmers' market is quite different than selling future options to buy or sell these commodities in a future market. In the wake of the Enron scandal, it is tempting to lay blame at a single cause and seek a corresponding solution. Yet this would be precisely the wrong action to take. Institutional reform is needed in both

private and public economies, but this reform must be closely attuned to the individual problem under consideration. Otherwise, we risk forcing problems to conform to institutions, rather than the other way around.

Second, we must understand that institutional solutions, if poorly implemented, can crowd out trust rather than enhancing it (Frey, 1994). This problem is especially prevalent with solutions imposed upon a group of people by outside experts. Any functioning system has evolved some institutions for its own maintenance. These institutions evolve through the reciprocal adaptation between the people and the overall process they are engaged in. They are rarely identical to the formal rules of the process, and often poorly understood by outsiders. As a result, imposed solutions often crowd out these adaptive institutions.

This is especially true where trust is concerned. Just as there is evidence for an innate tendency to trust others, there is also evidence that this tendency can be overridden if people are forced to trust others by sanctioning mechanisms or other means. For example, Cardenas, Stranlund, and Willis (2000) found that imposing rules on resource users without communication resulted in less efficient usage than allowing users the choice to adopt or reject rules during face-to-face communication. In a similar vein, Janssen et al., (2006) finds that subjects in a foraging experiment who vote to instantiate property rights showed greater compliance with them than when these rights were imposed upon them with no vote. Clearly, we must be careful in designing and repairing institutions not to crowd out people's willingness to trust one another by imposing sanctioning mechanisms upon them.

Conclusion

We began this chapter with a simple game in order to make a simple point: exchange of goods and services does not occur among strangers in the absence of trust-enhancing institutions. We then traced the interaction of trust, reputation, and reciprocity through the evolution of a simple institution to a complex one. In doing so, we have argued that the problem of imperfect information makes it difficult for exchange partners to rely on one another's reputations, and that one reason institutions evolve is to make reputation management less costly, more stable, and more effective. We then pointed out the problem of institutional growth, and made two suggestions for effective institutional design and reform.

In concluding, we note three things: first, ours is not the only solution to the problems of corporate scandal and government corruption. We have written about institutions because that is what we study. Yet, we strongly believe that any solution which does not take seriously the effect institutions have on exchange relationships is likely to fail.

Second, we have largely ignored questions of equity in order to focus on questions of efficiency. Yet the two are not the same. In any political-economic system, there is a great deal of leeway in how institutions are designed, and this leeway can institutionalize privilege in the hands of the powerful. It is important to keep this in mind when deciding which reforms to implement and which to forego.

Finally, it is worth noting that institutions—even well-designed ones—will not lead to beneficial outcomes by themselves. Institutions are inseparable from the people who make use of them, and as noted above, all rules are subject to manipulation by political actors. Thus, at some point we must cease to rely upon institutional corrections

and place our faith in a citizenry well-educated in virtue[6]. Ultimately, *we* must guard the guardians. Hopefully, by keeping our rules for institutional design in mind, we can guard them well.

Appendix

To arrive at the replicator equations, we use the replicator dynamics first defined by Maynard Smith (1982). A full description of the assumptions behind this method analysis can be found in Samuelson (1997).

Define players 1 and 2 with the strategy sets and payoffs represented by the following normal form game:

[Figure 5 about here]

Let x equal the percentage of Player 1's who play Don't Offer, and (1 – x) equal the percentage of Player 1's who play Offer. Similarly, let y equal the percentage of Player 2's who play Snatch, and (1 – y) equal the percentage of Player 2's who play Exchange. Player 1 then has the following utility functions for each strategy:

$u_1(\text{Offer}) = 15(1 - y) + 5y$

$u_1(\text{Don't Offer}) = 10(1 - y) + 10y$

Similarly, Player 2 has the utility functions:

$u_2(\text{Exchange}) = 15(1 - x) + 10x$

$u_2(\text{Snatch}) = 20(1 - x) + 10x$

Player 1's average utility is found by adding the expected utility of playing Offer and Don't Offer. This gives us:

$u_{1AVG} = x\,[10(1 - y) + 10y] + (1 - x)\,[15(1 - y) + 5y]$

which simplifies to: $u_{1AVG} = 10x + (1 - x)(15 - 10y)$

[6] See the chapters by Rakesh Kurana/ Herbert Gintis and Bob Solomon in this volume.

Player 2's average utility is found by adding the expected utility of player Exchange and Snatch, giving us:

$u_{2AVG} = y\,[20(1 - x) + 10x] + (1 - y)[15(1 - x) + 10x]$

which simplifies to: $u_{2AVG} = y(20 - 10x) + (1 - y)(15 - 5x)$

We want to find the rate of change of x and y with respect to time t as a function of the difference between each player's payoff from playing the Nash Equilibrium (Don't Offer, Snatch), and the average payoff for each player. This gives us the following two replicator equations:

$dx/dt = x\,[10(1 - y) + 10y - (10x + (1 - x)(15 - 10y))]$

$dy/dt = y[20(1 - x) + 10x - (y(20 - 10x) + (1 - y)(15 - 5x))]$

which simplify to $dx/dt = 5x\,(1 - x)(2y - 1)$ and $dy/dt = -5y\,(y - 1)(1 - x)$.

Figure 1: Game of Snatch

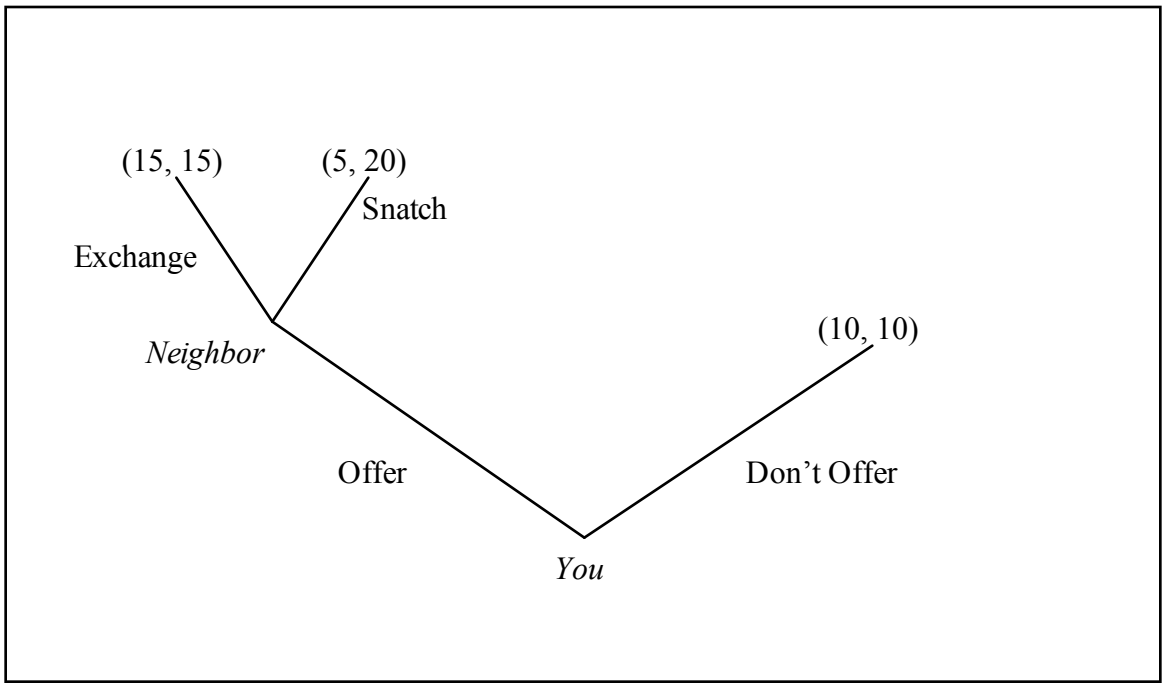


Figure 2: Game of Snatch with "Warm Glow"

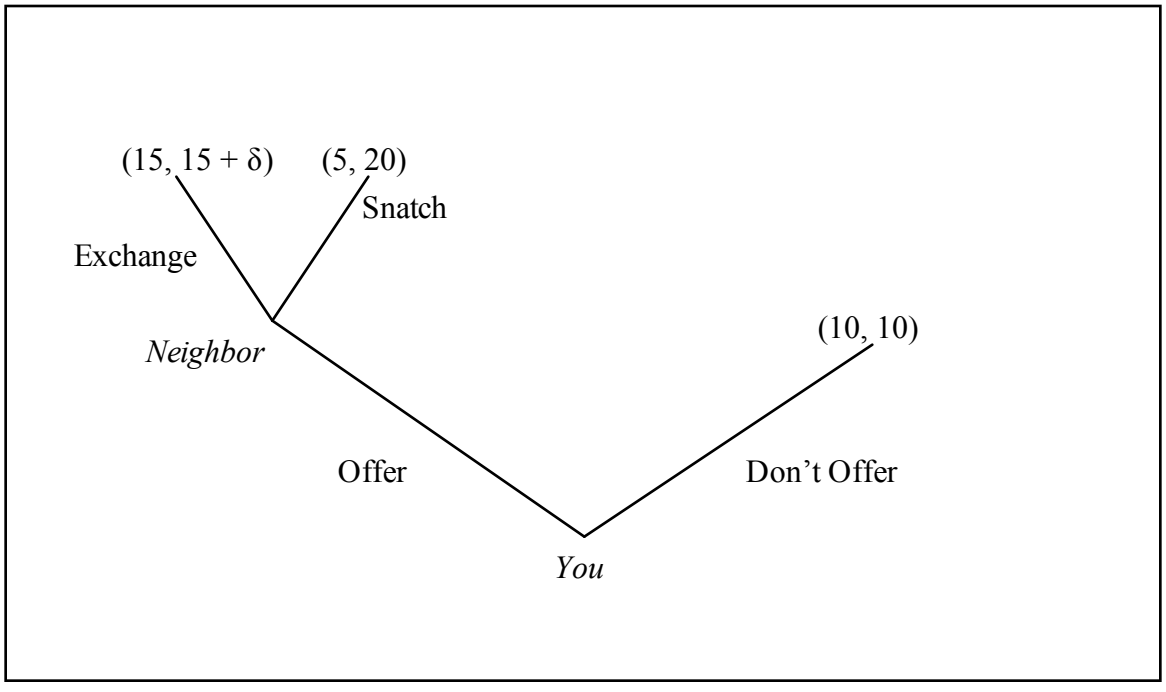


Figure 3: Game of Snatch with Property Rights and Sanctions[7]

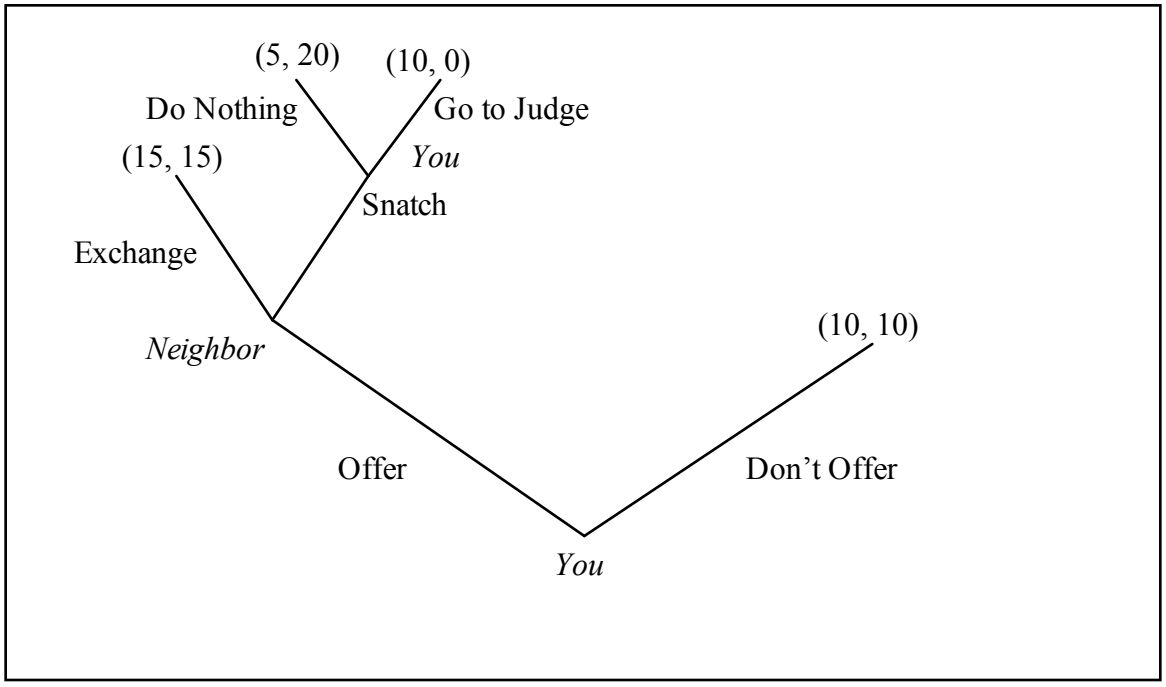
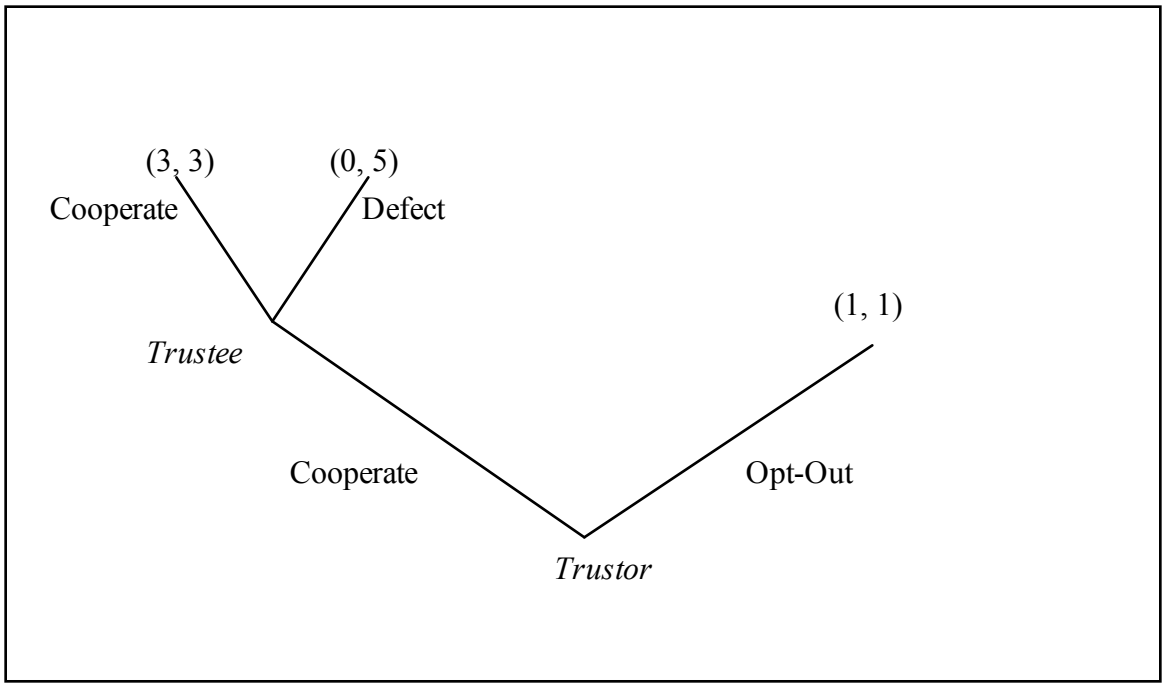


Figure 4: Sequential Prisoner's Dilemma with Opt-Out Option



[7] Source: Ostrom 2005. Used with permission

Figure 5: Game of Snatch (Normal Form)

	Exchange	**Snatch**
Offer	15, 15	5, 20
Don't Offer	10, 10	10, 10

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