Conflict, Settlement, and the Shadow of the Future*

Michael McBride†
Department of Economics
University of California, Irvine

Stergios Skaperdas
Department of Economics
University of California, Irvine

This version: February 3, 2009
Preliminary Draft

Abstract

Why is conflict in both its violent and non-violent forms, being so highly inefficient, still very common? Recent research argues that conflict arises as the optimal choice by an actor when long-term contracts that would enforce peace are not possible and when conflict today changes the relative bargaining powers of the actors tomorrow. Contrary to standard folk theorem intuition, higher discount factors lead to a higher valuation of future payoffs, a larger payoff to eliminating one's opponent, and a greater likelihood of conflict. We present a model to illustrate how a longer "shadow of the future" makes conflict more likely. We test for this effect in a laboratory experiment and find that subjects are, to a large degree, more likely to engage in risky conflict as the shadow of the future increases.

JEL Classifications: C72, C91, D01, D74.

Keywords: conflict, folk theorem.

*We thank friends, colleagues, seminar participants at Loyola Marymount University, participants in the Economic Science Insitute seminar at Chapman University, and attendees at the "Rationality and Conflict" conference at Yale University for valuable comments. For financial support we are grateful to the Center for the Study of Democracy and the Center for Global Peace and Conflict Studies, both at UC Irvine.

†3151 Social Science Plaza, Irvine, CA, 92697-5100, mcbride@uci.edu, sskaperd@uci.edu.

1 Introduction

It is difficult to understand conflict from an economic perspective, whether it is the violent conflict of war or the non-violent conflict of going to court or on strike. For, ideally, the resources expended on arming or lawyers and the possible destruction and inefficiency that can take place under conflict could conceivably be reduced, if not eliminated altogether, by some appropriate Coasian transfers.

The one type of explanation that has largely dominated the economics literature is that of incomplete or asymmetric information of one party about the preferences, endowments, available strategies, or other characteristics of another party. (See, for example, Brito and Intriligator, 1985.) In the presence of such information asymmetries – and the presumed inability of each side to credibly reveal the truth about itself to other parties – there can be states of the world in which one or more parties will choose conflict rationally, as part of some reasonable equilibrium concept.[1]

Whereas undoubtedly asymmetric information is relevant in many instances of conflict, there is scope for additional types of explanation that may add to informational explanations. In particular, there is another type of explanation for conflict that is potentially empirically important that has received almost no attention within economics. There are two key ingredients to this explanation. First, adversaries cannot write long-term contracts on an "enforcement" variable, like on arms or hiring lawyers to prepare for possible future litigation. However, the adversaries could write short-term contracts and settlement that are conditioned on such enforcement variables. Second, conflictual outcomes have different long-term implications for the strength of each adversary than peaceful settlement outcomes have. For example, the winner of a war could be expected to gain more resources, and therefore a strategic advantage, relative to the loser well into the future, whereas a peace-

[1] Other reasons, based on economic models, that may induce conflict include indivisibilities, increasing returns in production, risk seeking preferences. For a review of reason for going to war primarily concernced with international relations see Fearon (1995) and for a review based on conflict models that allow for bargaining see Skaperdas (2006).

ful settlement outcome would not be expected to have as dramatic a change in the future strategic positions of the adversaries. Similarly, going to court can be expected to enhance the property rights of the winner of a legal dispute and diminish those of the loser, whereas an out-of-court settlement keeps the relative position of litigants more constant.

For the case of war, Fearon (1995) first discussed this type of explanation, and models that make the argument explicit include a finite-horizon model in Garfinkel and Skaperdas (2000) and infinite-horizon models in Powell (2006) and McBride and Skaperdas (2007).[2] Similarly, Robson and Skaperdas (2008) show how going to court in the case of legal disputes can be an equilibrium outcome.

One robust comparative static result of this and other models is that conflict becomes more likely and settlement less likely as the discount factor of the adversaries becomes larger or, to use a more evocative term, as the shadow of the future becomes longer. A longer shadow of the future makes the valuation of future payoffs higher relative to current payoffs, and the future rewards of an enhanced strategic position under conflict then loom larger than the settlement payoffs that involve enforcement expenditures well into the future. Moreover, enforcement expenditures also typically become higher when the future becomes more important[3] and since the winner of a conflict can lower or completely eliminate these expenditures in the future this is an analytically distinct reason for conflict being induced as a result of lower discounting of the future.

This effect of discounting is obviously opposite of that implied by folk-theorem arguments. The supergame strategies that sustain cooperation (or peace) under repeated interaction are more likely to be adopted in stationary environments in which the long-term asymmetric effects of conflict do not change the relative strategic positions of adversaries in the future.

[2] Powell (1993) was the first dynamic model that included similar considerations (and the main comparative static result regarding the "shadow of the future") but did not include the possibility of within-period transfers between adversaries. That is, there is a within-period indivisibility in Powell's model, something that is an analytically distinct reason for conflict. However, there is no reason that Powell's (1993) model could be not be adapted to allow for within-period transfers and still yield conflict as a possible equilibirum outcome.

[3] In addition to the papers mentioned above, Powell (1993), Skaperdas and Syropoulos (1996), and Mehlum and Moene (2007) also show how enforcement costs increase with higher discount factors.

This paper presents theory and experimental evidence that our explanation is empirically relevant. After elaborating on the empirical relevance of our argument in section 2, section 3 develops an illustrative model on which our experiment is based. It yields the key prediction that settlement is less likely as the discount factors of the adversaries increase. Particular extensions and elaborations of the model, provided in the Appendix, illustrate how the main prediction is robust to changes in the adversaries' environment. Section 4 discusses the experiment design and results. Our subjects faced a choice between a certain payoff from settlement or the uncertain outcome of a conflict. The shadow of the future is approximated by a constant continuation probability of the same game. In this last feature of the experiment we have followed Dal Bó (2005), who has examined the effects of the shadow of the future in stationary environments in which the folk theorem could apply. We find a clear tendency for a longer shadow of the future to increase the subjects' choice of conflict, especially compared to the one-shot case with zero continuation probability.

2 Preliminary Considerations: Going to Court or War

The two necessary elements of the explanation of conflict we examine in this paper are (i) the impossibility of writing long-term contracts on enforcement levels and (ii) conflict and settlement have very different dynamic paths in terms of the initial conditions that adversaries face in the future. Condition (i) is very likely to be satisfied both in adversarial settings that can lead to war and in legal disputes. The main enforcement variable in wars is arming and in many cases it is impossible to write long-term disarmament contracts (although, it is typically possible as well as a frequent occurrence to have truces and cold wars – thought of as a series of short-term contracts – that are enforceable by each adversary's military strength). In legal disputes the main enforcement variable involves litigation expenditures on lawyers, paralegals, private investigators, or potential expert witnesses, and it is similarly difficult to write long-term contracts that would prevent potential legal adversaries from engaging in any such expenditures. However, the retention of lawyers and the threat to deploy them in court could help enforce shorter-term out-of-court settlements.

We next discuss why condition (ii) is plausible in many circumstances and why the type of explanation we examine here is promising.

2.1 Legal Disputes

As is the case with wars, information problems are considered the primary reason for legal disputes ending up in court (see, for example, Hay and Spier, 1998). However, going to court and settling out of court can have significantly different implications for the relative future strategic positions of potential litigants.

On the one hand, going to court enhances the strategic position of the winner and increases his chance of prevailing in similar future disputes with the same or different adversaries. Conversely, the loser has a diminished future strategic position to prevail in similar disputes. In other words, going to court and obtaining a decision enhances the property rights of the winner and diminishes those of the loser well into the future.

On the other hand, settling out of court tends to leave the relative property rights positions of adversaries in the future more stable, though not necessarily constant. Settling out of court with someone who has sued you could invite future litigants who might sue you solely in order to extract an out-of-court settlement. Therefore, going to court, though costly in the short-run, could deter future litigation and the costs that would accompany such litigation. Moreover, in many legal systems the holder of an asset who does not periodically exercise some form of open demonstration of ownership, including possibly receiving a positive court decision, could lead to the loss of the asset or at least the "atrophying" of his or her property right over that asset (Buchanan, 1989).

Thus, going to court enhances property rights whereas not doing so might erode one's property right. Indeed, going to court can be an equilibrium outcome, even in the absence of any informational problems, when it is necessary to ensure future property rights.

2.2 Wars

For disputes that could potentially lead to war it is evident that war affects the adversaries' future strategic positions differently than does a truce or peace. Winners can obtain a better future strategic position that they had prior to war, and losers typically have a worse strategic position than prior to war. In the absence of war, strategic positions do not change much, although one side's power may be declining over time while the other side's power might be ascending because of economic, demographic, or other reasons.

Clearly, informational problems can help explain many wars. However, there is no reason to think that all wars in all of their aspects must be due solely to such problems. We briefly offer some examples (discussed in Skaperdas, 2006) in which our hypothesis is relevant and identify some aspects of warfare difficult to explain with informational failures.

World War I is frequently mentioned as a war that started because of information problems (see, for example, Ch. 2 in Joll, 1992). Incompleteness of information might not be the whole story, however, if we were to consider that there was no peace after it became obvious to almost everyone that trench warfare brought stalemate and not quick victory. With trench warfare much of the initial incomplete information dissipated, the costs of the war continuing were horrendous with no end in sight, and yet war continued. Reasonably, it could be argued that each side saw the chance of eventual dominance well into the future as the carrot that kept the war going, and that all major adversaries had long-term strategic objectives that made them arm in the first place. At least some fraction of the elites within each of the major states involved saw a war as necessary for the defense of existing possessions or repossession of old ones close to them (like Alsace and Lorraine for France and Germany) or for the defense or capture of areas around the globe.

Also, relevant to our approach was the endgame of World War II. Why didn't the United States settle for the advantageous peace for which Japan was bidding? Why did the Soviet Union push so hard, and at such cost, in the Eastern front? Why were the Western allies rushing in the Western front? Certainly it could not be because they were not aware of

Japan's or Germany's strength or the other way around. The allies were all looking into the future. They wanted the Axis powers crushed without the possibility of even a remote comeback, as it happened with Germany after World War I. They were also eyeing one another, jockeying for position in the post-war period. The Cold War had effectively started considerably before the end of the actual hot war.

Finally, since the Second World War, civil wars have been much more common than interstate wars. With an average duration of over seven years (Collier et. al., 2003), by that time both informational asymmetries and the costs of war become apparent. Similarly, civil wars within Northern Italian city-states in late medieval times often lasted for decades with tremendous costs to the participants (see, for the case of Genoa, Ch.8 in Greif, 2006). Before attributing all such conflicts to informational problems, the gamble on gaining long-term advantage over opponents again appears as at least another, complementary to others, explanation of the many civil wars that have occurred.

2.3 Other Types of Conflict

In addition to warfare and litigation, there are other types of disputes that could be relevant for the approach we develop here. They include rent-seeking and related policy disputes, labor union and firm disputes, and possibly competition among firms that use marketing and advertising as major instruments of competition. For the case of rent-seeking and other policy disputes, the relevant enforcement variables are expenditures on lobbying and related activities that are clearly not contractible in the long-run. Settlement in this case would imply that the major sides to the policy dispute agree on a compromise proposal, whereas conflict would involve each side offering clearly different proposals, not compromising, and letting the lobbying and legislative process determine which proposal is eventually adopted.

For the case of disputes between labor unions and firms, the non-contractible variables would include the expenditures on the part of the union on strike preparation (including possibly the accumulation of a strike fund) and for the firms the resources expended on negotiation and preparations for a strike or a lockout. Conflict in this case would involve a strike or a lockout, whereas settlement would involve the signing of a new contract for a set period of time. For the case of competing firms, the non-contractible enforcement variable could be the resources expended on marketing and advertising, whereas conflict would be equivalent to a price war and settlement a more cooperative outcome on their part. In all these cases, the conflictual and settlement outcomes can bring about different future strategic position for the adversaries, and therefore our approach and the effect of the shadow of the future can be important for bringing about conflict or settlement. However, we do not pursue these applications further as the literature and applications do not appear to our knowledge to be as developed.

3 An Illustrative Model: Conflict vs. Settlement

Consider two agents, A and B, who interact over an indefinite horizon. In each period they compete over a prize of value Y. Because the two agents cannot write contracts on the ultimate source of enforcement each period they have to expend resources e_A and e_B to maintain their position. These expenditures are necessary regardless of whether Conflict or Settlement (under the threat of conflict) ultimately prevails. In the case that Conflict involves actual warfare, e_A and e_B would represent arming expenditures, and the two agents could be parties in a domestic dispute that could lead to civil war or adversarial states. In the case of litigation e_A and e_B would represent expenditures on lawyers' and related fees, and the two agents could be two parties that have property claims on a productive asset which they could exploit jointly without going to court or they could go to court and resolve their claims once and for all. (In Appendix B, we examine another model of litigation that involves a long-term agent who faces the potential of being sued for damages in each period by a series of short-term agents.)

In the event of Conflict, the enforcement expenditures e_A and e_B affect the probabilities of winning for each side; we denote these probabilities by q_A and q_B. We suppose that one agent's enforcement expenditures positively affect his own winning probability and negatively affect his opponent's winning probability. (As our experiments do not involve an endogenous choice of these expenditures, we do not endogenize them here, although as we show in Appendix A that the main comparative static results remain when enforcement expenditures are chosen endogenously.) In the case of Settlement, e_A and e_B – through their effect on the probabilities of winning in the event of Conflict – influence each agent's bargaining position in arriving at a particular deterministic settlement (shares of the prize Y).

If Conflict were to take place only a fraction $\phi \in (0, 1)$ of Y can be consumed with the rest, $(1 - \phi) Y$, being destroyed by the conflict. In each period, then, the expected single-period payoff of agent $i = A, B$ in the event of Conflict is:

$$U_i^c = q_i \phi Y - e_i. \tag{1}$$

Given that Conflict is destructive, in each period both sides would prefer to divide Y in shares that equal their winning probabilities because it would result in a payoff of $q_i Y - e_i > q_i \phi Y - e_i = U_i^c$. A range of other possible divisions of Y would also be Pareto superior to the expected payoffs under Conflict. With an indefinite repetition of such single-period interactions, there would never be an incentive to induce Conflict, provided the two agents could costlessly communicate and the prize Y were divisible.

Nevertheless, if Conflict were to occur, we would reasonably expect interactions between the two agents to be different in the future. The winner may have eliminated the loser's ability to carry out war in the future, or he could command more resources conducive to waging war than the loser in the future. In effect, conflict biases future conflicts even further in favor of today's winner. Such induced asymmetries could well make Conflict an attractive possibility by trading off a lower expected payoff today for higher payoffs in the future.

For simplicity, we allow a stark and simple form of dependence of future power on today's Conflict. We suppose that the loser of Conflict in any period would be unable to raise the resources that are necessary to challenge the winner in future periods and, thus, the winner would be able to enjoy the prize Y in all future periods whereas the loser receives nothing.

(McBride and Skaperdas, 2007, illustrate how the main results extend to the less stark setting in which for an agent to drop completely out of contention there is a series of small conflicts with probabilistic outcomes, and not just one, that would have to be lost.)

Next, consider the negotiations that would result in either Settlement or Conflict in any particular period in which no Conflict has occurred in the past and the agents have already expended resources on enforcement (i.e., e's have been expended and represent sunk costs). Further, and without loss of generality, suppose agent A is the one that has the initiative in making a proposal. In the case of Settlement, the agent would receive the whole value of Y and would make an offer of subsidy S to agent B, which would either accept or reject A's offer. If the offer is rejected, Conflict ensues. The resources that each party has invested on enforcement are considered sunk so that they play no more in current negotiations.

Assuming a discount factor $p \in (0, 1)$,[4] the discounted expected payoff for agent $i = A, B$ in the event of Conflict is the following:

$$V_i^C = q_i \phi Y + q_i \sum_{t=1}^{\infty} p^t Y + (1 - q_i) \sum_{t=1}^{\infty} p^t 0 = q_i \left(\phi + \frac{p}{1-p} \right) Y. \tag{2}$$

Note how in the event of Conflict, because one agent would be eliminated from contention, in the future no resources would be devoted to enforcement. Agent B would accept any offer S from agent A that satisfies inequality

$$S + pV_B(S) \geq V_B^C, \tag{3}$$

where $V_B(S)$ denotes the continuation payoff of agent B when she is a responder given the subsidy S. As part of any Markov Perfect Equilibrium in which a positive subsidy is given, agent A would offer a subsidy S^* that satisfies (3) as an equality. Assuming that S^* would be accepted in this period, it would be acceptable in all future periods and therefore $V_B(S^*) = \frac{S^* - e_B}{1-p}$. Then, from (3) and (2), the subsidy would be:

$$S^* = q_B \left[\phi (1 - p) + p \right] Y + p e_B. \tag{4}$$

[4]Given risk neutrality, could also be interpreted as the constant probability of the game continuing in each period, an interpretation that we maintain in the experiments.

Note that this Conflict-deterring subsidy from A to B depends positively on the power of agent B (as proxied by her probability of winning q_B), on the share of output that is not destroyed in the event of Conflict, on the discount factor, as well as on the value of the prize Y. However, this minimally acceptable subsidy to agent B might not be in agent A's interest to offer. In particular, agent A will only make this offer if the expected payoff under Settlement exceeds that under Conflict,

$$Y - S^* + pV_A(S^*) \geq V_A^C, \tag{5}$$

where $V_A(S^*) = \frac{Y - S^* - e_A}{1-p}$ is the continuation payoff of agent A if Settlement were to prevail forever. Supposing the probabilities of winning for the two sides sum to one (i.e. $q_A + q_B = 1$), it is straightforward to show that the condition for Settlement (so that (3) and (5) are both satisfied) is as follows:

$$\frac{p\,(e_A + e_B)}{(1-\phi)(1-p)} \leq Y. \tag{6}$$

If this inequality holds, there is a feasible and optimal subsidy that makes Settlement preferred to Conflict. Alternatively, based on (6), Conflict is more likely and Settlement is less likely, the lower is the contested output Y; the higher are the resources devoted to arming $(e_A + e_B)$ by the two agents; the less destructive Conflict is (or, the higher is ϕ); and, the higher is the discount factor p (i.e., the game's constant continuation probability).

It is this last effect of "shadow of the future" that we test experimentally. In Appendix A and B we show the robustness of this effect in different setting. In Appendix A, we endogenize the enforcement efforts e_A and e_B. In Appendix B, we provide a model of a legal dispute involving a long-term agent against a series of short-term agents who could potentially sue the long-term agent for damages.

4 An Experiment: Conflict vs. Settlement

4.1 Experiment Design

Our experiment consists of three sessions conducted at the California Social Science Experimental (CASSEL) Laboratory at UCLA. Each session used subjects recruited from the CASSEL subject pool database. After learning about the laboratory from advertisements or friends, a UCLA student registers in the subject pool through the laboratory's web site. All subjects in the pool were sent an email notifying them of an experiment session. An interested student then registers for a specific sessions; none participated in more than one session. To facilitate experiment management, instruction, and data collection, we conducted the experiment using specially designed software. Each subject accumulated "points" based on her choices, the choices made by her matched partner in a given round, and random draws by the computer. The more points earned, the more U.S. currency the subject received at the experiment session's end, with the exact amount determined by a publicly announce point-dollar exchange rate. Each subject also received a $5 show-up payment. The average earned amount was $30 for about 75 minutes of participation.

A Single Match. A single session consists of a number of matches (trials). Each match captures the reduced Settlement-or-Conflict decision scenario depicted in the model, the only difference being that, instead of having subjects choose the settlement amount as in the model above, we suppose Settlement involves an equal split of the surplus. The main comparative statics of the model are unchanged with this simpler exogenous Settlement amount, and this set-up is easier for subjects to understand.

In a single match, two subjects are paired and round one begins. Both are publicly told that the "point value" is 100 (prize Y in Section 3's notation), the "standard fee" is 30 (arming cost $e = e_A = e_B = 30$), the "flipping fee" is 30 (total destruction $(1-\phi)Y$), and the "continuation probability" (probability p) which takes three values (see below). Each subject then selects either "split" (Settlement) or "flip" (Conflict). Payments are then received according to the model presented earlier. That is, in round 1 each receives 20

($= \frac{1}{2}Y - e$) if both chose split; and if at least one chose flip, then a random draw by the computer selects one of the subjects to be the winner and the other to be the loser, where the winner's round 1 payment is 40 ($= Y - dY - e$) and the loser's round 1 payment is -30 ($= -e_i$). The computer then randomly determines whether the match continues to round 2. If both chose split in round 1, then the round 1 settlement applies to any future rounds. Thus, should round 2 be reached, settlement in round 1 implies settlement in round 2, and each receives 20. If there was conflict in round 1, then the winner from round 1 receives 100 in round 2, and the loser in round 1 receives 0 in round 2. Any other future rounds, should they be reached, have the same payoff structure as round 2. Having each subject only make one choice per match (rather than making a choice in each round following peace) simplifies the decision process for the subjects, speeds up the experiment, and facilitates the making of hypotheses (see below).

Continuation Probability. The continuation probability p is the key treatment variable as it reflects the shadow of the future. It takes one of three values: 0, 0.5, or 0.75. A match lasts a single round if $p = 0$. If $p = 0.5$ or $p = 0.75$, then the exact number of rounds in a given match is determined randomly by the computer. The expected number of rounds is 2 under $p = 0.5$ and 4 under $p = 0.75$. Subjects are told the continuation probability at the same time they are told the other parameters – immediately prior to making the split-or-flip (Settlement-or-Conflict) decision. These values for p were selected because, first, they are the same used by Dal Bó (2005), thereby providing a point of comparison with his study, and, second, they allow for sharp predictions as discussed below.

Rotation Matching. Dal Bó (2005) uses a rotation matching procedure "to avoid potential interaction and contagion effects between the different" matches (1596). In each session, subjects are divided into two equally-sized groups of agents: Blue and Red. In any given match, a Blue and Red are paired. In the next match, the Blue is matched with a different Red, and so on. One full rotation (also called a zipper) consists of each blue being paired exactly once with each Red. With 24 subjects split into Blue and Red groups each with 12 subjects, one rotation consists of 12 matches. With three treatment values for the continuation probability, we thus have 4 matches per treatment variable in one rotation. We use Dal Bó's rotation mechanism primarily for comparison with Dal Bó's design even though the contagion effects that might arise in his repeated game context are unlikely to be present in our setting. Contrary to the mixed-motive prisoner's dilemma game, the weakly dominant strategy in our setting yields the highest expected payoff *ex ante*, thus removing the incentive to play meta-strategies across matches.

Sessions. We conducted three sessions to consider how changes in the treatment variable may impact decisions. Session 1 uses one matching rotation (12 matches) with an ABC design: 4 matches of $p = 0$, then 4 matches of $p = 0.5$, and then 4 matches of $p = 0.75$. We supposed that this order would be easiest for subjects. Session 2 uses one rotation with a CBA design: 4 matches of $p = 0.75$, then 4 matches of $p = 0.5$, and then 4 matches of $p = 0$. The reverse order is meant to capture a priming effect. Session 3 uses two full rotations (24 matches) with an ABCCBA design: subjects do one full rotation akin to Session 1, are then reagented into Blues and Reds, and then do another full rotation akin to Session 2. Session 3 is meant to capture both the learning and priming effects. Table 1 summarizes basic information about the three sessions. The bottom panel of the table breaks Session 3 into its first and second matching rotations and calls them Sessions 3(a) and 3(b).

Instructions. After being seated at computers in the lab, the subjects were instructed in the basic payoff structure of the decision making environment, and then they participated in four practice matches.[5] This instructional period was designed to familiarize subjects with both the computer user interface as well as the payoff structure and basic strategic environment.

Bankruptcy Prevention. Because losing a contest involves a net loss of 30 points, it is possible for subjects to lose points throughout the experiment. To prevent bankruptcy

[5] In the first practice match, the continuation probability was $p = 0$, and each subject was told to select split. In the second practice match, the continuation probability was again $p = 0$, but each Blue was told to select split while each Red was told to select flip. The third and fourth practice matches had $p = 0.5$ and $p = \frac{3}{4}$, respectively, and subjects were asked to choose split or flip on their own.

and the risk-loving behavior that may accompany it, each subject in Sessions 1 and 2 was given an initial 240 points. Because subjects in Session 3 participated in two matching rotations, they were given 240 points twice, once at the start of each rotation. No subject in any session experienced or came close to bankruptcy.

Questionnaire. After the last match but before leaving the laboratory, each subject filled out a questionnaire that asked for age, sex, major, year in school, number of economics courses taken, number of statistics courses taken, and so on. We use information from the questionnaire for rough qualitative comparisons of the subjects across sessions.

4.2 Hypotheses

Having one choice per match collapses the potentially infinitely repeated game, in expected payoff terms, into a simple 2×2 matrix normal form game. Figure 1(a)-(c) presents the matrix for each treatment value of the continuation probability. In each case, the setting is the Hi-Lo game depicted in Figure 1(d). If the expected payoff when both choose split, $\frac{1}{1-p}\left(\frac{1}{2}Y - e\right) \equiv x$, is strictly greater than that when at least one flip is chosen, $\frac{1}{2}\left(\frac{1}{1-p}Y - dY\right) - e \equiv z$, then each player has a unique weakly dominant strategy to choose split. Alternatively, if $z > x$, then each has a dominant strategy to choose flip. Accordingly, an expected payoff maximizer has a weakly dominant strategy to choose split if $p = 0$ but choose flip if $p = 0.5$ or $p = 0.75$.

We note that each game in Figure 1(a)-(c) has multiple Nash equilibria. With $p = 0$, there are two pure strategy Nash equilibria: (split,split) and (flip,flip). With $p = 0.5$ or $p = 0.75$, there are three pure Nash equilibria: (flip,flip), (flip,split), and (split,flip). However, there is only one pure Nash equilibrium in each case if we eliminate the weakly dominated strategy for each player. Thus, applying standard game theoretic solution concepts (dominance solvability or Trembling Hand Perfection) will yield an unique prediction: (split,split) under $p = 0$ and (flip,flip) under $p = 0.5$ and $p = \frac{3}{4}$. Past experimental work also suggests that subjects overwhelmingly go for the higher expected payoff in Hi-Lo games (e.g., see Bacharach 2006). A possible moderating factor is that flipping is very risky. Thus, a risk averse subject may be inclined to choose the less-risky choice over a choice with a slightly higher expected payoff but more risky choice. Such reasoning would apply with $p = 0.5$. Our first hypothesis follows.

Hypothesis 1 (Choices)

(a) We will observe more flips under $p = 0.75$ *than under* $p = 0$.

(b) We will observe more flips under $p = 0.5$ *than under* $p = 0$.

(c) We will observe more flips under $p = 0.75$ *than under* $p = 0.5$.

Our second hypothesis focuses on outcomes not individual choices, though the former are clearly derived from the later.

Hypothesis 2 (Outcomes)

(a) We will observe more conflict under $p = 0.75$ *than under* $p = 0$.

(b) We will observe more conflict under $p = 0.5$ *than under* $p = 0$.

(c) We will observe more conflict under $p = 0.75$ *than under* $p = 0.5$.

We are also interested observing the patterns of choices by individual. Given Hypothesis 1, we predict the following.

Hypothesis 3 (Choices by subject) *Most subjects will choose more flips under* $p = 0.75$ *than under* $p = 0.5$ *and more flips under* $p = 0.5$ *than under* $p = 0$.

The first two hypotheses are meant to test the effect of the shadow of the future on Conflict. Given the structure of the interaction, it is natural to suppose each subject follows a cut-off rule when deciding to Settle or Fight. We are less interested in where this cut-off is for each subject (as it may differ from subject to subject) and more interested in whether or not the subjects are following such a cut-off rule. For this reason, we selected two values of the treatment variable to yield clear predictions via a clear payoff dominance (split under $p = 0$ and flip under $p = 0.75$) and one value which may have a moderating risk consideration ($p = 0.5$). The last hypothesis is meant to "unpack" any verification or rejection of the first hypothesis. By looking more closely at the choices by individual we can discern what other factors, if any, figure prominently in the subjects' decision making.

4.3 Results

Individual Choices. Table 2 reports the percent of flips by session and continuation probability. When pooling the data from all sessions, we see that, consistent with Hypothesis 1, subjects choose flip more often under $p = 0.75$ than under $p = 0$ and more under $p = 0.5$ than under $p = 0$. However, we observe that the percent of flips under $p = 0.5$ and $p = 0.75$ are very similar. We conducted a series of (Pearson) chi-square tests to test if the proportion of flips are the same under two given treatment values for p. As shown in Table 3, we reject at very high significance levels the hypothesis that the proportion under $p = 0$ and $p = 0.75$ and under $p = 0$ and $p = 0.5$ are equal, but we cannot reject the hypothesis that the proportions are the same under $p = 0.5$ and $p = 0.75$. Looking at choices by session, we see that the choices in Session 1 match Hypothesis 1 very closely, while choices in Sessions 2 and 3 match Hypothesis 1(a) and 1(b) but not 1(c). The percent of flips under $p = 0.5$ is actually higher than under $p = 0.75$ in those two sessions, although the chi-square tests indicate that they are essentially equal statistically.

Figure 2 displays the percent flips by match for each session. Each point captures the percent of subjects who chose flip in a given match and session. Matches have been grouped by continuation probability to facilitate comprehension. In each session, we observe a dramatic rise or drop in flips as the continuation probability changes from or to 0, consistent with our shadow of the future argument. We observe the increase in flips from $p = 0.5$ to $p = 0.75$ in Session 1, and we see no similar change in flipping rate in the other sessions.

The overall picture is that Hypotheses 1(a) and 1(b) are strongly confirmed, while evidence in support of Hypothesis 1(c) is mixed. That Hypotheses 1(a) and 1(b) are so strongly confirmed provide the best evidence that increasing the shadow of the future does increase the incidence of conflict because they consider stark changes in the continuation probability. The mixed evidence for Hypothesis 1(c) is not necessarily evidence against our main argument that the increased shadow of the future increases the occurrence of conflict because an expected payoff maximizer would choose flip under both $p = 0.5$ and $p = 0.75$. Thus, an equal number of flips under $p = 0.5$ and $p = 0.75$ would arise if all subjects were risk neutral. Because Hypothesis 1(c) was based on the premise that some subjects would be risk averse, one interpretation of our results is that subjects in Session 1 were more risk averse than those in Sessions 2 and 3, who were, on average, more risk neutral. Another interpretation is that the direction of changes in the treatment variable produces confounding effects. For example, subjects in Session 1 proceeded in what we consider the easiest format, experiencing $p = 0$ first and then experiencing "natural" increases in p; subjects in Session 2 proceeded in the more difficult format of highest p first; and subjects in Session 3 proceeded in a combination structure that was not natural for learning.

Outcomes. Table 4 reports the distribution of outcomes by session and continuation probability. The key measure is the percent of split-split outcomes; this outcome corresponds to Settlement while the other two outcomes correspond to Conflict. Consistent with Hypotheses 2(a)-(c), in the pooled data we observe the occurrence of Settlement decreasing as the continuation probability increases. By session we observe slight variation. Session 1 closely matches Hypothesis 2, whereas Sessions 2 and 3 match Hypothesis 2(a)-(b) but not Hypothesis 2(c). This pattern closely matches that of individual choices. Chi-square tests (not shown) confirm the pattern. Conflict is much more likely when the shadow of the future is large ($p = 0.5$ or $p = 0.75$) than when it is small ($p = 0$).

Choice Patterns. To evaluate Hypothesis 3, we classified subjects by their observed choices in Table 5. The columns partition the behavior into disjoint choice patterns. Column (1) corresponds to the selection of flip in all matches of the session, column (2) corresponds to the selection of split in all matches, and so on. Column (4) corresponds to the choice pattern that corresponds most closely to the behavior predicted in Hypothesis 3, i.e., a preference for high payoffs but a dislike for risk. To be placed in that column, a subject must have chosen flip weakly more often under $p = 0.75$ than under $p = 0.5$ and weakly more often under $p = 0.5$ than under $p = 0$, and the number of chosen fiips must not be equal under all three continuation probabilities. The most common choice pattern overall and by session corresponds to the behavior predicted in Hypothesis 3. It represents 56% (40 out of 72) of the subjects overall; more than half of the subjects increased the number of times they chose flip as the continuation probability increased. This choice pattern is also modal (not shown) in subsets of the subjects (males or females, undergraduates or graduates, exposure to economics or statistics or no exposure).

We observe wide variation in choice behavior among the other subjects. For example, some 6% of all subjects (4 of 72, column (8) plus (9)) flipped most under $p = 0$, 7% (5 of 72) never flipped, and 4% (3 of 72) always flipped. These other choice patterns may reflect preferences for risk, equity, or some combination of these or other concerns.[6] Another possibility is that these other choice patterns reflect misunderstanding the decision making environment. Ruling this out is not possible, yet gain some insight from the last question of the questionnaire, which asked, "Were you more likely or less likely to select FLIP as the continuation probability increased? Why or why not?" 72% (52 of 72) of the subjects answered yes and provided some explanation why (e.g., the "the chance of winning more money increased"), and of these subjects, 67% (35 of 52) increased their flipping as the continuation probability increased consistent with Hypothesis 3. Only 25% (5 of 20) of the other subjects did so. This is not a perfect measure of comprehension for many reasons.[7]

[6] We note that these other choice patterns need not be classified as irrational. For example, a subject who cares about payoff equity and not her own payoff would choose split under each of the treatment values for p; an extremely risk averse subject would also choose split under each value for p; a very risk-loving subject who disliked extreme inequity might flip under $p = 0$ but not $p = 0.5$ or $p = 0.75$; and a subject who wants a high expected payoff so long as it was not too inequitable might flip under $p = 0.5$ but not under $p = 0.75$ or $p = 0$.

[7] Clearly not all subjects who said they were more likely to flip under the higher continuation probability did so. The question was asked after subjects completed their choices and had time to consider an optimal

Nonetheless, it provides some indication that understanding the strategic setting led subjects to increase their flipping as the continuation probability increased. This evidence suggests that a large majority of the subjects understood the basic "shadow of the future" logic and that it guided their behavior in the predicted manner.

5 Conclusion

We have discussed, modeled, and shown experimentally how a longer shadow of the future can induce more conflict and less settlement under the threat of conflict. We have argued that this effect is both empirically relevant to the explanation of violent and non-violent conflict in the real world. Future research has many directions to go from here. The model and its extensions yield other hypotheses about the effect of changes in the destructiveness of conflict, the asymmetry of power, the size of the surplus, etc., on the incidence of conflict. These effects should be studied experimentally. But given that conflict is frequently so destructive and inefficient, we believe that an important and fruitful direction of research is the study of how rivals may invest in institutions that manage or deter conflict.

A Endogenous Enforcement

In this Appendix we present an extension, based on McBride and Skaperdas (2007), of the model from Section 3 to allow for endogenous enforcement levels. The main comparative static result regarding the effect of the shadow of the future is shown to hold in this setting.

To allow for endogenous enforcement, we first need to specify how probabilities of winning depend on enforcement. We suppose that these probabilities depend on arming through the following additive contest success function (see Tullock, 1980, and Hirshleifer, 1989):

$$q_i\left(e_A, e_B\right) = \frac{e_i^m}{e_A^m + e_B^m} \text{ where } i = A, B \text{ and } m \in (0, 1] \tag{7}$$

In each period, the sequence of moves by the two sides is the following:

strategy. The very asking of the question may have prompted an answer more indicative of what the subject thought the experimenter wanted to hear.

1. Levels of enforcement, e_A and e_B, are chosen simultaneously by the two agents.

2. The two agents bargain. Agent A offers a division (subsidy) S of the period's surplus to B. If B accepts, then agent B receives S, agent A receives $Y - S$, and the next period repeats steps 1 and 2. If B rejects the offer, Conflict occurs with winner selected according to probabilities q_A and q_B. The winner receives ϕY for the period and Y in each period thereafter, whereas the loser receives 0 for the period and thereafter.

Note that when agent A contemplates whether to offer a subsidy to agent B or decide to engage in Conflict, the continuation payoff of agent B would still be the one described in (2). Conditional on Settlement, the subsidy that would just induce B not to go to Conflict is the following variation of (4):

$$S^*(e_A, e_B) = q_B\left(e_A, e_B\right)\left[\phi(1-p) + p\right] Y + pe_B \tag{8}$$

This subsidy is derived under the condition that the same level of enforcement, (e_A, e_B), would be chosen in every future period as well as in the current period. Note how this subsidy to agent B depends on its probability of winning, which is increasing in the enforcement level of the agent, as well as directly on the enforcement level of the agent, for under Settlement the agent would have to incur this cost of enforcement in every period.

The payoffs of the two agents under Settlement can now be calculated. Agent A would receive in every period the total surplus minus the subsidy, $Y - S^* = Y - q_B(e_A, e_B)[\phi(1 - p) + p]Y - pe_B$, whereas in every period it would pay the cost of enforcement, e_A.We denote by (e_A^P, e_B^P) the future levels of enforcement as part of a Markov perfect equilibrium, whereas the choices in the current period are denoted by (e_A, e_B). Then, agent A's payoff is as follows:

$$V_A^P(e_A, e_B) = \frac{1}{1-p}\left\{Y - q_B(e_A, e_B)\left[\phi(1-p) + p\right] Y - pe_B^P - pe_A^P\right\} - e_A. \tag{9}$$

Agent A receives subsidy $S^* = q_B(e_A, e_B)[\phi(1-p) + p]Y + pe_B$ in every period and pays the cost of arming (e_B) in every period as well. Then, agent B's payoff reduces to

$$V_B^P(e_A^P, e_B^P) = \frac{1}{1-p}\{q_B(e_A, e_B)\left[\phi(1-p) + p\right] Y\} - e_B. \tag{10}$$

The payoffs are not symmetric because A is always the proposer and the subsidy offered is just the one that equates B's Settlement payoff with his expected payoff under Conflict.

The Markov perfect equilibrium strategies under Settlement are such that e_A^P maximizes $V_A^P(e_A, e_B^P)$ whereas e_B^P maximizes $V_B^P(e_A^P, e_B)$. To solve for these equilibrium strategies, first differentiate to obtain the first order conditions $\frac{\partial V_A^p}{\partial e_A} = 0$ and $\frac{\partial V_B^p}{\partial e_B} = 0$. Next, use

$$\frac{\partial q_B}{\partial e_A} = \frac{-m e_A^{m-1} e_B^m}{(e_A^m + e_B^m)^2}, \frac{\partial q_B}{\partial e_B} = \frac{m e_A^m e_B^{m-1}}{(e_A^m + e_B^m)^2} \tag{11}$$

obtained from (7) and the first order conditions to show that

$$e_A^P = e_B^P = \frac{m}{4} \frac{(\phi(1-p)+p)}{(1-p)} Y \tag{12}$$

Both sides choose the same level of arming despite the asymmetry of payoffs in (9) and (10) because the cost of arming is the same and what becomes effectively contestable is the discounted total surplus under Conflict $\left(\frac{(\phi(1-p)+p)}{(1-p)} Y\right)$.

Note the strong positive dependence of enforcement on the discount factor through the effect of the discounted total surplus under Conflict $\left(\frac{(\phi(1-p)+p)}{(1-p)} Y\right)$. For example, supposing $\phi = 0.5$, an increase in the discount factor from 0.9 to 0.95 more than doubles the term $\frac{(\phi(1-p)+p)}{(1-p)}$ from 9.5 to 19.5. As we've seen in section 3 (see (6)), a higher discount factor, as well higher levels of (fixed) arming, increases the likelihood of Conflict. With endogenous enforcement levels, a higher discount factor increases equilibrium enforcement, and the set of parameters for which Conflict becomes an equilibrium must increase compared to the case with exogenous enforcement.

Before deriving such a set of parameters, we consider the case of Conflict. The payoffs under Conflict are the following:

$$V_i^W(e_A, e_B) = q_i(e_A, e_B) \frac{(\phi(1-p)+p)}{(1-p)} Y - e_i, \; i = A, B \tag{13}$$

It is straightforward to show that equilibrium enforcement is not just symmetric but the same as under Settlement:

$$e_A^C = e_B^C = \frac{m}{4} \frac{(\phi(1-p)+p)}{(1-p)} Y = e_i^S, \; i \in A, B \tag{14}$$

The reason for the identical levels of enforcement under both Settlement and Conflict is that, even under Settlement, the determinant of equilibrium enforcement is the payoff under Conflict, and the latter determines the disagreement point in bargaining for the two sides. Under both Settlement and Conflict the relevant portion of B's payoff that can be influenced by its choice of arming is $q_B(e_A, e_B)\frac{(\phi(1-p)+p)}{(1-p)}Y$, whereas for A it is either $-q_B(e_A, e_B)\frac{(\phi(1-p)+p)}{(1-p)}Y$ (for the case of Settlement) or $q_A(e_A, e_B)\frac{(\phi(1-p)+p)}{(1-p)}Y$ (for the case of Conflict) which equals $(1 - q_B(e_A, e_B))\frac{(\phi(1-p)+p)}{(1-p)}Y$, both of which leads to the same marginal incentives in the choice of enforcement.

The set of parameters under which either Settlement or Conflict prevail can be derived by substituting the endogenous enforcement levels from (14) or (6). Settlement occurs when

$$\frac{pm\,(\phi(1-p)+p)}{2(1-p)^2(1-\phi)} \leq 1. \tag{15}$$

From (15) we conclude that Conflict is more likely and Settlement less likely when (i) the effectiveness of conflict as represented by m is high; (ii) the higher is the discount factor p; and (iii) the less destructive Conflict is (or, the higher is ϕ). The effect of the discount factor is, if anything, stronger here because as we mentioned above a higher discount factor not only increases the discounted value of the future cost of arming under Settlement but also increases the equilibrium level of arming.

B An Alternative Litigation Setting

The models of section 3 and Appendix A could be interpreted as involving two parties that are involved in a long-term legal but potentially decisive dispute. For example, they might have competing claims on a productive asset which they can exploit jointly under a series of short-term agreements (that is, under the Settlement outcome), backed by their respective litigation expenditures, or they could resolve once-and-for-all in court (under the Conflict outcome). In this Appendix, we examine a variation of the model of section 3 with one long-term agent potentially facing a series of short-term agent who could sue the long-term agent for damages. The main purpose of this model is to show how the main comparative-static result of the effect of the shadow of the future readily extends to such settings.

Consider a long-term agent A, with an indefinite horizon, who faces in each period a short-term potential challenger b (each lasting one period) who could sue agent A for the rights to a one-time payment of Y. To sue A a challenger would have to incur a fixed cost of $e_b > 0$. If no court decision has taken place in the past, let q_o denote the probability of winning in court of agent A, with $1 - q_o$ thus representing the challenger's probability of winning. We suppose that $q_o \geq 1/2$ (so that A can be thought of as having a better initial property right than the challengers. If sued, agent A incurs a legal cost $e_A > 0$ regardless of whether the two sides go to court or not; this cost can be thought of as the cost of hiring a legal team that would help A with the possible settlement and pre-trial costs but also preparing for the eventuality of going to court. If the two sides were to go to court, both would incur an additional cost $c > 0$.

As in the model of section 1, A can make a Settlement offer to b, which the latter accepts or rejects. Once b has sued (and has paid cost e_b), his expected payoff of going to court is:

$$U_b^c(q_o) = (1 - q_o)Y - c.$$

A could offer a payment $S_o = (1 - q_o)Y - c$ to b,which b could accept, and thus settle or she could offer something less, which b would reject, resulting in the two sides going to court. Let us now consider what could occur under the two possibilities.

First, if A were to make the payment S_o and then continue doing so to each future challenger, her payoff would be:[8]

$$\begin{aligned} V_A^s(q_o) &= Y - S_o + \sum_{t=1}^{\infty} p^t (Y - S_o - e_A) \\ &= q_o Y + c + \sum_{t=1}^{\infty} p^t (q_o Y + c - e_A) = \frac{q_o Y + c - p e_A}{1 - p}. \end{aligned} \tag{16}$$

[8]Note that this value does not include the cost of e_A which is considered to have been already paid. We continue the same practice in denoting values functions net of this cost below.

Note that for the challenger in each period to choose to sue, it must be the case that the settlement payment received from A is higher than the cost of suing, or

$$S_o = (1 - q_o)Y - c \geq e_b. \tag{17}$$

We suppose that this condition is satisfied for the remainder of this Appendix.

Going to court yields more complicated long-term outcomes. If the court decides in favor of A, then all future challengers b face worse odds of winning in the future. Let q_h ($> q_o$) denote A's future probability winning in court in the future. Conversely, if A loses in court following an initial challenge, her future probability of winning decreases to q_l ($< q_o$). To determine the expected payoffs of going to court, we thus need to determine the expected payoffs in the case of a court win and and in the case of a court loss.

Suppose that in the case of a win, A would not be challenged in the future. (This could be assured if $e_b > (1 - q_h)\,Y - c$, the latter being the expected payoff of a challenger.)[9] Then, the value of having a probability of winning of q_h from next period onward would be $\frac{Y}{1-p}$.

In the case of a loss, there will always be a challenge given that $(1-q_l)Y-c > (1-q_o)Y-c$ which by assumption is greater or equal than e_b. Then, there is the possibility of settlement and that of going to court, again, in that case. Suppose first the case of settlement. Each challenger b would receive in each period a settlement payment $S_l = (1 - q_l)Y - c$, with the expected payoff of A, denoted $V_B^s(q_l) = \frac{Y - S_l - e_A}{1-p} = \frac{q_l Y + c - e_A}{1-p}$. Therefore, if there is settlement when A loses after going to court the first time, the expected payoff of going to court is:

$$V_A^{Cs}(q_o) = q_o Y - c + q_o p \frac{Y}{1-p} + (1 - q_o)p \frac{q_l Y + c - e_A}{1-p}. \tag{18}$$

In that case, A will choose to go to Court if and only if:[10]

$$\begin{aligned} V_A^s(q_o) &< V_A^{Cs}(q_o) \Rightarrow \\ \frac{q_o Y + c - pe_A}{1-p} &< q_o Y - c + q_o p \frac{Y}{1-p} + (1 - q_o)p \frac{q_l Y + c - e_A}{1-p} \Rightarrow \\ (2 - p(2 - q_o))c &< p(1 - q_o)q_l Y + q_o e_A. \end{aligned} \tag{19}$$

[9] If there were to be future challenges, similar results would be obtained.

[10] We suppose that Settlement occurs when the two payoffs are equal.

Because both sides of this inequality are positive, the range of parameters that would result in going to court is larger the higher is p. In other words, the effect of the shadow of the future holds in this setting, a setting that involves less decisive conflict than that of the models in section 3 and appendix A. We also note, but do not have space to show formally here, that the effect remains under still richer variations of this setting. For example, if A's win probability, once it drops after a loss may later rise again after a win, then the shadow of the future effect still operates. We thus see that the shadow of the future looms large across many settings.

References

[1] **Acemoglu, Daron, and James Robinson**, 2000, "Why did the West Extend the Franchise? Democracy, Inequality, and Growth in Historical Perspective," *Quarterly Journal of Economics*, 115, 1167-1199.

[2] **Bacharach, Michael**, 2006, *Beyond Individual Choice: Teams and Frames in Game Theory*, Princeton: Princeton University Press.

[3] **Bester, Helmut and Kai Konrad**, 2004, "Delay in Contests," *European Economic Review* 48 (5), 1169-1178.

[4] **Bester, Helmut and Kai Konrad**, 2005, "Easy targets and the timing of conflict," *Journal of Theoretical Politics*, 17 (2): 199-215.

[5] **Bester, Helmut and Karl Warneryd**, 1998, "Conflict Resolution Under Asymmetric Information."

[6] **Brito, Dagobert and Michael Intriligator**, 1985, "Conflict, War and Redistribution," *American Political Science Review*, 79 (4), 943-957.

[7] **Buchanan, James,** 1989, Notes on Irrelevant Externalities, Enforcement Costs, and the Atrophy of Property Rights. In: Tollison, R. and Vanberg, V. (eds) *Explorations Into Constitutional Economics*. College Station: Texas A&M University Press.

[8] **Budd, Christopher, Christopher Harris, and John Vickers**, 1993, "A Model of the Evolution of Duopoly: Does the Asymmetry between Firms Tend to Increase or Decrease?" *Review of Economic Studies*, 60, 543-573.

[9] **Collier, Paul, Elliott V.L., Hegre Havard, Hoeffler, Anke, Reynal-Querol, Marta, and Sambanis, Nicholas**, *Breaking the Conflict Trap; Civil War and Development Policy*, (World Bank Policy Report), 2003, Washington, DC: World Bank and Oxford University Press.

[10] **Dal Bó, Pedro**, 2005, "Cooperation under the Shadow of the Future: Experimental Evidence from Infinitely Repeated Games," *American Economic Review*, 95 (5), 1591-1604.

[11] **Fearon, James**, 1995, "Rationalist Explanations for War," *International Organization,* 49(3), 379-414.

[12] **Fearon, James, and David D. Laitin**, 2003, "Ethnicity, Insurgency, and Civil War." *American Political Science Review* 97(1), 75-90.

[13] **Fudenberg, Drew, and Jean Tirole**, 1996, *Game Theory*, Cambridge: MIT Press.

[14] **Garfinkel, Michelle and Stergios Skaperdas**, 2000, "Conflict Without Misperception or Incomplete Information: How the Future Matters," *Journal of Conflict Resolution*, 44(6), 793-807.

[15] **Genicot, Garance and Stergios Skaperdas**, 2002, "Investing in Conflict Management," *Journal of Conflict Resolution*, 46, 154-170.

[16] **Gradstein, Mark**, 2004, "Governance and Growth," *Journal of Development Economics*, 73, 505-518.

[17] **Greif, Avner,** 2006, *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade,* New York: Cambridge University Press.

[18] **Grossman, Sanford and Oliver Hart**, 1986, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 84, 691-719.

[19] **Harris, Christopher and John Vickers**, 1987, "Racing with Uncertainty," *Review of Economics Studies*, 54, 1-21.

[20] **Hay, B. and Spier, K**, 1998 Settlement of Litigation. In: Newman, P. (ed.) *The New Palgrave Dictionary of Economics and the Law*, New York: Stockton Press.

[21] **Hirshleifer, Jack**, 1989, "Conflict and Rent-seeking Success Functions: Ratio Vs. Difference Models Of Relative Success." *Public Choice*, 63(2), 101-12.

[22] **Joll, James**, 1992, *The Origins of the First World War*, 2nd Edition, New York: Longman.

[23] **McBride, Michael**, 2005, "Crises, Reforms, and Regime Persistence in sub-Saharan Africa," *European Journal of Political Economy* 21 (3): 688-707.

[24] **McBride, Michael and Stergios Skaperdas**, 2007, "Explaining Conflict in Low-Income Countries: Incomplete Contracting in the Shadow of the Future," in M. Gradstein and K.A. Konrad, (eds.), *Institutions and Norms in Economic Development*, 141-161, Cambridge, MA: MIT Press.

[25] **McNeill, William**, 1982, *The Pursuit of Power,* Chicago: University of Chicago Press.

[26] **Mehlum, Halvor and Karl Moene**, forthcoming, "Fighting Against the Odds," *Economics of Governance.*

[27] **Powell, Robert**, 1993, "Guns, Butter, and Anarchy," *American Political Science Review,* March, 87(1), 115-132.

[28] **Powell, Robert**, 2006, "War as a Commitment Problem," *International Organization.*

[29] **Robson, Alexander and Skaperdas, Stergios**, 2008, "Costly Enforcement of Property Rights and the Coase Theorem," *Economic Theory*, July, 36(1), 109-128

[30] **Sambanis, Nicholas,** 2004, “Using Case Studies to Expand Economic Models of Civil War,” *Perspectives on Politics*, 2(2), 259-279.

[31] **Skaperdas, Stergios**, 2006, "Bargaining vs. Fighting," *Defense and Peace Economics,* December, 17(6), 657-676.

[32] **Skaperdas, Stergios and Constantinos Syropoulos**, 1996, “Can the Shadow of the Future Harm Cooperation,” *Journal of Economic Behavior and Organization*, 29, 355-372.

[33] **Tilly, Charles**, 1992, *Coercion, Capital and European States*, New York: Blackwell.

[34] **Tullock, Gordon**, 1980, “Efficient Rent Seeking.” In *Toward a Theory of the Rent Seeking Society*, edited by James M. Buchanan, Robert D. Tollison, and Gordon Tullock, College Station: Texas A&M University Press, 3-15.

Table 1: Session Information

	Date	Number of subjects	Number of matches	Direction of change in continuation probability	Exchange rate (points/ dollar)	Number of males/ females	Percent with 1+ economics courses*	Percent with 1+ statistics courses*	Average take-home earnings**
Overall	--	72	--	--	--	39/33	46%	67%	$32
Session 1	24-Sep-2008	24	12	Increase	40	13/11	54%	71%	$30
Session 2	9-Oct-2008	24	12	Decrease	40	13/11	42%	79%	$30
Session 3	30-Oct-2008	24	24	Increase-decrease	80	13/11	42%	50%	$34
Session 3(a)	30-Oct-2008	24***	12	Increase	80	13/11	42%	50%	$34
Session 3(b)	30-Oct-2008	24***	12	Decrease	80	13/11	42%	50%	$34

Notes: Sessions 3(a) and 3(b) comprise the first and second halves of Session 3, respectively; i.e., the subjects in Sessions 3(a) and 3(b) (***) are the same subjects listed for Session 3. Information on courses (*) is obtained from subject questionnaires. This average take-home earnings (**) reporrted do not account for round-offs made before paying subjects, but reported earnings do include initial amounts given to prevent bankruptcy. Subjects in Sessions 1 and 2 were given an initial amount of $6, and subjects in Session 3 were given an initial amount of $3 in each half.

Figure 1: Payoff Matrix by Continuation Probability

(a) Expected Payoff Matrix for *p*=0

Blue \ Red	split	flip
split	20,20	5,5
flip	5,5	5,5

(b) Expected Payoff Matrix for *p*=1/2

Blue \ Red	split	flip
split	40,40	55,55
flip	55,55	55,55

(c) Expected Payoff Matrix for *p*=3/4

Blue \ Red	split	flip
split	80,80	155,155
flip	155,155	155,155

(d) Hi-Lo Game Payoff Matrix

Blue \ Red	split	flip
split	x,x	z,z
flip	z,z	z,z

Table 2: Percent Flips by Continuation Probability, Overall and by Session

	Continuation Probability		
	0	0.5	0.75
Overall	27%	63%	66%
Obs.	384	384	384
Session 1	22%	51%	73%
Obs.	96	96	96
Session 2	35%	59%	57%
Obs.	96	96	96
Session 3	26%	71%	68%
Obs.	192	192	192
Session 3(a)	22%	71%	65%
Obs.	96	96	96
Session 3(b)	29%	71%	71%
Obs.	96	96	96

Notes: The overall average uses all data from Sessions 1, 2, and 3. Sessions 3(a) and 3(b) comprise the first and second halves of Session 3, respectively.

Table 3: Chi-square Test Statistics for Hypothesis 1, Overall and by Session

	Hypothesis		
	1(a) Proportion of flips under p=0 equals proportion under p=0.75	1(b) Proportion of flips under p=0 equals proportion under p=0.5	1(c) Proportion of flips under p=0.5 equals proportion under p=0.75
Overall	119.261	100.168	0.964
p-value	< 0.01	< 0.01	0.33
Session 1	50.157	17.626	9.747
p-value	< 0.01	< 0.01	< 0.01
Session 2	9.237	11.051	0.086
p-value	< 0.01	< 0.01	0.79
Session 3	68.659	78.949	0.440
p-value	< 0.01	< 0.01	0.51
Session 3(a)	35.675	46.267	0.858
p-value	< 0.01	< 0.01	0.35
Session 3(b)	33.333	33.333	0.000
p-value	< 0.01	< 0.01	1.00

Notes: The overall average uses all data from Sessions 1, 2, and 3.

Figure 2(a): Percent Flips by Match, Session 1

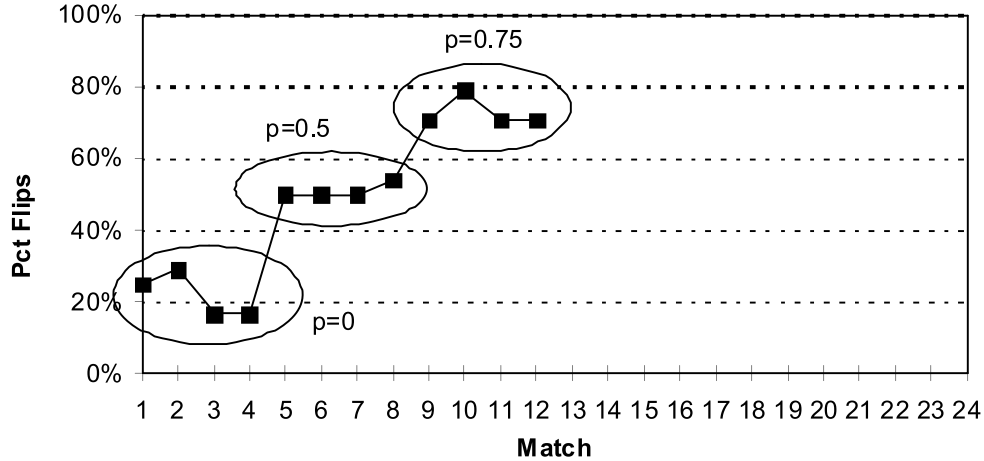

Figure 2(b): Percent Flips by Match, Session 2

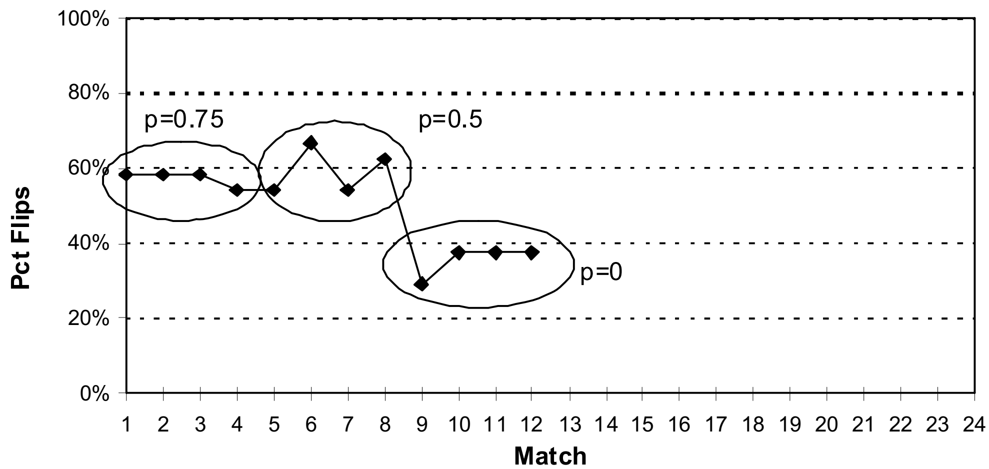

Figure 2(c): Percent Flips by Match, Session 3

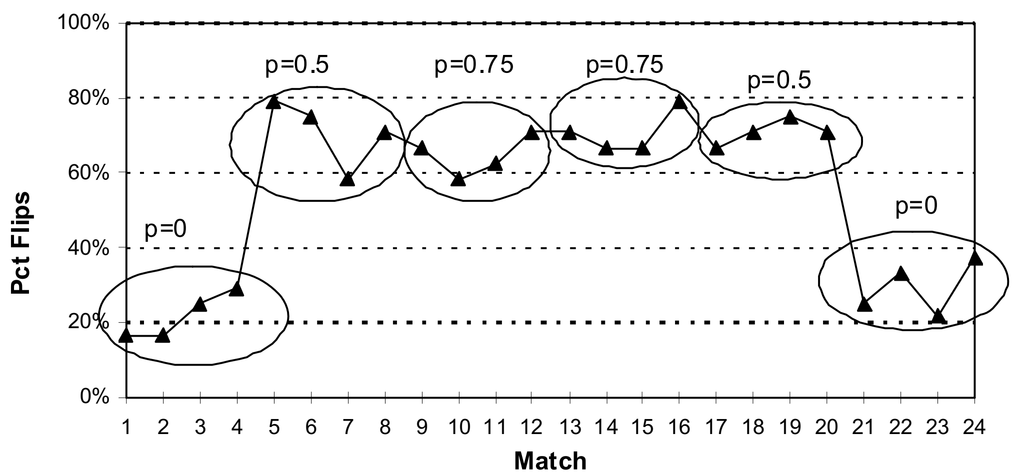

Table 4: Percent Outcomes by Continuation Probability, Overall and by Session

	Continuation Probability		
	0	0.5	0.75
Overall			
Flip-flip	5%	39%	41%
Flip-split	45%	49%	51%
Split-split	51%	13%	8%
Session 1			
Flip-flip	0%	23%	52%
Flip-split	44%	56%	42%
Split-split	56%	21%	6%
Session 2			
Flip-flip	8%	31%	27%
Flip-split	54%	56%	60%
Split-split	38%	13%	13%
Session 3			
Flip-flip	5%	50%	43%
Flip-split	41%	42%	50%
Split-split	54%	8%	7%
Session 3(a)			
Flip-flip	4%	52%	40%
Flip-split	35%	38%	50%
Split-split	60%	10%	10%
Session 3(b)			
Flip-flip	6%	48%	46%
Flip-split	46%	46%	50%
Split-split	48%	6%	4%

Notes: The overall average uses all data from Sessions 1, 2, and 3. Sessions 3(a) and 3(b) comprise the first and second halves of Session 3, respectively. Averages may not sum to 100 due to round-off error.

Table 5: Number of Subjects by Choice Classification, Overall and by Session

	Choice Classification									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Flips0 = Flips0.5 = Flips0.75 = all	Flips0 = Flips0.5 = Flips0.75 = 0	0 < Flips0 = Flips0.5 = Flips0.75 < All	Flips0.75 ≥ Flips0.5 ≥ Flips0 (not all equal)	Flips0.75 ≥ Flips0 ≥ Flips0.5 (not all equal)	Flips0.5 ≥ Flips0.75 ≥ Flips0 (not all equal)	Flips0.5 ≥ Flips0 ≥ Flips0.75 (not all equal)	Flips0 ≥ Flips0.75 ≥ Flips0.5 (not all equal)	Flips0 ≥ Flips0.5 ≥ Flips0.75 (not all equal)	Total
Overall	3	5	1	40	7	7	5	2	2	72
Session 1	1	3	1	15	2	1	1	0	0	24
Session 2	2	2	0	11	2	2	3	2	0	24
Session 3	0	0	0	14	3	4	1	2	0	24
Session 3(a)	0	0	0	16	0	4	2	1	1	24
Session 3(b)	1	2	0	13	1	2	1	3	1	24
Overall using 3(a) and 3(b)*	4	7	1	55	5	9	7	6	2	96

Notes: The overall total uses all data from Sessions 1, 2, and 3. Sessions 3(a) and 3(b) comprise the first and second halves of Session 3, respectively. Column (4) best matches the predicted behavior of expected payoff maximization. The overall total (*) that uses 3(a) and 3(b) treats the subjects in Session 3 as if they are different persons in 3(a) than in 3(b).