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# THE JOURNAL OF *conflict* RESOLUTION

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# Moments of Opportunity

## RECOGNIZING CONDITIONS OF RIPENESS FOR INTERNATIONAL MEDIATION BETWEEN ENDURING RIVALS

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Some points in time are more favorable for mediation success than others and result from the concatenation of contextual factors that encourage movement toward more cooperative behavior by disputants. Ripeness for mediation between enduring rivals is examined by focusing on mediation success in the short and extended term. Results suggest that the factors conducive to the achievement of short-term mediation success differ significantly from those that promote extended-term improvement in the rivalry relationship. These results help to reconcile some of the diversity of expectations in the ripeness literature by demonstrating that short-term and extended-term mediation success follow distinct dynamics.

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The best time to hit a serve is when the ball is suspended in the air, neither rising nor falling. We felt that this equilibrium had arrived, or was about to, on the battlefield. On the trip from Sofia to Sarajevo, after an intense discussion we decided to shift from “exploration” of a ceasefire to advocacy.

—Richard Holbrooke (1998, 193)

Holbrooke’s comment suggests that conflict management in Bosnia became possible not when the underlying issues were resolved; rather, it was when sufficiently traumatic losses forced both sides to change their perception of the dispute that a ripe moment was created for conflict management. Such ripe periods of time create opportunities for conflict management. In essence, the costs of continued conflict in Bosnia had reached a sufficiently painful level for both sides that the status quo could no longer be maintained. In this respect, the context under which mediation was conducted was decisive to the outcome of the mediation process.

An extension of the notion of ripeness to the relations between enduring rivals offers significant intuitive appeal. Enduring rivalries are among the most dangerous and conflict-prone dyads in the international system. As a result, developing means to

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aid conflict management between long-term rivals is a critical goal. The very nature of enduring rivalries, with their legacy of mutual distrust and pain, makes conflict management more difficult to achieve than in other types of disputes.

Understanding the conditions associated with mediation ripeness is important from both a theoretical and a policy standpoint to determine under what conditions mediation between enduring rivals is most likely to produce conflict management. First, a better understanding of ripe conditions for mediation would aid policy makers in deciding when international mediation would be most likely to improve relations between disputing states. Such an understanding would result in fewer wasted mediation attempts and encourage more concerted efforts when favorable mediation conditions prevail. Second, a better understanding of ripeness for international mediation may actually prevent the deterioration of relations between rivals. The idea that mediation might cause a deterioration of relations between rivals at first seems counter-intuitive. Yet, this expectation is consistent with a learning model of disputant behavior within a rivalry. If states continually update their beliefs about their opponents and the likelihood of improvement or deterioration of relations based on their prior experience, then unsuccessful mediations may teach rivals that management of their conflict is unlikely, forcing the adoption of more coercive, aggressive strategies by both sides. A better understanding of the conditions under which mediation is most likely to be successful would aid in preventing the deleterious effect of unsuccessful mediation.

Within the scholarly literature, ripe moments of conflicts are commonly conceived of as periods of time under which conflict management is most likely to be achieved. Although ripeness is typically treated as a discrete variable, in actuality, ripeness is better thought of as part of a continuum. Less ripe periods are less likely to result in successful mediation; more ripe periods are more likely to result in successful mediation. Indeed, only on rare occasions is a period sufficiently ripe that mediation success is virtually guaranteed or sufficiently unripe that mediation failure is virtually certain (Kriesberg 1992). The conceptions of ripeness in the literature have tended to fall into two broad groups. The first group tends to view ripeness in terms of temporal factors related to when within the lifecycle of a dispute mediation is attempted. The second group conceives of ripeness in terms of contextual factors related to the dispute and the relationship between the disputants. Disputes persist within the literature, however, regarding how factors such as the costs and pain of conflict and the distribution of power between disputants impact mediation success.

One underexamined area within the literature on ripeness in international mediation is the relationship between ripeness and extended-term mediation success. The small amount of empirical work about the nature of ripeness largely views mediation outcomes in terms of short-term achievements. As a result, I seek in this study to determine under what specific circumstances international mediation is most likely to achieve extended-term conflict management and short-term mediation success between enduring rivals. I focus on mediation success across two timeframes: short-term—the immediate result of the mediation attempt—and extended-term—the change in the rivalry relationship beyond the immediate mediation outcome.

One noticeable exception to the tendency of the ripeness literature to focus on short-term mediation outcomes is Regan and Stam's (2000) analysis of the impact of the timing of mediation efforts on the duration of interstate disputes. Because Regan and Stam's results provide a useful basis for comparison with the results obtained in this study, I discuss the parallels between our findings at the conclusion of this article. The results of this study emphasize that simply applying the lessons learned about ripeness and short-term mediation outcomes is not sufficient to understand ripeness and extended-term mediation outcomes.

### RIPENESS AMONG ENDURING RIVALS

In this study, I argue that five sets of contextual factors influence the prospects for mediation success. First, the costs and pain that develop throughout the lifetime of a rivalry carry important consequences for the ability of mediation efforts to improve the rivalry relationship. Second, the perception among rivals that they are unlikely to unilaterally alter the rivalry status quo in their favor is likely to encourage them to begin to pursue more cooperative strategies toward one another. Third, the level of threat, both inside and outside the rivalry, perceived by the rivals is likely to have a powerful influence on the degree to which rivals are open to international mediation efforts. Fourth, internal political changes within rivals themselves can foster the reevaluation of policies and increase the likelihood that mediation efforts will translate into an improvement in the rivalry relationship. Finally, the belief among rivals that a basis for settlement, a way out, exists improves the prospects for mediation success. It is important to emphasize that I regard the impact of each set of factors as largely independent of the others, and none of them are fully determinative of mediation success. Instead, each set of contextual factors carries an independent influence on the likelihood of mediation success. When conditions are fully ripe, the features of each set of contextual factors will be such that the likelihood of mediation success will be significantly improved.

The powerful effect of the past on the relationship between enduring rivals is a fundamental feature of enduring rivalries. As a result, the specific timing of mediation attempts within the lifecycle of an enduring rivalry is likely to have a strong effect on the likelihood of mediation success. The mediation literature, however, is divided regarding the direction of the effect that the timing of mediation exerts on the prospects for mediation success. One logic suggests that mediation attempted early in the lifetime of a dispute is more likely to be successful because the disputants have not yet begun to experience the increased hostility that is typically the product of a prolonged dispute (Edmead 1971). This argument suggests that early mediation permits the mediator to intervene before the dispute gets out of hand, and the willingness of the disputants to compromise with one another becomes sharply limited. As such, mediation becomes an effort to seize the moment before the conflict boils over and becomes unmanageable. This logic suggests the following hypothesis:

*Hypothesis 1a:* Mediation conducted early in the lifetime of an enduring rivalry is more likely to be successful.

A second logic suggests that a longer duration between the onset of the dispute and the mediation attempt can permit the disputants to continually engage in costly conflicts with one another, permitting them to eventually arrive at the realization that compromise is a more desirable outcome than recurring conflict. In this view, mediation that occurs too early is less likely to be successful because the disputants have yet to have sufficient opportunity to conclude that conflictual strategies are costly and unlikely to be successful. Instead, mediation is more likely to be successful later in the lifetime of a rivalry. This expectation is consistent with the arguments of Wickboldt, Bercovitch, and Piramuthu (1999); Bercovitch, Anagnoson, and Wille (1991); and Pruitt (1981) and suggests the following hypothesis:

*Hypothesis 1b:* Mediation conducted later in the lifetime of an enduring rivalry, after the rivals have experienced the costs of conflict, is more likely to be successful.

Another logic, however, suggests that it is the nature of the experiences gained by the rivals in relation to one another, rather than the duration of rivalry per se, that influences the prospects for mediation success. This view emphasizes the role of the characteristics and outcomes of past disputes between disputants in determining the likelihood of mediation success. In this sense, mediation success is most likely when a hurting stalemate develops between the disputants in which each pays the high costs of conflict without achieving any appreciable gain.

Implicitly, an enduring rivalry is a reflection of strategies chosen by states to achieve their goals with respect to the other side. In this sense, enduring rivalries are not exogenously defined but are, instead, dyads in which two sides tend to rely on conflictual strategies in dealing with one another. Zartman (2000, 1985) has suggested that the buildup of costs and pain during a dispute can encourage disputants to change their strategies toward one another. In these ripe moments, the disputants are locked in a mutual hurting stalemate in which unilateral solutions become blocked and joint solutions become more possible. Zartman argued that when a hurting stalemate prevails, and the parties begin to believe that there is a way out of the conflict, then a conflict is ripe for resolution. Fundamental to Zartman's conception of the hurting stalemate is the idea that when disputants find themselves following a pain-producing strategy with little gain, they will seek alternative strategies. Intuitively, ripeness occurs when both states increasingly become willing to move toward less conflictual strategies to achieve a mutually satisfactory outcome.

Similarly, Mor (1997) argued that a key time point during a rivalry occurs as the leadership and/or the general publics within the rivals realize that a transition to a more cooperative strategy would better serve state interests than a continued reliance on conflictual strategies. Recognition of the viability of cooperative strategies is likely to increase as the costs of continued conflict become more apparent. As military conflicts between rivals continually result in stalemate and generate high economic and human costs for the rivals, leaders are more likely to seek alternatives to the current conflictual strategy. Indeed, Richter (1992) suggested that repeated international crises may function to demonstrate to leaders that the existing foreign policy is likely to continue to result in heavy losses.

In this respect, the high costs of conflict within a rivalry may serve to encourage movement toward less conflictual strategies. Because more severe conflicts involve higher expressions of hostility by the rivals and larger conflict casualties, these conflicts impose higher economic and human costs on the rivals. As a result, when mediation is conducted after rivals have been forced to pay the high costs of conflict, it is more likely to facilitate movement by the rivals toward less conflictual policies toward one another. This logic suggests the following relationship:

*Hypothesis 2:* As the average severity level of previous disputes increases, the likelihood of mediation success will increase.

The second key element of the hurting stalemate is the failure of either rival to impose its preferred solution to the issues under dispute—the stalemate itself. Enduring rivals that are locked in patterns of repeated conflict may continue to follow conflictual policies toward one another as long as they expect that such policies are likely to yield a favorable shift in the rivalry status quo. Yet, reliance on conflictual policies carries high costs for the rivals themselves in terms of materiel, casualties, and resource allocation. Such costs may be borne by a rival so long as they provide a favorable return on their investment by either allowing or increasing the likelihood of a favorable alteration of the status quo.

The pattern of repeated disputes between rivals, however, may not be sufficient to suggest to them that conflictual policies toward one another are unlikely to achieve their desired goals. Frequently, stalemated rivalry disputes result in costs for the rivals without any appreciable benefit in the status quo to either side. As such, when mediation is conducted when rivals have had a high ratio of their disputes end in stalemate, the rivals should be more likely to move away from conflictual rivalry strategies toward more cooperative rivalry strategies, increasing the likelihood that mediation will successfully improve the rivalry relationship. As a result, I expect that

*Hypothesis 3:* As the percentage of disputes ending in stalemates increases, the likelihood of mediation success will increase.

The decision making of Egyptian president Anwar Sadat provides a clear example of how the high costs of conflict and the inability to favorably alter the rivalry status quo can create opportunities for mediation success. Following years of continued conflict with Israel, Egypt was in considerable economic and domestic turmoil. In 1977, these circumstances encouraged Sadat to conclude that maintenance of the continued pattern of conflict with Israel would only further damage Egypt. Indeed, Sadat argued that peace with Israel would provide a large peace dividend that would aid in solving many of Egypt's internal problems. Thus, Sadat recast Egyptian policy and announced that he was willing to go anywhere to discuss peace with Israel. This action created the impetus for the United States to seize a perceived moment of ripeness, launching the Camp David process. This momentum culminated in the 1978 Camp David Accords and the 1979 peace treaty with Israel.



Sadat's actions provide a good example of the manner in which a pattern of continued conflict within a rivalry can foster movement away from conflictual strategies. It was Sadat's perception of the costs and stalemate of past Egyptian-Israeli conflicts and his conclusion that they were likely to continue without a change in policy that functioned to encourage a reevaluation of the relationship with Israel and created the environment under which broader improvement in the rivalry relationship could occur.

Similarly, even without repeatedly stalemated dispute outcomes, a transition toward more cooperative strategies can also occur as both sides realize that their ability to impose a settlement on the other is small. Bercovitch (1997b) and Young (1967) each suggested that such a realization is particularly likely to occur when rivals are approximately equal in power. Although substantially weaker parties might be more likely to acquiesce to the demands of the other party in any international negotiations, it is important to emphasize the pattern of repeated conflict between enduring rivals that makes them unique. Even in cases in which the disparity of power is great among enduring rivals, we still often witness an unwillingness by the weaker power to yield to the demands of the stronger power. When power is roughly evenly distributed among enduring rivals, however, the ability of each side to unilaterally impose its preferred solution to rivalry issues through force should decline as each rival becomes more capable of resisting hostile actions by the other. This logic suggests that

*Hypothesis 4:* When rivals have roughly equal levels of power, the likelihood of mediation success will increase.

Rivals may be motivated to adopt more cooperative strategies toward one another not only as a result of what has happened in the past but also out of fear of what may happen in the rivalry relationship in the future. Zartman (2000) suggested that the perception by disputants of a precipice, the sense of an impending or recently avoided catastrophe, can be a source of ripeness encouraging disputants to move toward more cooperative relations, improving the prospects for mediation success. For enduring rivals, such a precipice may occur when rivals step across the line that divides militarized actions that simply involve threats, shows of force, and limited uses of force to actions that result in actual military deaths. Such an action essentially raises the ante in the rivalry relationship, increasing both the level of hostility and danger within the rivalry. As a result, the occurrence of a dispute between rivals that results in fatalities may provide the rivals with a sense that relations are on the verge of becoming significantly worse, suggesting to them that mediation may be their last chance to improve the rivalry relationship before circumstances spiral out of control. In this respect, the occurrence of fatalities in the last dispute before a mediation effort is conducted may function to encourage rivals to become more open to negotiation and compromise because they fear stepping off the ledge toward more significant levels of conflict. This logic suggests the following hypothesis:

*Hypothesis 5:* When the most recent dispute before a mediation attempt involved fatalities between the disputants, the likelihood of mediation success will increase.



Rivalry policies, however, are not easy to change. In general, conflict tends to beget conflict. Repeated conflicts between rivals, particularly those that involve significant numbers of fatalities, are likely to engender considerable hostility toward the adversary among the general population. Mor (1997), for example, argued that public support is particularly important within enduring rivalries because regimes must continually mobilize the public to sustain the effort against the rival. Yet, to continually mobilize the public against the rival, regimes must convince their constituents of the immediate threat of the rival. Typically, the danger of the rival is expressed to the population by creating images of an evil or threatening state. Such images, once in place, are quite difficult to change. Richter (1992), for example, suggested that external pressures serve to create a foreign policy; and the policy and its associated images of the adversary, in turn, create autonomous roots within the domestic environment.

In cases like enduring rivals in which conflictual strategies become institutionalized and deeply ingrained in the foreign policies of the states, substantial change in the strategies toward the other rival are likely to require the emergence of new thinking among decision makers. Typically, however, status quo policies toward the other rival are difficult to change without new decision makers in the rivals who can question the current policy. Mitchell (1995), for example, suggested that normal decision making is typically incremental in nature, leaving major goals and assumptions about policies unquestioned. In this respect, the simple installation of a new leader is not likely to be sufficient for reevaluation of policy toward the rival. A new leader entering office may be more dovish or hawkish toward the other rival depending on his or her own assumptions about the rivalry.

The reevaluation of rivalry policy is more likely to occur in the wake of broader political changes in the governmental structure of one of the rivals. As these political changes occur, a wide range of policy beliefs and assumptions begin to be reevaluated and replaced. In effect, polity changes provide the "jolt" that Mitchell (1995) argued is necessary for the reevaluation of goals and strategies by policy makers. Particularly in cases like enduring rivalries in which patterns of repeated conflict exist, policies toward the other rival are likely to be included among those that are reevaluated and altered following major domestic political changes. In this respect, structural changes within one of the rivals should provide an opening for changing rivalry relations and create a greater opportunity for mediation success. The political direction of the structural changes, however, may also have an important effect on the prospects for mediation success. The norms of compromise and negotiation inherent in democratic systems suggest that polity changes toward greater levels of democracy may be more conducive to mediation success than other types of political changes. This logic suggests the following hypotheses:

*Hypothesis 6a:* A recent polity change within one of the enduring rivals increases the likelihood of mediation success.

*Hypothesis 6b:* Only recent democratic polity changes within one of the enduring rivals increases the likelihood of mediation success.

Opportunities for the reevaluation of rivalry strategies, however, need not be confined only to political restructuring within enduring rivals. Instead, an increase in the level of threat directed toward the rivals, either internal or external, can also promote a movement toward less conflictual policies, increasing the prospects for mediation success. A civil war within a rival, for example, may encourage it to improve the rivalry relationship so that it may focus its attention on dealing with the internal conflict. Because states have only a finite amount of attention and resources they can devote to all potential threats, an increase in the number of other threats that a state faces external to the rivalry should make that state more amenable to conflict management, making it more likely to seek to reduce conflict with its rival to devote attention to the more pressing domestic conflict. This logic suggests the following hypothesis:

*Hypothesis 7a:* The occurrence of a civil war within one of the rivals at the time of mediation increases the likelihood of mediation success.

Another possibility, however, is that a civil war will diminish the likelihood of successful mediation. Internal conflict may weaken the leadership within the rival state sufficiently to make compromise with the other rival no longer possible. A leader weakened by internal conflict may be unable to grant sufficient concessions because of the domestic constraints that he or she faces, or he or she may lack sufficient credibility to bargain with the other adversary. Haas (1990) and Bercovitch (1997b), for example, both emphasized the importance of leadership strength to mediation success. Domestic conflict may encourage a rivalry leader to externalize his or her problems by encouraging conflict within the rivalry to garner support domestically. In addition, the opposing side may view internal conflict within the other rival as an opportunity to be exploited, encouraging it to adopt a more conflictual policy toward the rivalry. This argument suggests that

*Hypothesis 7b:* The occurrence of a civil war within one of the rivals at the time of mediation reduces the likelihood of mediation success.

Because enduring rivalries do not exist in isolation from the broader international system, an increase in the level of threat the rivals feel from the international system is also likely to increase the prospects for mediation success. As with internal threats, the limited amount of resources available to states compels them to address the most pressing threats first. As a result, rivals embroiled in multiple rivalries may seize upon a mediation effort and improve their relationship to deal with other threats outside of the rivalry. This argument suggests the following hypothesis:

*Hypothesis 8:* As the number of other rivalries in which rivals participate increases, the likelihood of mediation success will increase.

Beyond the impact of the costs and pain of previous conflict, the level of threats to the rivals, and the stimulation of new thinking brought about by internal political changes within the rivals, the ability of mediation to achieve any form of success is likely to be tied to the perception among the rivals' leadership that it is possible for a

deal to be reached. Zartman (2000) and Mitchell (1995) each suggested that the perception by the parties of a way out is an important component of a ripe moment. In this sense, the perception of a way out develops when the rivals anticipate that the possibility for reconciling their goals exists and concession making becomes possible.

One means of recognizing the perception of a way out among rivals is to focus on who initiates a mediation effort. A rival calling for mediation of disputes within the rivalry may recognize that some basis for agreement exists between the disputants. This expectation may develop when previously incongruent positions now permit compromise. Similarly, the sense of a way out can develop when the willingness of the rivals to hold to their positions wanes as the costs and pain of conflict mount. Under these circumstances, rivals may call for third-party involvement to assist them in fostering improvement in the rivalry relationship by seizing on the perceived possibility of agreement. Even if this expectation develops within only one rival, the perception of a way out may foster greater flexibility in negotiations—improving the prospects for mediation success. This logic suggests the following hypothesis:

*Hypothesis 9:* Mediation is more likely to be successful when it is initiated by at least one of the rivals.

Although I expect that the initiation of mediation by the rivals will increase the prospects for mediation success, disputants may also seek to initiate mediation for reasons unrelated to the achievement of an agreement or broader conflict management within the rivalry relationship. Richmond (1998), for example, suggested that disputants often initiate mediation with “devious objectives.” Rather than using mediation as a vehicle with which to reduce the level of conflict within the rivalry relationship, Richmond suggests that disputants may become involved in mediation efforts to gain breathing space and regroup resources, internationalize the dispute to improve its bargaining position, gain legitimacy for its bargaining position, or even to avoid making significant concessions by prolonging the dispute. The inclusion of a third party into negotiations may function to improve the power position of the weaker party in the dispute. This observation may explain the relative infrequency with which major powers permit mediation of their disputes, particularly those involving minor powers. Because of the possibility of mediation with devious objectives, I am open to the possibility that mediation efforts initiated by the rivals may not be more likely to result in either short-term or extended-term mediation success and may, in fact, actually reduce the likelihood of successful mediation.

I expect that the context under which mediation occurs will have a strong effect on the willingness of enduring rivals to move away from conflictual strategies toward more cooperative strategies. Patterns of repeated stalemated outcomes, high dispute costs, increases in the level of perceived threats to the rivals, power parity, and internal political changes are each expected to influence the degree to which enduring rivals are willing to adopt less conflictual strategies toward one another. When these conditions prevail, I expect that both short-term and extended-term mediation success are more likely to be achieved.

It is important, however, to note the extent to which short-term and extended-term mediation success involve different levels of change in strategy. Short-term mediation success, the immediate outcome of a mediation effort, is typically less difficult to achieve, requiring a lower level of commitment by the parties and less of a change in strategies than extended-term mediation. Mediation agreements can be achieved on peripheral issues without improving the broader rivalry relationship. Similarly, mediation agreements may be entered into without necessarily changing the behavior of the rivals toward one another. In addition, mediation agreements may be broken, fostering a deterioration of the rivalry relationship in the long term.

By contrast, extended-term mediation success, such as the reduction of dispute severity or conflict frequency, implies a more fundamental improvement in the rivalry relationship. Extended-term mediation success involves a higher degree of strategy change among enduring rivals because it requires the rivals to alter their actual behavior toward one another. This more fundamental shift in the strategies of rivals toward one another suggests that extended-term mediation success is more difficult to achieve and more strongly related to the context under which mediation occurs. Although context is important to short-term mediation success, I expect that under poor contextual conditions it will be easier for a mediator to encourage a short-term agreement than an extended-term improvement in the rivalry relationship. In this respect, I anticipate that contextual factors will have a stronger impact on the prospects for extended-term mediation success than the features of the mediation effort itself.

## RESEARCH DESIGN

This study covers the temporal domain from 1946 to 1992 and examines the population of enduring rivalries that began after 1945 and experienced at least one third-party mediation attempt. Enduring rivalries are dispute dyads that persist at least 20 years and experience at least six disputes during this timeframe (Diehl and Goertz 2000). Thirty-five rivalries meet these criteria. Operationally, there are 19 enduring rivalries that experienced mediation attempts during the timeframe of the study. These rivalries are listed in the appendix. The number of individual mediation attempts experienced by these rivalries ranges from a low of 1 to a high of 48 (with a median number of 6).<sup>1</sup> Examining ripeness in enduring rivalries is important because these dyads are both particularly conflict prone (accounting for nearly half of all militarized disputes) and also particularly likely to experience third-party conflict management attempts (Bercovitch, Diehl, and Goertz 1997). In addition, because enduring rivalries exhibit repeated patterns of conflict, they provide a useful population for examining ripeness from an extended-term perspective.

The unit of analysis for the study is the mediation attempt. I use Bercovitch's (1997a) International Conflict Management (ICM) data set to identify mediation attempts. At each mediation attempt, I take a cross-section of the rivalry relationship, the features of the mediation attempt, and the domestic political characteristics of the

1. The range of mediation attempts for the severity analysis is 1 to 11 with a median of 3.

rivals. In examining conditions of ripeness for mediation, I seek to determine those factors that are associated with higher probabilities of mediation success. Operationally, these factors may be those features associated with the most recent dispute prior to the current mediation attempt or factors endemic to the rivals that prevail at the time of the mediation attempt.

Although much of the mediation literature has focused on short-term mediation outcomes, it is possible that full settlements or partial settlements achieved through mediation may not translate into improvements in the overall rivalry relationship. In this respect, although mediation may appear successful in the short run, any longer term impact may be absent. Regan and Stam (2000), for example, suggested that third-party interventions can have a cumulative effect in which repeated short-term failures yield long-term success. I therefore use two extended-term measures of mediation success.

Bercovitch and Diehl (1997, 300) described conflict management as a process in which the conflicting parties "take steps to transform, de-escalate, or terminate a conflict in an acceptable way." Following this lead, I examine the extended-term success of mediation in terms of the reduction in the severity of future disputes and increased waiting times until the next use of force. Improvement in each of these extended-term measures signals that mediation has successfully improved the broader rivalry relationship beyond simply achieving an agreement.

Ideally, mediation will function to increase the waiting time between uses of force, delaying the onset of the next use of force following mediation. I examine the duration until the next use of force rather than the duration until the next dispute to focus the analysis on the ability of mediation to reduce the most serious types of militarized disputes. Lower level disputes that involve alerts, token shows of force, or threats may simply represent saber rattling between rivals that is substantively different from an actual use of force. I measure the waiting time until the next use of force as the number of months between the last mediation attempt and the onset of the next militarized dispute that involves the use of force. Uses of force are determined using the Correlates of War (COW) Militarized Interstate Dispute (MID) 2.1 (Jones, Bremer, and Singer 1996) dispute hostility variable. Disputes with hostility scores of 4 or 5 (uses of force or war) are counted as uses of force.

There are 238 mediation attempts among 19 enduring rivalries during the period from 1946 to 1992. The duration until the next usage of force is calculated in months. Because multiple mediation attempts sometimes occur between uses of force, the durations for these mediations are censored by the occurrence of an intervening mediation attempt. In addition, several censored mediation efforts occur in the same month. In this respect, the duration between these mediations and the next mediation attempt is 0 months. Because event history models cannot estimate observations with 0 durations, it is necessary to aggregate these multiple mediation efforts that occur temporally proximate to one another. As a result, I aggregate all mediations that occur in the same month into a single mediation observation. However, I include the count of the aggregated mediations into the total mediations-attempted variable. This process results in a database of 202 mediations. The contextual features of the mediation effort most temporally proximate to the next usage of force are coded in the database.

Because some mediation attempts are censored by the occurrence of a subsequent mediation attempt before the next dispute, it is impossible to determine the true time between that censored mediation attempt and the next use of force. To account for this censoring effect, I use a conditional Cox model for the analysis.<sup>2</sup> The Cox model is an event history approach that permits the estimation of models for censored data without introducing the bias into the analysis that simply dropping censored cases or arbitrarily ending durations between spells would interject. In addition, the Cox model carries fewer assumptions about the shape of the hazard rate.

International mediation efforts within a rivalry, however, are not independent events. As Regan and Stam (2000) demonstrated, mediation can have a cumulative effect on international conflict. Ordinary event history models, however, fail to adequately account for this nonindependence of events. In these models, the 3rd mediation attempt in a rivalry would be treated the same as the 10th mediation in a rivalry. Repeated events models, such as the conditional Cox model, however, explicitly model the nonindependence of events. The nonindependence of the mediation efforts is modeled by clustering the model by rivalry. The data are then stratified by the number of mediation efforts to date—the failure order. As a result, the model restricts the coefficients to be the same across strata but permits each stratum to have a unique baseline hazard rate (Box-Steffensmeier and Jones 1999).

I gauge short-term mediation success in terms of the immediate outcomes of individual mediation attempts. Using Bercovitch's (1997a) ICM data set, I create a tri-chotomous mediation outcome variable. I differentiate mediation outcomes as full successes (full settlements of the issue under mediation), partial successes (cease-fires, partial agreements), and failures. I use an ordered logit model to examine the factors associated with successful immediate mediation outcomes. For greater comparability, I use the same 202 mediation cases in the short-term analysis that are used in the waiting-time analysis.

Another important measurement of extended-term mediation success is the ability of mediation to improve the level of conflict within the rivalry relationship. I examine changes in the severity level of rivalry disputes immediately following the last mediation attempt in reference to a baseline rivalry severity average. Because individual rivalries may demonstrate distinctly different patterns of conflict, it is important to reference changes in severity with respect to a unique baseline for the rivalry. This methodology is consistent with Diehl and Goertz's (2000) finding that individual rivalries each have a unique basic rivalry level (BRL), an average hostility level around which dispute severity fluctuates.

In examining the impact of mediation on the severity of the next militarized dispute, I derive the dispute severity scores directly from Diehl and Goertz (2000). Dispute severity is measured on a 0 to 200 scale that reflects the general level of hostility and the number of battle deaths resulting from the dispute.<sup>3</sup> I calculate the difference in the severity level between the first dispute following a mediation attempt and the average

2. I tested for the suitability of a Weibull model for the analysis. The Weibull model's shape parameter was not significantly different from 1, suggesting the use of a Weibull model was not necessary. Therefore, I estimate the more general Cox model, which carries fewer distributional assumptions.

3. Diehl and Goertz (2000) provided a detailed discussion of the calculation of the severity score.



of the last three disputes before a mediation attempt.<sup>4</sup> I use the average of the last three disputes as the reference point so that the baseline for comparison is sufficiently long for a reasonable comparison but sufficiently recent that it reflects the state of the rivalry at the time of the mediation attempt. Simply using the severity of the last dispute as the baseline for comparison might arbitrarily find a reduction in severity following a dispute with a randomly high severity level, regardless of the impact that mediation has on the rivalry. In such cases, the tendency would be for the severity of subsequent disputes to return closer to the BRL, even without the influence of mediation. By contrast, comparing the severity of the next dispute to the severity average for the life of the rivalry would find a successful impact of mediation on cases in which early disputes were very severe but were followed by disputes with declining severity levels (perhaps as a result of earlier mediation attempts). Such cases would effectively have an improvement in rivalry severity built into the analysis.<sup>5</sup> Because of these concerns, I focus on the average of the last three disputes as the baseline for dispute severity comparison.

Because multiple mediation attempts occur between disputes, it is not possible to independently gauge the impact of mediations that are followed by a subsequent mediation attempt rather than a dispute. As a result, the data for the analysis consist of the 73 mediation attempts among enduring rivals that are followed by a dispute without an intervening mediation attempt. I create a 3-point scale that describes the level of reduction in the severity level of the next dispute following mediation. Mediations in which there is *no severity reduction or an increase in severity* in the next dispute are coded as a 0—these cases represent the failure of mediation to improve the rivalry relationship. Moderate improvement in the severity level of the next dispute—*severity reduction between 1 and 80 units*—is coded as a 1. Large improvement in the severity level of the next dispute—*severity reduction greater than 80 points*—is coded as a 2.<sup>6</sup> I use an ordered logit model to estimate the factors associated with improvement in the severity level of rivalry disputes after mediation.

I measure the impact of the timing of the mediation attempt on the likelihood of mediation of success by including a variable describing the elapsed time in months between the first rivalry dispute and the current mediation attempt. In addition, to control for the impact that the features of the mediation attempt itself have on the prospects for mediation success, I include several control variables describing the features of the mediation attempt. The data for each of these variables and the mediation date information are taken from the Bercovitch (1997a) ICM data set. The ICM data set provides rich data on the date, parties, and characteristics of conflict management efforts for the post–World War II period. The data set includes information on the type of conflict

4. For mediation efforts that occur very early in the rivalry, before three disputes have occurred, I use the average severity level of all previous disputes as the baseline. As a result, the baseline for a few of the cases is the severity level of only one or two disputes. I use this methodology to avoid the bias that would be caused by excluding mediation attempts that occurred early in a rivalry.

5. I do, however, estimate this model as a basis for comparison with a model using the last three disputes as the basis for comparison. The results are substantively similar. I report the results of the three-dispute model for the reasons described above.

6. For robustness, I also estimated the model using several variations of the severity reduction scale, including several in which the scale of the lowest level of severity improvement is narrowed. The results across scales were substantively similar. I use the 3-point scale because it best reflects the underlying distribution of the severity change after mediation.



management activity (negotiation, mediation, arbitration, etc.), characteristics of the mediator, and the outcome of the conflict management activity.

Because mediation is more likely to be successful as the parties build a relationship between themselves and the mediator, I include a variable describing the number of previous mediations with the same mediator. In addition, because a mediation attempt can have a cumulative impact as part of a broader process, I include a variable counting the total number of previous mediation attempts that have occurred between the rivals. Similarly, the cumulative effect of multiple mediation efforts within the same dispute can provide progress toward a mediated agreement. I therefore incorporate into the analysis the ICM variable describing the total number of mediation attempts conducted in this dispute.

The characteristics of the mediator can also have an important impact on the prospects for successful mediation. Mediations conducted by state leaders themselves signal a greater commitment by a third party to assist the rivals in improving their relationship and may increase the prospects for mediation success. Major power mediators are often able to bring considerable resources to bear on the mediation attempt that may greatly increase its chances of success. An examination of the combinations of carrots and sticks available to American mediators during the Egyptian-Israeli or the current Israeli-Palestinian mediations suggests an important role that the resources available to the mediator have on the prospects for mediation success. As a result, I include dummy variables in the model describing whether the mediation attempt was conducted by a state leader and if it was conducted by a major power. Operationally, I define major power status as permanent membership in the UN Security Council.

The nature of the issue under mediation may impact the prospects for reaching an agreement. The war literature suggests that territorial issues tend to have the highest severity levels, suggesting that disputes involving territory may be less amenable to mediation efforts. I therefore include a control variable describing whether one of the primary issues under dispute involves territory. This variable is derived from the primary issue variable within the Bercovitch (1997a) ICM data set. In addition, as a proxy for the perception by the rivals that a way out exists for mediation, I include a variable that describes whether mediation was initiated by at least one of the rivals. Data for this variable are taken from the mediation initiation variable in the Bercovitch ICM data set.

I measure the impact of domestic political factors on mediation success by including dichotomous variables describing polity changes and the existence of internal conflicts within either rival. Data for polity changes are taken from the Polity 98D data set (Gleditsch 2000). The Polity 98D data set includes both the date of polity changes and information regarding the direction of polity changes. Because the data set focuses on changes in the political structure of states, these data are ideally suited for identifying points in time when political changes are most likely to promote a reevaluation of rivalry strategies. A polity change is coded if a polity change occurred within at least one of the rivals no more than 24 months prior to the mediation attempt. I code two polity change variables, one indicating shifts toward democracy and one indicating shifts toward autocracy.<sup>7</sup> The 2-year cutoff was selected to coincide with the expectation that

7. I am grateful to Glenn Palmer for this suggestion.

relatively recent reorientations of the political system would most strongly influence the success of mediation. Civil war data were derived from the COW file (Singer and Small 1993). A civil war was coded if an internal conflict was occurring within either rival at the time of the mediation attempt.

I also include a term that measures the power distribution between the rivals. Using the COW composite index of national capabilities data set (Singer, Bremer, and Stuckey 1972), I create a power ratio variable by dividing the percentage of system capabilities held by the more powerful rival by the percentage of system capabilities held by the less powerful rival. The COW capabilities measure is determined as a percentage of system capabilities across six dimensions: total military personnel, total military expenditures, total energy consumption, iron and steel production, urban population, and total population. The dyadic capability data were generated using the EUGene software program (Bennett and Stam 2000).

To measure the impact that participation in other rivalries has on the likelihood of mediation success, I include an interaction term describing the total number of enduring rivalries of which each rival is a member at the time of the mediation attempt. Because this variable includes the rivalry that is under mediation, the smallest possible value for this variable is 1. To measure the impact of past conflict costs and stalemated outcomes on the likelihood of mediation success, I also include variables describing the percentage of past rivalry disputes that have ended in stalemate at the time of the mediation attempt and the average severity level of all previous rivalry disputes.

Data on dispute stalemates are derived from the COW MID 2.1 date set (Jones, Bremer, and Singer 1996). I use the percentage of disputes ending in stalemates rather than the total number of stalemates as a measure for two key reasons. First, measuring stalemates this way removes time, which I consider in the timing variable, from the variable and significantly reduces the problem of multicollinearity in the model. Second, using the percentage of disputes ending in stalemates allows the analysis to differentiate between rivalries that experience stalemates quickly from those that do not. If we compare two hypothetical cases, one in which the rivals experience 4 stalemated outcomes in the first 4 disputes and one in which the rivals experience 4 stalemated outcomes distributed over 12 disputes, the basis for this decision becomes more obvious. If the accumulation of evidence of the failure of conflictual strategies is driving the likelihood of mediation success, we would expect the first case to be more prone to mediation success than the last rivalry because all of the previous disputes in the first case ended in stalemate. By contrast, in the latter case, only a fraction of the disputes ended in stalemates, offering little suggestion to the rivals that conflictual strategies are unlikely to be successful. Only looking at the total number of stalemated outcomes would code each case exactly the same. Calculating the variable as a ratio compares more favorably with the theoretical expectations that I have described.

The average severity measure provides a good means for evaluating the costs of past conflict in the rivalry. Data for this variable are derived from Diehl and Goertz (2000). Because Diehl and Goertz calculated the severity score as an interaction term between each state's MID hostility score and the total dispute fatalities, this variable does a reasonably good job of capturing how costly previous disputes have tended to be for the rivals. As disputes move to higher levels of severity, they entail higher costs

for the rivals in both economic and human terms. The addition of the fatality term to the measure serves to further underscore the overall pain previous disputes have inflicted on the rivals. As these measures increase, the willingness of the rivals to abandon these policies should also begin to increase.

Zartman (2000) suggested that the perception that the disputants have reached a precipice in which events are likely to further deteriorate can be a powerful force to encourage successful mediation. When a rivalry dispute is sufficiently severe that it involves military fatalities for the participants, it may suggest to the rivals that subsequent disputes present a considerable danger of escalation to higher levels of conflict. To capture this effect in my examination of enduring rivalries, I code a dichotomous variable that describes whether the last dispute involved fatalities. To count, this last dispute must have occurred no more than 12 months before the current mediation attempt. I include this requirement to adequately control for cases in which the last dispute occurred several years before the current mediation attempt. In these cases, even if fatalities occurred, it is unlikely that they would provide a sense of impending disaster by the time mediation actually occurs.

## EMPIRICAL RESULTS

### SHORT-TERM RIPENESS

The short-term mediation outcome analysis suggests that the context under which mediation occurs, rather than the features of the mediation attempt, has the strongest impact on the prospects for a mediated agreement. The results of the ordered logit analysis are summarized in Table 1.

Mediations attempted early in the lifetime of a rivalry were more likely to result in an agreement than those attempted later in the rivalry. Deriving the estimated probabilities of mediation success from the ordered logit model offers some insight into the factors associated with mediation success. For example, there was more than a 60% probability of achieving a partial or full mediation agreement on the issues under dispute for mediations attempted 6 months after the first rivalry dispute. By contrast, mediation efforts conducted very late in the rivalry relationship were significantly less likely to achieve any type of agreement. The probability of a partial or full agreement was slightly less than 40% for mediations conducted 240 months after the first rivalry dispute. The likelihood of achieving a mediation agreement that resulted in a full settlement of the issues under dispute for mediations conducted 6 months after the first rivalry dispute was more than double that of mediations conducted 240 months into the rivalry (9.2% and 4.2%, respectively).

This finding suggests that short-term mediation success is more closely associated with the limitation of conflict rather than the pain and costs of conflict. Mediations conducted early in a rivalry, before the rivals have had the opportunity to experience significant levels of hostility and pain, are most likely to be successful. The findings for the percentage stalemate and average severity variables bear this expectation out. Although neither variable is statistically significant, both coefficients are negative,

TABLE 1  
Ordered Logit of Short-Term Mediation Outcomes

<i>Variable</i>	<i>Coefficient</i>	<i>Robust SE</i>
Mediation features		
Number of mediations by same mediator	.102	.098
Mediation conducted by state leader	-.405	.548
Elapsed time since first rivalry dispute	-.004*	.002
Number of previous mediation attempts	.009	.010
Number of mediation attempts this dispute	-.224**	.053
Mediation conducted by a major power	-.140	.286
Issue under dispute involves territory	.953*	.530
Mediation initiated by at least one rival	.730**	.393
Rivalry features		
Percentage of rivalry disputes ending in stalemate	-.006	.011
Average severity of previous disputes	-.009	.011
Fatalities in last dispute within 12 months	.212	.374
Power ratio	.0002	.016
Other threats		
Other rivalry involvement	.060	.065
Civil war	-.697	.543
Polity change		
Authoritarian polity change in last 24 months	.072	.401
Democratic polity change in last 24 months	.091	.374
<i>N</i> = 202		
Wald $\chi^2(16) = 774.13$		
Prob > $\chi^2 = .0000$		

\*Significant at .10. \*\*Significant at .05.

suggesting that if the intensity and outcomes of previous disputes have any effect on short-term mediation success, it is to reduce the likelihood of agreement.

Consistent with theoretical expectations, mediation efforts that were initiated by at least one of the rivals were significantly more likely to yield a mediated agreement. This suggests that when at least one of the parties believes that the possibility for agreement exists to a sufficient extent to actually initiate a mediation effort, the likelihood of an agreement was significantly higher than when mediation was initiated by a third party. Indeed, the likelihood of a full agreement on the issues under dispute was nearly double for mediation efforts initiated by at least one of the parties than for those initiated by a third party. The baseline likelihood of any type of mediated agreement, holding continuous variables at their means and dichotomous variables at their modal values, was .418. When mediation was initiated by the parties, the likelihood of any type of mediated agreement increased markedly to .598.

The nature of the issue under dispute was also significantly related to the likelihood of mediation success. Interestingly, the territorial control variable was statistically significant but opposite theoretical expectations. Territorial issues were significantly more likely to result in a mediation agreement than nonterritorial issues. In general, the

key issues between enduring rivals, because they tend to be highly salient for both parties, are resistant to mediation. As a result, territorial issues between enduring rivals may not be any more salient than other types of issues between enduring rivals. Territorial issues, however, can be more divisible than other types of issues between enduring rivals. Brams and Taylor (1996, 240) defined a divisible good as "one that can be divided at any point along a continuum (infinite divisibility), or in discrete units (finite divisibility), without destroying its value." Because divisible issues offer the ability to provide benefits to both disputants instead of a winner-take-all solution, they increase the likelihood of agreement between disputants. As such, because of their greater divisibility, some territorial disputes between enduring rivals may be more open to mediation agreements than disputes over ideology, regime, or ethnic issues. This higher level of divisibility makes territorial issues more prone to mediation agreements than other types of issues between enduring rivals.

Contrary to expectations, short-term mediation success was not significantly related to the distribution of power between the rivals. Threats to the rivals outside the rivalry, either external or internal, were not significantly related to the likelihood of mediation success because neither the level of participation in other rivalries nor the civil war variables were significant. Surprisingly, a recent dispute involving fatalities did not increase the likelihood of a mediated agreement. It may be possible that even dispute fatalities are insufficient to provide a sense of impending disaster sufficient to encourage enduring rivals to achieve a mediated agreement.

Domestic political changes within the rivals were also not significantly related to the likelihood of short-term mediation success. Neither authoritarian nor democratic polity changes significantly influenced the likelihood of mediation success. The directions of both the democratic and authoritarian polity change variables, however, were in the expected direction. This result may suggest that, because short-term mediated agreements require less of a fundamental shift in rivalry relations, they do not require the reevaluation of rivalry policies that are fostered by polity changes.

Surprisingly, however, multiple mediation attempts during a particular dispute reduced the likelihood of a mediated agreement. This finding is likely a selection effect in which the most difficult disputes to resolve are also the most likely to attract third-party conflict management efforts. The fact that none of the mediation control variables was significant was also surprising. Neither previous experiences with the same mediator, mediations conducted by state leaders, nor mediations conducted by major powers significantly increased the likelihood of a mediation agreement. This suggests that the ability of a mediator to foster an agreement between enduring rivals under poor contextual conditions may be limited.

#### **EXTENDED-TERM RIPENESS**

The results of the use of force waiting-time analysis suggest that the factors associated with extended-term mediation success follow a different dynamic from those associated with short-term mediation success. In contrast with the short-term results, evidence of the failure of previous conflictual strategies had a strong effect on the ability of mediation to postpone future uses of force. In general, the context under which

TABLE 2  
Conditional Cox Model for Waiting Time until the Next Use of Force

<i>Variable</i>	<i>Hazard Ratio</i>	<i>Coefficient</i>	<i>Robust SE</i>
Mediation features			
Number of mediations by same mediator	1.136	.127	.141
Mediation conducted by state leader	0.704	-.351	.630
Elapsed time since first rivalry dispute	0.994	-.006**	.003
Number of mediation attempts this dispute	0.957	-.044	.145
Mediation conducted by a major power	0.934	-.069	.610
Issue under mediation involves territory	1.426	.355	.414
Mediation initiated by at least one rival	.751	-.286	.689
Rivalry features			
Percentage of disputes ending in stalemate	0.992	-.008*	.006
Average severity of previous disputes	0.983	-.017**	.006
Fatalities in last dispute within 12 months	3.065	1.120	.748
Power ratio	0.911	-.093**	.038
Other threats			
Other rivalry involvement	1.070	.066*	.035
Civil war	0.351	-1.047	.745
Polity change			
Authoritarian polity change in last 24 months	0.371	-.991	.872
Democratic polity change in last 24 months	0.252	-1.380**	.809
<i>N</i> = 202			
Wald $\chi^2(15) = 151.44$			
Prob > $\chi^2 = .0000$			

\*Significant at .10. \*\*Significant at .05.

mediation occurs was more important to extended-term success than the features of the mediation effort itself. The results of the waiting-time analysis are summarized in Table 2.

Rivalries with a high percentage of previous disputes ending in stalemate had significantly longer durations until the next use of force than those with low levels of stalemated outcomes. A one standard deviation increase in the percentage of disputes ending in stalemate decreased by nearly 20% the likelihood of observing a usage of force at any given point in time following a mediation attempt. Similarly, as the average dispute severity level for the rivalry increased, the likelihood of a use of force at any time point after mediation decreased significantly. A one standard deviation increase in previous rivalry dispute severity reduced by nearly 47% the likelihood of a use of force. These results demonstrate that as rivals experience high dispute costs coupled with repeated dispute stalemates, they are more likely to reduce their level of conflict toward one another following mediation.

The timing of the mediation effort in the lifetime of the rivalry was also significantly related to the likelihood of a usage of force after mediation. Unlike the results in the short-term mediation agreement analysis, mediation efforts conducted later in the lifetime of a rivalry significantly improved the prospects for a reduction in the fre-

quency of uses of force. This finding, coupled with the results regarding the effect of dispute stalemates and dispute severity levels, suggests that mediation efforts are best able to facilitate improvement in the rivalry relationship and reduce the frequency of the most conflictual types of activities after enduring rivals have had sufficient opportunity to experience an extended pattern of high-cost disputes that fail to yield a change in the rivalry status quo.

Domestic political factors within the rivals also significantly influenced the waiting time until the next use of force after mediation. Democratic polity changes had the strongest statistically significant impact among the variables on the waiting time until the next use of force. A democratic polity change within 24 months of a mediation attempt reduced the likelihood of a usage of force at any point in time following the mediation by nearly 75%.<sup>8</sup> The direction of the effect of authoritarian polity changes was also positive but was not statistically significant. This finding fits the expectation that fundamental changes in the structure of the regimes of enduring rivals encourages the reevaluation of policy toward the enduring rivalry, increasing the prospects for improvement in the rivalry relationship. The fact that only democratic polity shifts were significantly related to improvement in the waiting time until the use of force compares favorably with the work within the democratic peace literature. Significant political liberalization at home appears to support efforts to improve the level of conflict within the rivalry relationship after mediation.

The existence of threats to the rivals outside the rivalry had a mixed effect on the waiting time until the next use of force following mediation. The civil war variable was not significant at the .10 level using a two-tailed test. By contrast, increased international threats to the rivals reduced the delay until the next use of force. As the number of rivalries in which both rivals are participants at the time of mediation increased, the likelihood of a use of force following mediation significantly increased. This finding was contrary to theoretical expectations. Each additional rivalry in which members of a mediated rivalry participate increases by almost 7% the likelihood of a use of force following mediation. This finding suggests a selection effect in which states that tend to be more conflict prone in the international system also tend to be more conflict prone within the rivalries in which they are involved.

The effect of the rivalry power distribution was also contrary to theoretical expectations. A use of force at any time following mediation was more than 17% less likely for rivalries in which there was a three to one distribution of power than for rivalries with an even distribution of power. This suggests that power parity at the time of mediation can suggest to rivals that, under the right circumstances, they may have sufficient power to impose through force their preferred settlement to rivalry issues. In this respect, power parity may make rivals more willing to accept the risks of a use of force, reducing the waiting time between mediation and the next use of force.

Consistent with the results in the short-term analysis, none of the control variables that describe the characteristics of the mediation attempt were significantly related to

8. Shorter durations between polity changes and mediation attempts were also attempted. The effect of polity changes within 12 and 6 months was similar to the reported findings across all of the models in both magnitude and direction. The level of statistical significance, however, declined due to the small number of polity changes that occurred as the timeframe declined.



TABLE 3  
Ordered Logit of Rivalry Severity Change

<i>Variable</i>	<i>Coefficient</i>	<i>Robust SE</i>
Mediation features		
Number of mediations by same mediator	.486*	.305
Mediation conducted by state leader	1.128**	.611
Elapsed time since first rivalry dispute	.004	.003
Number of previous mediation attempts	.012	.020
Number of mediation attempts this dispute	-.556**	.130
Mediation conducted by a major power	.782**	.436
Issue under dispute involves territory	-1.810**	.953
Mediation initiated by at least one rival	-.251	.746
Rivalry features		
Percentage of rivalry disputes ending in stalemate	.024**	.012
Average severity of previous disputes	.044**	.012
Fatalities in last dispute within 12 months	-.494	.665
Power ratio	.015	.020
Other threats		
Other rivalry involvement	-.027	.051
Civil war	-.209	.947
Polity change		
Authoritarian polity change in last 24 months	-.366	1.313
Democratic polity change in last 24 months	1.520**	.722
<i>N</i> = 73		
Wald $\chi^2(16) = 933.54$		
Prob > $\chi^2 = .0000$		

\*Significant at .10. \*\*Significant at .05.

the duration until the use of force following mediation. Similarly, the occurrence of fatalities in the last rivalry dispute before mediation did not reduce the likelihood of a use of force following mediation. Indeed, although the fatalities in the last dispute variable do not meet the .10 significance level, the direction of the coefficient suggests that fatalities in the last dispute before mediation may increase the occurrence of a use of force after mediation. In this respect, recent dispute fatalities do not appear to suggest a precipice for enduring rivals and do not foster any form of mediation success.

The results of the severity-change analysis are quite similar to the results obtained in the waiting-time analysis. This further suggests that the forces that foster improvement in the prospects for a mediated agreement follow a very different pattern from those that encourage broader improvement in the rivalry relationship. The results of the severity-change analysis are summarized in Table 3.

The costs imposed by previous conflicts significantly influenced the likelihood of observing a reduction in dispute severity following international mediation. As the average severity level of previous rivalry disputes increased, the likelihood of a reduction of severity in the next dispute following mediation also increased. Similarly, as the percentage of disputes ending in stalemate increased, the likelihood of improvement in

the severity of the next dispute increased. At the baseline, when dichotomous variables were held at their modes and all other variables were held at the mean, the probability of observing any type of improvement in the severity level of the next dispute following mediation was slightly more than 47%. By contrast, when the average dispute severity and the percentage of disputes ending in stalemate variables were each increased by one standard deviation, there was more than an 84% probability of observing any type of dispute severity reduction. The effect of the costs and stalemates of previous disputes on the likelihood of severity reduction is most striking at the highest level of the dispute severity change scale, when dispute severity is reduced by more than 80 points. The probability of a major improvement of more than 80 points in the severity level of the next dispute when the model is held at the baseline was only slightly less than 3%. By contrast, when a hurting stalemate prevails and the average severity and percentage stalemate variables were each increased by one standard deviation, the probability of a severity reduction more than quadrupled to almost 14%.

These findings underscore the powerful effect that the pattern of costs and failure experienced by rivals has on the ability of mediation to reduce the intensity of conflict within a rivalry. The results of the waiting-time and severity-change analyses suggest that the idea of a hurting stalemate provides a useful way of examining the manner in which mediation can improve the broader rivalry relationship. Enduring rivals appear to change their behavior toward one another following mediation as the costs of previous conflict mount without yielding any change in the status quo of the issues under dispute. As with the findings in the short-term and event-history analyses, however, the occurrence of fatalities in the last dispute was not significantly related to the reduction of subsequent dispute severity following mediation.

Domestic political changes within the rivals themselves also positively influenced the propensity for dispute severity reduction following mediation. The direction of the political changes, as was found in the waiting-time analysis, had a significant impact on the prospects for dispute severity reduction. Polity shifts toward greater levels of autocracy did not significantly influence the likelihood of observing a reduction in dispute severity following mediation. By contrast, polity shifts toward greater levels of democracy strongly increased the likelihood of observing a reduction in dispute severity. Indeed, there was more than an 80% probability of any type of dispute severity reduction following mediations that occurred within 24 months of a democratic polity shift within one of the rivals when all other variables were held at the baseline. Similarly, there was more than an 11% likelihood of observing a severity reduction of more than 80 points when mediation occurs within 24 months of a democratic polity change, an increase of more than 2.5 times the probability of a significant severity reduction when all variables are held at their means. In this respect, political changes within rivals that fostered greater competitiveness of elections, political openness, or freedom of discourse also encouraged the reduction of severity in subsequent rivalry disputes. Thus, although democratic polity shifts do not appear to influence the prospects for short-term mediation success, they do encourage improvement in the broader rivalry relationship.

There were several differences between the results obtained in the event-history analysis and the severity-change analysis. First, the timing of the mediation attempt in

the life of the rivalry, unlike in the waiting-time analysis, was not significantly related to the reduction of dispute severity following mediation. The direction of the variable, however, was in the posited direction. The lack of significant findings in the severity analysis may be due to the reduced sample size in the severity analysis. Second, neither the level of involvement in other rivalries nor the distribution of power between the rivals was significantly related to the reduction of dispute severity following mediation. Finally, unlike in the short-term and event-history analyses, the characteristics of the mediation attempt itself were significantly related to the ability of mediation to reduce subsequent dispute severity.

For example, as the level of previous experience with the same mediator increased for enduring rivals, the likelihood of a reduction in dispute severity after mediation increased. In this respect, the development of a rapport and a sense of commitment between the mediator and the disputants functions to improve the broader rivalry relationship by reducing the intensity of future disputes after mediation. The standing of the mediator also significantly increased the likelihood of a reduction in subsequent dispute severity. Mediations conducted by state leaders and mediations conducted by representatives of major powers were both significantly more likely to achieve a reduction in subsequent dispute severity. Indeed, a mediation conducted by a state leader had nearly as large an effect on the likelihood of severity reduction as a democratic polity change. The probability of a reduction in dispute severity following mediation conducted by a state leader was more than 73%. When mediation was conducted by a state leader from a major power, there was nearly an 86% probability of a reduction in dispute severity.

As in the short-term analysis, the selection effect between the number of mediation attempts during a dispute and the likelihood of mediation success was also observed in the severity-change analysis. As the number of mediation attempts during a dispute increased, the likelihood of a reduction in future dispute severity decreased. This finding suggests that mediators tend to be drawn to the most difficult types of conflicts, an effect noted in Diehl and Goertz (2000).

Examining the combined effect of the outcomes and costs of previous disputes coupled with the development of new thinking through a democratic polity change demonstrates a dramatic effect on the likelihood of severity reduction following mediation. When each of these three conditions prevailed, there was only slightly less than a 4% probability that the next dispute after mediation would have either an increase in dispute severity or no improvement. When these conditions occurred simultaneously, there was more than a 42% probability of observing a reduction of more than 80 points in the next dispute following mediation.

## DISCUSSION

In this study, I sought to identify and compare the contextual factors that were associated with ripeness for short-term and extended-term mediation success. This study underscores the importance of the context under which international mediation occurs. Despite the highly conflict-prone nature of enduring rivalries and their resis-

TABLE 4  
Summary Results Table

<i>Variable</i>	<i>Short-Term Outcome</i>	<i>Use of Force Waiting Time</i>	<i>Severity Change</i>
<i>Mediation features</i>			
Number of mediations by same mediator			+
Mediation conducted by state leader			+
Elapsed time since first rivalry dispute	–	+	
Number of previous mediation attempts			
Number of mediation attempts this dispute	–		–
Mediation conducted by a major power			+
Issue under dispute involves territory	+		–
Mediation initiated by at least one rival	+		
<i>Rivalry features</i>			
Percentage of rivalry disputes ending in stalemate		+	+
Average severity of previous disputes		+	+
Fatalities in last dispute within 12 months			
Power ratio		+	
<i>Other threats</i>			
Other rivalry involvement		–	
Civil war			
<i>Polity change</i>			
Authoritarian polity change in last 24 months			
Democratic polity change in last 24 months		+	+

NOTE: + = significant positive effect on mediation success; – = significant negative effect on mediation success.

tance to mediation success, the prospects for achieving mediated agreements and extended-term improvements in the rivalry relationship are strongly influenced by the conditions under which the mediation attempts occur. Because the factors conducive to the achievement of mediated agreements differ greatly from those that increase the prospects for more extended-term improvement in the rivalry relationship, this study emphasizes the importance of mediators selecting the context for mediation that is most opportune for the type of mediation result that is desired. Three dominant patterns in the factors associated with ripeness for short-term and extended-term mediation success emerged from this study. These patterns are summarized in Table 4.

The first key pattern suggests that the characteristics of previous disputes in the life of a rivalry provide a powerful influence on the prospects for both short-term and extended-term mediation success. The difference in the direction of the effect of the characteristics of previous rivalry disputes on short-term and extended-term mediation success, however, demonstrates that each follows a separate causal logic. Short-term mediation success is most likely early in the life of a rivalry, suggesting that mediation is most likely to result in an agreement before rivals develop significant levels of hostility toward one another. In such cases, the level of trust between the rivals and the degree to which they are flexible to make concessions and achieve compromise is likely to be higher.

Extended-term mediation success, however, follows an opposite causal pattern that fits the arguments of Zartman (2000, 1985), Mor (1997), and Young (1967). Although high dispute severity levels and a high percentage of stalemated disputes can promote hostility between enduring rivals, they also demonstrate the inability of conflictual strategies to achieve the goals of the enduring rivals. Mediation attempts that occur late in the lifetime of enduring rivalries, after they have experienced high levels of dispute severity and a high proportion of stalemated dispute outcomes, are significantly more likely to result in reductions of dispute severity and increases in the waiting time until the next use of force.

Interestingly, the finding that the timing of mediation in the lifetime of the rivalry follows two conflict management patterns roughly parallels Regan and Stam's (2000) finding of a curvilinear relationship between the timing of mediation during a dispute and the dispute duration. Regan and Stam found that mediations attempted either early or late in a dispute serve to reduce dispute duration. By contrast, mediations attempted after the initial opening but before the latter stages of a dispute actually contribute to an increase in the duration of disputes. In this respect, mediation is most successful at two distinct points in time. Mediation can be successful early in a conflict, before the disputants have built up high levels of hostility that make compromise difficult. Yet, mediation can also become successful late in a conflict, after disputants have expended significant resources in conflict with one another and become more willing to improve their relationship.

The differential effects of previous rivalry relations on the prospects for short-term and extended-term mediation success suggest that a key cause of the diversity of expectations regarding the impact of both timing and previous dispute characteristics on mediation success is a consequence of a lack of agreement on how to define mediation success. In this respect, the results of this study suggest the happy conclusion that both those who suggest that mediation success is more likely early in the relationship (Edmead 1971) and those who argue that success is more likely later in the relationship (Wickboldt, Bercovitch, and Piramuthu 1999; Bercovitch, Anagnoson, and Wille 1991; and Pruitt 1981) are partially correct. If mediation success is defined in terms of short-term mediation agreements, then early intervention is most likely to be successful. If, however, mediation success is defined in terms of an improvement in the broader rivalry relationship, then later intervention, after the rivals have experienced the costs and failure of conflictual strategies, is more likely to be successful. These results underscore the need for greater specificity in the definitions of mediation success within the theoretical ripeness literature.

The second pattern that emerges from the analysis highlights the difference in the degree to which both short-term and extended-term mediation success depend on the emergence of new thinking within the regimes of enduring rivals. Mediation agreements, although they may address difficult issues in the rivalry relationship, require lower levels of change in the conflictual strategies that enduring rivals pursue toward one another. Indeed, mediation agreements need not translate into noticeable changes in the interactions of enduring rivals with one another. As such, it is not surprising that polity changes were not significantly related to the likelihood of achieving a mediated agreement. Extended-term mediation success, by contrast, entails more fundamental

changes in the manner in which enduring rivals relate to one another. Reductions in the frequency of the use of force and declines in dispute severity levels following mediation both involve more basic changes in the strategies that enduring rivals follow in relating to one another. Yet, because the conflictual strategies that emerge within enduring rivalries tend to become deeply ingrained into the foreign policies of the rivals, these strategies are resistant to change. As a result, change in the behavior of enduring rivals following mediation is more likely following structural changes within their regimes because they foster the reanalysis and change of existing policies.

The third general pattern that emerged in the analysis was the difference in the influence on the prospects for short-term and extended-term mediation success of mediations initiated by enduring rivals themselves. When mediation was initiated by at least one of the rivals, the likelihood of achieving a mediated agreement significantly increased. Indeed, this factor had one of the strongest effects on the likelihood of short-term mediation success of all of the independent variables in the model. By contrast, mediations initiated by the rivals were not significantly related to either the reduction of the frequency of uses of force or the reduction of dispute severity following the mediation attempt. These results suggest two possible interpretations.

One possible interpretation of this effect is that enduring rivals are only able to successfully recognize and take advantage of circumstances when a mediated agreement is likely. Under these circumstances, rivals initiate the mediation effort themselves and often achieve a mediated agreement. By contrast, recognition of the possibility for broader improvement in the rivalry relationship may be more difficult for enduring rivals, making them unlikely to call for third-party intervention when conditions are most conducive to extended-term mediation success. Instead, an outside party may be necessary to recognize the possibility for broader improvement in the rivalry relationship that occurs as the rivals exhaust themselves in repeated disputes without achieving any favorable improvement in the status quo.

The results, however, also suggest a more ominous interpretation. Short-term mediation success may be significantly related to the initiation of mediation by disputants because enduring rivals often initiate mediation with the "devious objectives" that Richmond (1998) described. The null results obtained in the analysis of both forms of extended-term mediation success may reflect the influence of cases in which enduring rivals initiate mediation without any intention of improving their broader relationship. Instead, a rival may call for mediation to gain breathing space, shore up its power position, or gain legitimacy for its demands within the international community. In this respect, enduring rivals may call for international mediation efforts when such an effort is least likely to result in any form of broader improvement in the rivalry relationship, even if a brokered agreement is achieved. This possibility underscores the need for mediators to recognize the importance of the broader context under which a mediation attempt might occur, even when the disputants call for third-party intervention. As the results of this study suggest, mediation efforts can improve the relationship within even the most conflict-prone dyads in the international system. The careful selection of the conditions under which mediation attempts occur, however, is a critical factor in the ability of mediation efforts to reduce the level of conflict between enduring rivals.

## APPENDIX

### Enduring Rivalries Beginning after 1945

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#### MEDIATED RIVALRIES

United States–Soviet Union	Iran–Iraq
United States–China	Iraq–Kuwait
Chile–Argentina	Egypt–Israel
Spain–Morocco	Syria–Israel
Greece–Turkey	Jordan–Israel
Cyprus–Turkey	Afghanistan–Pakistan
Uganda–Kenya	China–India
Somalia–Ethiopia	North Korea–South Korea
Morocco–Algeria	India–Pakistan
	Thailand–Cambodia

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United States–Cuba	Iraq–Israel
United States–Ecuador	Syria–Jordan
United States–Peru	Israel–Saudi Arabia
United States–North Korea	Saudi Arabia–North Yemen
United Kingdom–Iraq	China–South Korea
Soviet Union–Norway	South Korea–Japan
Congo Brazzaville–Zaire	Thailand–Laos
Ethiopia–Sudan	Thailand–North Vietnam

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# Conflict and Renewable Resources

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The economic literature on conflict employs a static, game-theoretic framework developed by Jack Hirshleifer. The authors introduce conflict dynamics into a model with two rival groups, each dependent on a single contested renewable resource. The model is based on two stylized facts: conflict often arises over scarce renewable resources, and those resources often lack well-defined and/or enforceable property rights. In each period, groups allocate their members between resource harvesting and resource appropriation (or conflict) to maximize their income. This leads to a complex nonlinear dynamic interaction between conflict, the two populations, and the resource. As developed, the model relates most closely to conflict over renewable resources in primitive societies. The system's global dynamics are investigated in simulations calibrated for the historical society of Easter Island. The model's implications for contemporary lesser developed societies are examined.

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## 1. INTRODUCTION

The economic literature on conflict can be traced back to Malthus ([1798] 1970), who argued that conflict over natural resources would arise as a consequence of population growth and environmental degradation. Contemporary studies have moved away from a focus on natural resources. Recent advances in the literature can be traced to the seminal, game-theoretic model of Hirshleifer (1989). Hirshleifer-type models, including ours, share two central features. First, there is the lack of secure individual or group property rights. Second, conflict is understood as a rational activity. Actors may devote effort to create wealth through production and/or appropriate the wealth of rival actors through conflict. A third common feature of Hirshleifer-type models is that they are static. We, however, offer a dynamic model of conflict that concentrates specifically on the dynamic interplay between conflict and the contested wealth.

The economic literature on conflict has abstracted from modeling the underlying source of conflict and conflict dynamics. Although this abstraction allows authors to claim applicability to many conflict situations, it weakens the ultimate predictive power of the models, giving rise to questions that the current literature fails to address. For example, once groups are in conflict, does a rise in the contested wealth lead to a

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lessening or a strengthening of conflict? How does conflict affect (or, how is it affected by) changes in the allocated effort and/or contested wealth over time? Our dynamic model of conflict allows us to gain insight into these questions. We study conflict dynamics within the context of conflict over renewable resources. However, our approach could be applied to other Hirshleifer-type models.<sup>1</sup>

Our model features two rival groups. Each group is dependent on a single contested renewable resource. In each period, the groups allocate their members between resource harvesting and resource appropriation (or conflict) to maximize their incomes. This leads to a complex nonlinear dynamic interaction between the two populations and the resource. The complexity arises in part because of our decisions to model the disputed resource as renewable and assume that the resource is essential for procreation. These decisions are motivated by a desire to probe the model's implications for conflict in lesser developed societies that closely depend on the environment for livelihood.<sup>2</sup>

In recent years, many social scientists have argued that renewable resource scarcity (e.g., land degradation, deforestation, fisheries depletion, food scarcity, and water scarcity) is increasingly a factor that contributes to political conflict.<sup>3</sup> In the post-1945 era, conflict over renewable resources has typically occurred in lesser developed countries (LDCs). For example, turmoil in Haiti has been linked to deforestation (Wallich 1994; Homer-Dixon 1999). Land scarcity and deforestation are said to have played a role in the 1994 Rwandan civil war, whereas land pressures and hunger stimulated the Chiapas uprising in Mexico in the early 1990s (Renner 1996; Baechler 1998; Brown, Gardner, and Halweil 1999).<sup>4</sup> Other examples involve conflict over scarce water. Some observers in fact argue that future wars will be increasingly about water.<sup>5</sup> Conflicts

1. Although we focus on renewable resources, as noted by Hirshleifer (1995) and Neary (1997), Hirshleifer's setup could be used to analyze many situations, including gang warfare, criminal-victim interactions, labor disputes, legal disputes, and animal territoriality disputes. Using a static model, Neary motivated his general-forms Hirshleifer-type model by referring to Homer-Dixon's (1999) review of real world conflicts over renewable resources.

2. Conflict over nonrenewable resources also exists. For reasons of tractability, however, our model has only one resource. The resource is meant to capture the entire basket of resources on which a primitive society depends. Given this dependence, it is appropriate to model the resources as renewable, because most life-giving resources are renewable.

3. Scholars suggest four channels through which this tends to happen: a decline in economic performance, ethnic clashes due to population migration, a weakening of political institutions, and a general exacerbation of existing socioeconomic-political cleavages. For reviews of theories and case studies, see Myers (1993), Baechler (1998), and Homer-Dixon (1999).

4. This list is by no mean exhaustive. For example, social strife in the post-1945 Philippines has been linked to deforestation and land degradation leading to population displacements (Hawes 1990). Durham (1979) described how land scarcity caused migration from El Salvador to Honduras, resulting in competition between immigrants and natives over land and leading to a war in 1969. Subsistence crisis in Peru led to the Luminoso rebellion (McClintock 1984). Since the 1970s, cropland and food scarcities have aggravated ethnic conflict along the border between India and Bangladesh (Ashok 1996). Since the 1980s, there has been a rise in piracy directed at fishing boats in lesser developed countries (*Oceans and the law of the sea* 1998), and land pressures have stimulated squatters on ranches in Brazil (Brazil: Land for the landless 1996).

5. See, for example, the press release by the World Bank's vice president, Ismail Serageldin (1995). Contemporary cases include the 1989 Mauritania-Senegal conflict, the ongoing Arab-Israeli conflict, the mid-1980s South Africa-Lesotho conflict, the ongoing Syrian-Turkish conflict (Myers 1993; Homer-Dixon 1999), and the 1990s social strife in China's Ningxia province (Pomfret 1998).

over renewable resources have also occurred among developed countries (DCs) but with lower intensity (e.g., the 1972–73 English-Icelandic Cod War; recent U.S.-Canada or Canada-Spain fishing conflicts).<sup>6</sup>

Due to its tendency to describe specific episodes of conflict, the extant literature on conflict over renewable resources in political science has generally neglected the complex dynamic interplay between population, natural resources, and conflict. Our stylized model allows an investigation of this interplay, which can take relatively long periods of time to play out.<sup>7</sup> Thus, our model contributes to three literatures. Our chief contribution is the dynamic extension of the static, game-theoretic conflict framework of Hirshleifer (1989). We also extend the literature on the dynamic interplay (absent conflict) between population and resources by admitting conflict as a rational economic activity. In this literature, the studies of Prskawetz, Feichtinger, and Wirl (1994); Milik and Prskawetz (1996); and Brander and Taylor (1998) are particularly relevant to our study. These studies employ a similar predatory-prey setting, where man is the predator and a renewable resource is the prey. Finally, we contribute to the literature on resource scarcity and conflict in political science by providing insights on the system's dynamic behavior while in conflict.

The article proceeds as follows. In section 2, we review the literature and discuss our contribution. In section 3, we develop the model. In section 4, we consider various modeling extensions. In section 5, we analyze our model in the context of the Easter Island society and evaluate its implications for other societies. Section 6 concludes the study.

## 2. THE ECOLOGICAL COMPETITION AND CONFLICT LITERATURES

Two bodies of literature are relevant for our study, namely, the ecological competition literature and the economic literature on conflict. The first body of literature contains a class of dynamic models aimed at representing competition between two interacting species that feed off the same renewable resource. Arising from the works of Lotka (1924) and Volterra (1931), these models are specified as a system of equations of motion (or differential equations) for the stocks of each of the two species and a resource stock. Lotka and Volterra assumed that a rise in the size of either species reduces the resource stock, whereas a rise in the size of one species reduces the size of the other.<sup>8</sup>

Some scholars find analogies between ecological competition and economic situations. However, in the Lotka-Volterra model, the population numbers of one species

6. Choucri and North (1975) argued that land pressures in Europe caused World War I, and Westing (1986) listed wars from 1914 to 1982 involving developed countries and natural resources.

7. Maxwell and Reuveny (2000) studied the dynamics of conflict over renewable resources, but they did not model the conflict decision.

8. Depending on their parameters, the Lotka-Volterra trajectories oscillate over time, converging to one out of five steady states. In one steady state, the two populations and the resource coexist. In the second and third, only one population exists, respectively. In the fourth, both populations vanish; and in the fifth, the population and resource vanish. See, for example, MacArthur (1972) and Slobodkin (1980).

respond automatically to the numbers of the other species.<sup>9</sup> This behavior makes this model a less attractive tool for studying human behavior. Although we employ elements of ecological competition, we add to them the notion of optimization.

Turning to the economic conflict literature, Hirshleifer (1989) developed a one-period game-theoretic model in which conflict is treated as a rational activity. Studies using this framework typically include two rival groups modeled as unitary actors. Hirshleifer's initial framework has been extended in various ways, including allowing for trade among rivals, the consideration of various conflict interaction protocols (e.g., Stackelberg) and nonunitary actors.<sup>10</sup> However, each of these extensions employs a static framework. There are no equations of motion, and the time trajectories of variables are not analyzed. Several authors are aware that this is a limitation of Hirshleifer's approach and have called for its extension to the dynamic case.<sup>11</sup>

We believe our study is the first to explicitly introduce dynamics into Hirshleifer's work. However, the general issue of conflict dynamics has been considered in prior work. Usher (1989) developed a model in which a society moves between states of anarchy and despotism. Yet, only population has an equation of motion, the state of anarchy is simply assumed to be transitory due to the high costs it imposes on actors, and the model is not solved explicitly. A few other studies employ a two-period game-theoretic model. For example, Brito and Intriligator (1985) studied the circumstances under which conflict over the rights to a flow of a single good leads to war. In Skaperdas and Syropoulos (1996) and Garfinkel and Skaperdas (2000), the factors allocated between conflict and production in the second period of the game are assumed to be positively related to the payoffs received in the first period. These models are basically static, however, because the game is played only once. Recently, Hausken (2000) has studied the mismatch between individual and group interests in a Hirshleifer-type model. His model also is basically static, computing numerically the one-period equilibrium solution successively as did Hirshleifer (1995), which we discuss next.

Hirshleifer (1995) argued that the literature considers only a one-time allocation of resources between conflict and production but that his study examined continuing conflict.<sup>12</sup> However, he did not specify equations of motion, employing instead the one-period solution in successive iterations. Moreover, the condition he identified as determining dynamic stability is not derived based on standard dynamic analysis but rather is the condition ensuring the existence of a one period-based internal solution, an issue to which we will return later.<sup>13</sup>

9. For studies that find analogies between ecological competition and economic situations, see, for example, Jacquemin (1987) and Hirshleifer (1977).

10. Works in this area include, among others, Hirshleifer (1991, 1995); Skaperdas (1992, 1996); Grossman and Kim (1995); Skaperdas and Syropoulos (1996); Neary (1997); Anderton, Anderton, and Carter (1999); Garfinkel and Skaperdas (2000); and Hausken (2000).

11. See, for example, Skaperdas (1992), Grossman and Kim (1995), and Hirshleifer (1995).

12. See Hirshleifer (1995, 29).

13. Hirshleifer (1995, 47) acknowledged that his "steady state assumption rules out issues involving *timing*, such as arms races, economic growth or (on a smaller time scale) signaling resolve through successive escalation."

We study the dynamic interaction between conflict, population, and resources in a lesser developed society. The optimization component of the model extends Hirshleifer's work. From the ecological competition literature, we draw the idea that our model should have equations of motion for the rival populations and the contested good. However, in our model, the population sizes do not respond automatically to each other. Instead, they are affected by the actors' optimal allocation choices, as in the nonconflict models of Prskawetz, Feichtinger, and Wirl (1994); Milik and Prskawetz (1996); and Brander and Taylor (1998).

In our model, parties fight over wealth not only for instant gratification but also for the ability to invest their spoils to increase their own resource pool in the future. This pool is then available for future productive and conflictive activities. In a dynamic setting, therefore, it is necessary to link each group's spoils to its effort pool to be allocated in subsequent periods. In our setup, the allocated effort is population. Hence, the model has differential equations for the two populations, and each equation includes the spoils of conflict of the particular group as an input.

The production of wealth (resource harvesting in our case) also may require inputs that cannot be easily redirected for use in conflict. Often, the usage rate of these inputs has an impact on their availability in future periods. In our case, this input is given by the renewable resource stock, which is an input into the harvesting production process together with labor. Thus, the model distinguishes between these two inputs and tracks their interactions and availability over time.

Our approach could be applied to other Hirshleifer-type models, but it is not without limitations. To the extent that property rights could be enforced, an economic model of conflict might allow for interacting choices of optimal time-path decisions, in which actors take into account future incomes. In our model, there is optimization-based decision making, but the actors do not take into account the future consequences of their chosen actions. We believe our approach is appropriate in a model of conflict over resources in lesser developed societies that feature ill-defined or unenforceable property rights. We defer the development of a dynamic model featuring farsighted actors to future research.

### 3. THE BASIC MODEL

This section first develops our model and then investigates its properties in three respects: steady states solutions, comparative statics, and model's dynamics.

#### 3.1 MODEL DEVELOPMENT

The model features two groups with population sizes of  $N_1(t)$  and  $N_2(t)$  in period  $t$ . Each group harvests from the same resource. The groups then engage in conflict over the total harvest. Population is allocated each period between harvesting effort ( $E$ ) and conflict effort ( $F$ ) to maximize the group's income. Conflict entails reduced harvest but also results in the appropriation of a portion of the rival group's harvest. Each group fully utilizes its population. Thus,  $N_1(t) = E_1(t) + F_1(t)$  and  $N_2(t) = E_2(t) + F_2(t)$ .

Each group's harvest level,  $H_1(t)$  and  $H_2(t)$  is given by

$$H_1(t) = \beta R(t) E_1(t) \quad (1)$$

$$H_2(t) = \beta R(t) E_2(t). \quad (2)$$

Equations (1) and (2) illustrate that the harvest depends on the resource stock ( $R$ ), the harvesting effort ( $E_1$  or  $E_2$ ), and a parameter denoting the efficiency of harvesting ( $\beta$ ).<sup>14</sup> For now, we assume each group possesses the same harvesting efficiency. We explore the impact of differences in  $\beta$  in section 4.

The total harvest,  $H(t) = H_1(t) + H_2(t)$ , is contested by both groups. In Hirshleifer-type models, the payoff (the portion of the contested good won by each group) depends on the group's relative allocation of effort to conflict. We define  $P_1(t)$  and  $P_2(t)$  as follows:

$$P_1(t) = \frac{\alpha_1 F_1(t)^m}{\alpha_1 F_1(t)^m + \alpha_2 F_2(t)^m} \quad (3)$$

$$P_2(t) = \frac{\alpha_2 F_2(t)^m}{\alpha_1 F_1(t)^m + \alpha_2 F_2(t)^m}, \quad (4)$$

where  $\alpha_1$  and  $\alpha_2$  denote the efficiency of conflict effort of the two groups, and  $m$  is called the decisiveness parameter.<sup>15</sup>

Equations (3) and (4) are typically denoted as contest success functions. These functions have been interpreted in the conflict literature as either determining the proportion of the total prize going to each side or the probability of winning the entire prize. We adopt the former interpretation. As noted by Skaperdas (1996) and Garfinkel and Skaperdas (2000), many studies set  $m = 1$  and  $\alpha_1 = \alpha_2 = 1$ . Hirshleifer (1995) set  $\alpha_1 = \alpha_2 = 1$  and examined the impact of changes in  $m$ . In this section, we set  $m = 1$  and assume that  $\alpha_1$  and  $\alpha_2$  are positive. We investigate the impact of changes in  $m$  in section 4.<sup>16</sup>

14. This technology was proposed by Schaefer (1957) and is popular in the resource literature (e.g., Clark 1990, chap. 1; Brander and Taylor 1998). Expressions (1) and (2) assume that each group's harvest is independent of the harvest of the rival group. Although this assumption is likely to hold when the resource is in abundance, when the resource is scarce, each group's harvest may impose a negative externality on its rival's harvest. Although our assumption has been made principally for analytical tractability, it is worth observing that the marginal return to harvesting effort,  $\beta S$ , falls as the resource declines.

15. The parameters  $\alpha_1$ ,  $\alpha_2$ , and  $m$  are positive (Hirshleifer 1989, 1991, 1995).

16. In some studies, including his 1989 paper, Hirshleifer set  $m = 1$ . Although many Hirshleifer-type models are based on equations (3) and (4), some studies specify these equations as general forms: as, for example, in Neary's (1997)

$$P_1 = \frac{f(F_1)}{f(F_1) + f(F_2)},$$

where  $f$  is twice continuously differentiable. We employ a specific form to be able to compare to Hirshleifer's work and because we investigate the dynamics in numerical simulations.



The income of each group ( $Y_1$  and  $Y_2$ ) is given by the portion of the total contested harvest it wins:<sup>17</sup>

$$Y_1(t) = P_1(t)H(t) \quad (5)$$

$$Y_2(t) = P_2(t)H(t). \quad (6)$$

We now proceed to the optimization. To simplify the notation, from here on we drop the time dependency of variables. It is helpful to observe that the contested harvest may be written, using equations (1) and (2), as

$$H = R\beta(E_1 + E_2). \quad (7)$$

Substituting equations (7), (3), and (4) into (5) and (6), we obtain each group's income:

$$Y_1 = \left( \frac{\alpha_1 F_1}{\alpha_1 F_1 + \alpha_2 F_2} \right) R\beta(E_1 + E_2) \quad (8)$$

$$Y_2 = \left( \frac{\alpha_2 F_2}{\alpha_1 F_1 + \alpha_2 F_2} \right) R\beta(E_1 + E_2). \quad (9)$$

Each group maximizes its income by choosing how many people to allocate to conflict and harvesting, subject to the constraint  $E_i + F_i = N_i$ , where  $i = \{1, 2\}$ . When optimizing, the two groups are assumed to follow a Cournot-Nash-type conflict protocol.<sup>18</sup> Performing the optimization for group 1 yields its reaction function:

$$\frac{F_1}{F_2} = \frac{\alpha_2(E_1 + E_2)}{\alpha_1 F_1 + \alpha_2 F_2}. \quad (10)$$

Similarly, the reaction function of group 2 is given by

$$\frac{F_2}{F_1} = \frac{\alpha_1(E_1 + E_2)}{\alpha_1 F_1 + \alpha_2 F_2}. \quad (11)$$

Solving equations (10) and (11) for  $F_1$  and  $F_2$ , we get

$$F_1 = \frac{\sqrt{\alpha_2}(N_1 + N_2)}{2(\sqrt{\alpha_1} + \sqrt{\alpha_2})} \quad (12)$$

$$F_2 = \frac{\sqrt{\alpha_1}(N_1 + N_2)}{2(\sqrt{\alpha_1} + \sqrt{\alpha_2})}. \quad (13)$$

17. This assumption is conceptually equivalent to assuming that each group tries to consume its own harvest but that the harvest is also subject to appropriation by the rival group.

18. That is, each group takes the effort allocation of its rival as given when choosing its own allocation.

Substituting  $F_1$  and  $F_2$  in equations (8) and (9), we obtain the income solutions:

$$Y_1 = \frac{\sqrt{\alpha_1}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})} R\beta \frac{(N_1 + N_2)}{2} \quad (14)$$

$$Y_2 = \frac{\sqrt{\alpha_2}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})} R\beta \frac{(N_1 + N_2)}{2}. \quad (15)$$

Populations grow according to the equations  $\frac{dN_i}{dt} = \delta_i N_i, i = \{1, 2\}$ . The population growth rates are given by  $\delta_1 = \varepsilon + \phi \frac{Y_1}{N_1} + a_1(\alpha_1)F_1 + b_1(\alpha_2)F_2$  and  $\delta_2 = \varepsilon + \phi \frac{Y_2}{N_2} + a_2(\alpha_2)F_2 + b_2(\alpha_1)F_1$ . Incorporating  $\delta_1$  and  $\delta_2$  into the population equations of motion, we get

$$\frac{dN_1}{dt} = N_1 \left( \varepsilon + \phi \frac{Y_1}{N_1} + a_1(\alpha_1)F_1 + b_1(\alpha_2)F_2 \right) \quad (16)$$

$$\frac{dN_2}{dt} = N_2 \left( \varepsilon + \phi \frac{Y_2}{N_2} + a_2(\alpha_2)F_2 + b_2(\alpha_1)F_1 \right), \quad (17)$$

where  $\varepsilon$  denotes the difference between natural birth rate and death rate and  $\phi \frac{Y_i}{N_i}$  captures the positive dependence of population growth on income per capita ( $\phi > 0$ ).<sup>19</sup> We assume that  $\varepsilon < 0$ , implying that without the resource to consume or for sufficiently low per capita income, which is tied to the resource via equations (14) and (15), our resource-dependent populations will eventually decline to 0.<sup>20</sup> The negative terms  $a_i$  and  $b_i$  model the destructive effect of conflict on population:  $a_i$  grows with  $\alpha_i$  (i.e., as group  $i$  becomes more efficient in conflict), and  $b_i$  declines with  $\alpha_j$  ( $j \neq i$ ) (i.e., as group  $j$  becomes more efficient in conflict).<sup>21</sup>

The growth rate of the resource is given by the difference between its natural growth and total harvesting. The natural growth of the resource is given by the standard logistic form inside the square brackets in equation (18).<sup>22</sup> Combining the logistic growth with the harvesting functions gives the following resource equation of motion:

$$\frac{dR}{dt} = \left[ r^* R \left( 1 - \frac{R}{K^*} \right) \right] - \beta R E_1 - \beta R E_2, \quad (18)$$

19. This assumption is used in many studies (e.g., Prskawetz, Feichtinger, and Wirl 1994; Milik and Prskawetz 1996; Brander and Taylor 1998) and is supported empirically in LDCs (Heerink 1994). In many DCs, fertility seems to decline with income. We return to this topic in section 5. An alternative interpretation, which may well also apply to DCs, is that the resource is essential for procreation (e.g., when food declines, fertility declines).

20. For a similar assumption in a model without conflict, see, for example, Brander and Taylor (1998).

21. One could assume that  $\varepsilon$  and  $\phi$  differ across groups. This would complicate the model without adding much insight, as there is no a priori reason to assume that the rival groups differ in these respects.

22. The logistic form applies to renewable resources, which are our focus (see, e.g., Clark 1990, 10). The model can be applied to non renewable resources by setting  $r^* = 0$ . In this case, one may want to introduce a term for resource discovery.

where  $r^*$  is the rate of growth of the resource and  $K^*$  is the resource-carrying capacity. The parameters  $r^*$  and  $K^*$  are assumed to fall with conflict ( $F_1 + F_2$ ):  $r^* = r + r_c(F_1 + F_2)$  and  $K^* = K + K_c(F_1 + F_2)$ .  $K$  and  $r$  are the intrinsic resource-carrying capacity and growth rate parameters, respectively, and  $r_c$  and  $K_c$  are negative coefficients. Noting that  $E_1 = N_1 - F_1$  and  $E_2 = N_2 - F_2$ , equation (18) can be rewritten as follows:

$$\frac{dR}{dt} = \left[ r^* R \left( 1 - \frac{R}{K^*} \right) \right] - \beta R \left( \frac{N_1 + N_2}{2} \right). \quad (19)$$

Substituting equations (12), (13), (14), and (15) into (16) and (17), we get a system of three nonlinear differential equations, (16), (17), and (19) that describe the dynamics in terms of  $R$ ,  $N_1$ , and  $N_2$ .

### 3.2 STEADY STATES

The model's steady states are found by setting the time derivatives of  $N_1$ ,  $N_2$ , and  $R$  in equations (16), (17), and (19) to 0. This results in a simultaneous system of nonlinear equations.

$$N_1 = \left( \varepsilon + \phi \frac{\sqrt{\alpha_1}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})} R \beta \frac{(N_1 + N_2)}{2N_1} \right) = 0 \quad (20)$$

$$N_2 = \left( \varepsilon + \phi \frac{\sqrt{\alpha_2}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})} R \beta \frac{(N_1 + N_2)}{2N_2} \right) = 0 \quad (21)$$

$$rR \left( 1 - \frac{R}{K} \right) - \beta R \left( \frac{N_1 + N_2}{2} \right) = 0. \quad (22)$$

To make the analysis tractable, we have abstracted from the destructive effects of conflict on the population and resource stocks in equations (20), (21), and (22), setting  $a_p$ ,  $b_p$ ,  $r_c$ , and  $K_c$  to 0. We discuss the likely impacts of these destructive effects in section 5.3.

The system of equations (20), (21), and (22) has five steady-state solutions (four "corner" and one "internal").<sup>23</sup> Beginning with the corner solutions, the steady state with  $N_1 = 0$ ,  $N_2 = 0$ ,  $R = 0$  depicts a situation in which both populations have declined to 0 following an exhaustion of the resource. The steady state with  $N_1 = 0$ ,  $N_2 = 0$ ,  $R = K$  depicts a situation in which both populations have declined to 0 before the resource has been depleted. Subsequently, the resource recovers to its carrying capacity.<sup>24</sup> In the next two steady states,  $N_1 = 0$ ,  $N_2 = N_2^*$ , and  $R = R^*$  or  $N_1 = N_1^*$ ,  $N_2 = 0$ , and  $R = R^*$ , respectively, where asterisks denote some positive level. Obviously, in these four corner steady states, there is no conflict in the system.

23. This steady state configuration is typical in the ecological competition literature (see section 2).

24. In section 5, we provide human historical examples of societies going extinct due to environmental degradation precipitated by conflict over renewable resources.

The fifth internal steady state is given by

$$N_1 = \frac{2r}{\beta} \left( \frac{2\varepsilon}{K\beta\phi} + 1 \right) \frac{\sqrt{\alpha_1}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})} \quad (23)$$

$$N_2 = \frac{2r}{\beta} \left( \frac{2\varepsilon}{K\beta\phi} + 1 \right) \frac{\sqrt{\alpha_2}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})} \quad (24)$$

$$R = \frac{-2\varepsilon}{\beta\phi}. \quad (25)$$

This internal steady state features conflict between the two rival groups. Using equations (12) and (13), the effort allocations for conflict and harvesting can be written as

$$F_1 = \frac{N_1}{2} \sqrt{\frac{\alpha_2}{\alpha_1}} \quad (26)$$

$$F_2 = \frac{N_2}{2} \sqrt{\frac{\alpha_1}{\alpha_2}} \quad (27)$$

$$E_1 = \frac{N_1}{2} \frac{(2\sqrt{\alpha_1} - \sqrt{\alpha_2})}{\sqrt{\alpha_1}} \quad (28)$$

$$E_2 = \frac{N_2}{2} \frac{(2\sqrt{\alpha_2} - \sqrt{\alpha_1})}{\sqrt{\alpha_2}}. \quad (29)$$

For the internal steady state to exist, the condition  $\frac{2\varepsilon}{\beta K\phi} + 1 > 0$  must hold. Otherwise, equation (25) implies  $R > K$ , and equations (23) and (24) imply  $N_1 < 0$  and  $N_2 < 0$ . In this case, the system will collapse to one of the corner steady states.<sup>25</sup>

### 3.3 COMPARATIVE STATICS

The partial derivatives of equations (23) through (29) determine the impact of changes in the exogenous variables on the internal steady state. Equations (26) and (23) imply that in a steady state where group 2 is better at conflict ( $\alpha_2$  is greater), ceteris paribus, relative to a base case steady state, group 1 allocates less effort to harvesting, whereas group 2 devotes more effort to harvesting (i.e.,  $\frac{\partial E_1}{\partial \alpha_2} < 0$  and  $\frac{\partial E_2}{\partial \alpha_2} > 0$ ). This is so because the larger is  $\alpha_2$ , the greater is the portion of the total harvest accruing to group 2 and the smaller is the portion accruing to group 1. Thus, group 2 has a greater incentive to harvest relative to the base case, whereas group 1 has less incentive to harvest. In

25. When the groups are equal in every respect, the steady states  $S = K$ ,  $R_1 = R_2 = 0$  or  $S = 0$ ,  $R_1 = R_2 = 0$  could also be attained. When the groups differ, the system also could collapse to one of the steady states with only one group. For that to occur, the rate of population growth of one of the groups needs always to be negative due to a too low income (e.g., because its conflict efficiency is too low).

the new steady state, group 2 then devotes less effort to conflict, whereas group 1 devotes more effort to conflict, relative to their base case steady state allocations (i.e.,  $\frac{\partial F_1}{\partial \alpha_2} > 0$  and  $\frac{\partial F_2}{\partial \alpha_2} < 0$ ).

Equations (14), (15), (23), and (24) imply that a steady state featuring a greater  $\alpha_2$  relative to a base case, *ceteris paribus*, features smaller group 1 population and income and larger group 2 population and income. Hence, a group that is better at conflict is able to sustain a higher income and population. But, when its rival is relatively better at conflict, the group's population and income are lower. These results are driven by the fact that a group that is better at conflict gains more from it, raising its income and ultimately its population via the fertility function.

A steady state that features higher resource-carrying capacity ( $K$ ) or intrinsic growth rate ( $r$ ) relative to a base case, *ceteris paribus*, has a higher population (see equations [23] and [24]) and the same resource stock (see equation [25]). To gain intuition, observe from equation (19) that larger  $r$  and  $K$  imply a greater resource growth rate ( $\frac{dR}{dt}$ ). Hence, for any harvesting level, the marginal return to harvesting tends to rise when  $r$  or  $K$  rise (see equations [1] and [2]). In turn, income also rises. Fertility then rises, which raises population levels (see equations [16] and [17]). In the new steady state, the higher population offsets the higher resource growth rate (through harvesting), which is just enough to bring back the resource stock to its base case level.

Equations (26) and (27) imply that the higher are  $r$  and  $K$ , the greater is the conflict effort. Since the steady state resource stock is unaltered by changes in  $r$  and  $K$ , the steady state marginal return to harvesting is also unaltered (see equations [1] and [2]). Hence, the allocation of effort between conflict and harvesting in a steady state with higher  $r$  and  $K$  is driven by the greater populations.

A steady state featuring a higher fertility parameter  $\phi$ , *ceteris paribus*, features a lower resource stock (see equations [23], [24], [26], and [27]). Higher fertility leads to greater populations, which in turn tend to deplete the resource stock. The effect of a greater natural net death rate ( $\epsilon$ ) is naturally opposite that of a greater  $\phi$ .

The comparative statics effect of harvesting efficiency ( $\beta$ ) on conflict is given by

$$\frac{\partial F_i}{\partial \beta} = \frac{\sqrt{\alpha_j}}{(\sqrt{\alpha_1} + \sqrt{\alpha_2})K\beta^3\phi} (-4\epsilon - K\beta\phi) \quad i, j = \{1, 2\}; i \neq j. \quad (30)$$

Thus, given a steady state with a relatively higher (lower)  $R$ , the greater is  $\beta$ , the higher (lower) is the steady state level of conflict.<sup>26</sup> From equation (25),  $R$  rises with  $\epsilon$  and falls with  $\beta$  and  $\phi$ . Hence, when death rate is high and harvesting efficiency and fertility are low, a rise in harvesting efficiency may result in more conflict.

### 3.4 DYNAMICS

Abstracting from the destructive effects of conflict, our dynamic system is given by

26. The sign of equation (30) is positive if in steady state  $S > K/2$  and negative if  $S < K/2$  (see equation [25]).

$$\begin{aligned}
\frac{dN_1}{dt} &= N_1 \left( \varepsilon + \phi \frac{\sqrt{\alpha_1}}{\sqrt{\alpha_1} + \sqrt{\alpha_2}} \frac{N_1 + N_2}{2N_1} \right) \beta R \\
\frac{dN_2}{dt} &= N_2 \left( \varepsilon + \phi \frac{\sqrt{\alpha_2}}{\sqrt{\alpha_1} + \sqrt{\alpha_2}} \frac{N_1 + N_2}{2N_2} \right) \beta R \\
\frac{dR}{dt} &= rR \left( 1 - \frac{R}{K} \right) - (N_1 + N_2) \beta R.
\end{aligned} \tag{31}$$

To the best of our knowledge, this system of nonlinear differential equations does not have an analytical solution. Two methods are typically used in such cases to learn about the dynamics: local stability analysis and numerical simulation. We study the dynamics via simulation.<sup>27</sup>

To simulate the system, we need to choose a particular parameterization. There are, of course, many sets of parameters from which one could choose. It is clear that the particular outcome may apply only to the chosen set. For comparison purposes, we set  $\alpha_1$  and  $\alpha_2$  to 1, as is (implicitly) the case in Hirshleifer (1995). However, we also require population and resource parameters. To that effect, one could choose a parameterization not based on real-world records.<sup>28</sup> Alternatively, one could pick parameters based on real-world records. Brander and Taylor (1998), for example, studied the collapse of the Easter Island society and set their parameters accordingly. They chose a carrying capacity  $K = 12,000$  units, a resource growth rate  $r = 0.04$  per decade, a population natural death rate  $\varepsilon = -0.1$  per decade, a population fertility parameter  $\phi = 4$ , a resource-harvesting efficiency parameter  $\beta = 0.00001$ , an initial population = 40, and an initial resource stock = 12,000 units.

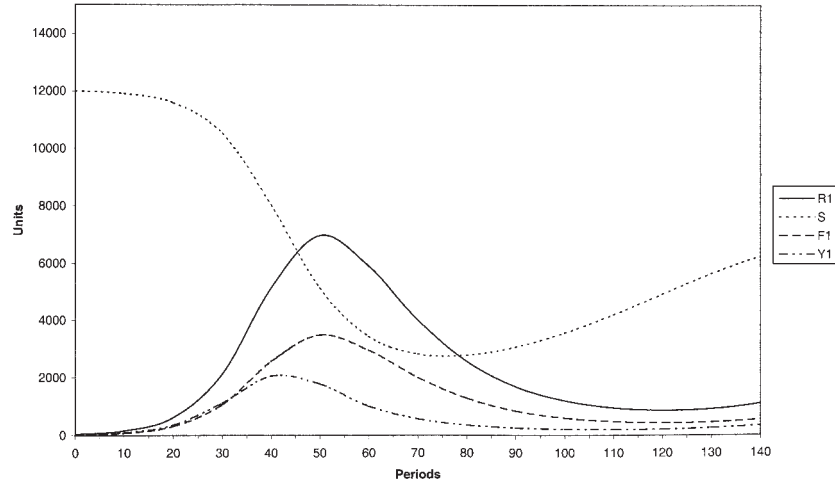
The story of Easter Island is interesting for our study because it provides a natural experiment of man-nature interaction involving conflict over resources in a system that lacks well-defined and/or enforceable property rights. We use the parameters of Brander and Taylor (1998) here and discuss the story of Easter Island in further detail in section 5.<sup>29</sup>

Let us focus now on the model's basic dynamics. Figure 1 presents the simulation results for group 1's population ( $N_1$ ), conflict effort ( $F_1$ ), the resource stock ( $R$ ), and income ( $Y_1$ ).<sup>30</sup> As shown, the system cycles toward an internal steady state. Along the dynamic path,  $R$  and  $Y_1$  lead  $N_1$  and  $F_1$ . Intuitively, this is so because income affects fertility, and a rise in  $R$  raises income. Note also that conflict is often at its peak when the

27. A local stability analysis involves finding the system's eigenvalues around each steady state. This method is not tractable here because the system's characteristic equation (which determines the eigenvalues) is cubic. Since the system is of order 3, the phase diagram approach also is not tractable. For studies that employ dynamic numerical simulation, see, for example, Prskawetz, Feichtinger, and Wirl (1994); Milik and Prskawetz (1996); and Brander and Taylor (1998).

28. In this case, the goal is mainly to demonstrate the mathematical properties of the dynamic system simulated, as in, for example, Prskawetz, Feichtinger, and Wirl (1994) and Milik and Prskawetz (1996).

29. As noted by Brander and Taylor (1998), the estimated initial population for the island ranges from around 20 to 100. Our simulation results are virtually the same for different initial populations within this range.



**Figure 1: Conflict on Easter Island**  
NOTE:  $R_1$ ,  $S$ ,  $F_1$  = conflict effort.  $Y_1$  = income.

resource reaches its trough. This fact coincides with the observed tendency of resource scarcity to promote and/or intensify conflict in many less developed societies.

We conclude this section with brief report of additional simulation results. Because the general behavior of the system in these cases is similar to Figure 1, we do not graph them.<sup>31</sup> When group 1 is better at conflict than group 2 ( $\alpha_1 = 1.25$ ,  $\alpha_2 = 0.75$ ), the less conflict-effective group allocates more effort to conflict along each point of the trajectory, whereas the more conflict-effective group allocates less effort to conflict. Raising  $r$  (0.06) suppresses the fluctuations but raises conflict in the steady state. Thus, although the system becomes less vulnerable to intensive conflict, there is a steady state trade-off. A higher  $K$  (20,000) makes the system less damped and also raises conflict in the steady state. Finally, a higher  $\beta$  (0.001) drives the system to the steady state with  $R = K$  and  $N_1 = N_2 = 0$ . In this case, both populations go to 0 before  $R$  is fully diminished. Consequently, the resource grows back to carrying capacity.

#### 4. EXTENDING THE BASIC MODEL

In the basic model, the decisiveness parameter of the contest success functions was equal to unity, and the groups were equally efficient at harvesting. In this section, we relax these assumptions.

30. In this symmetric case, the values for group 2 are identical. Income is plotted at 10 times its actual level to better visualize it.

31. In each case, the parameters not mentioned are kept as in Figure 1.



## 4.1 CHANGES IN THE DECISIVENESS PARAMETER

As in Hirshleifer (1995), the contest success functions are now given by<sup>32</sup>

$$P_i(t) = \frac{F_i^m(t)}{F_1^m(t) + F_2^m(t)} \quad i = \{1, 2\}. \quad (32)$$

In equation (32), as  $m$  grows, the marginal effectiveness of group  $i$ 's fighting effort in capturing a proportion of contested goods rises. As Hirshleifer noted, with low  $m$ , the defensive resources have the upper hand. Hirshleifer's main findings are that the existence of the internal equilibrium requires  $m < 1$ , and a rise in  $m$  (from 0 to 1) raises the equilibrium level of effort devoted to conflict. He referred to the situation with  $m > 1$  as the breakdown of anarchy.

Hirshleifer (1995) assumed that the total allocated effort ( $N_1 + N_2$  in our model) is open to appropriation.<sup>33</sup> In other studies (e.g., Hirshleifer 1989), he assumed, as we do in this study, that only the total output produced ( $H$  in our model) is open to appropriation. In Hirshleifer (1989), the equilibrium exists for any  $m$ , or anarchy never breaks. As we shall see, this result does not hold in our dynamic case. That is, we can get the breakdown of anarchy only when harvested resources are contested.

Using equation (32) and assuming that the two groups have equal harvesting efficiencies, our dynamic system may be written as

$$\begin{aligned} \frac{dN_1}{dt} &= N_1 \left( \varepsilon + \phi \frac{(N_1 + N_2)}{2N_1(m+1)} \right) \beta R \\ \frac{dN_2}{dt} &= N_2 \left( \varepsilon + \phi \frac{(N_1 + N_2)}{2N_2(m+1)} \right) \beta R \\ \frac{dR}{dt} &= rR \left( 1 - \frac{R}{K} \right) - \frac{(N_1 + N_2)}{(m+1)} \beta R. \end{aligned} \quad (33)$$

Similar to system (31), system (33) also has four corner steady states. The fifth (internal) steady state is given by

$$\begin{aligned} N_1 = N_2 &= r(m+1) \left( \frac{(m+1)\varepsilon}{\beta\phi K} + 1 \right) \\ R &= - \frac{(m+1)\varepsilon}{\beta\phi}. \end{aligned} \quad (34)$$

For the internal steady state to exist, the condition  $\frac{(m+1)\varepsilon}{\beta\phi K} + 1 > 0$  must hold. In contrast to Hirshleifer (1995),  $m > 1$  need not ensure the breakdown of anarchy (recall that

32. To make the analysis tractable and focus attention on  $m$ , we assume  $\alpha_1 = \alpha_2 = 1$  and keep our earlier assumption regarding the nondestructive aspects of conflict, both of which are as in Hirshleifer (1995).

33. This assumption would imply in our model that human beings can be forced to fight against their own group or harvest for the other group, both of which we find unappealing.

$\varepsilon < 0$ ). Our breakdown of anarchy condition also depends on resource and population parameters. In addition to large  $m$ , inefficient harvesting, low fertility, a high death rate, and a low carrying capacity all lead to the breakdown of anarchy via system collapse.

We now examine the impact of  $m$ , assuming anarchy does not break. The comparative statics of population with respect to  $m$  in equation (34) are ambiguous, *ceteris paribus*. Since the optimal allocation of effort for conflict is given by  $F_1 = F_2 = (\frac{m}{m+1})(\frac{N_1+N_2}{2})$ , the comparative statics of conflict allocations also are ambiguous, which is a markedly different result from Hirshleifer (1995). In that study, a rise in  $m$  raises the conflict allocation. In our study, the effect of  $m$  on conflict is ambiguous, depending on the population and resource parameters. We may gain insight by inspecting the effect of  $m$  on the relative conflict allocation  $(\frac{F_1}{N_1}) = \frac{m}{m+1}$ . This ratio is growing with  $m$  as in Hirshleifer. However, since  $N_1$  and  $N_2$  are exogenous in Hirshleifer, that model does not exhibit the ambiguity of our dynamic case, where  $N_1$  and  $N_2$  are endogenous.

The dynamic system (33) is structurally similar to system (31). The only differences are the replacement of  $\sqrt{\alpha_i}/(\sqrt{\alpha_1} + \sqrt{\alpha_2})$  in the first two differential equations by  $1/(m+1)$  and the introduction of  $1/(m+1)$  in the third differential equation. Thus, the dynamics of the two systems will be qualitatively similar.

#### 4.2 DIFFERENCES IN HARVESTING EFFICIENCY

In section 3.1, we saw that raising the conflict efficiency of a group relative to its rival raises its income and lowers the effort it devotes to conflict. Since total effort is devoted to conflict or harvesting, a natural question to ask is, what happens when the harvesting efficiency of one group is raised relative to its rival? To answer this question, we rework the basic model under the assumption of differences in harvesting efficiency.

Letting  $\beta_i$  denote the harvesting efficiency of group  $i$ , the internal steady state is given by

$$\begin{aligned} N_1 &= 2r \left( \frac{\sqrt{\alpha_1\beta_2}}{\beta_1\sqrt{\alpha_1\beta_2} + \beta_2\sqrt{\alpha_2\beta_1}} \right) \left( 1 + \frac{2\varepsilon}{K\phi} \left( \frac{\sqrt{\alpha_1\beta_2} + \sqrt{\alpha_2\beta_1}}{\beta_1\sqrt{\alpha_1\beta_2} + \beta_2\sqrt{\alpha_2\beta_1}} \right) \right) \\ N_2 &= 2r \left( \frac{\sqrt{\alpha_1\beta_2}}{\beta_1\sqrt{\alpha_1\beta_2} + \beta_2\sqrt{\alpha_2\beta_1}} \right) \left( 1 + \frac{2\varepsilon}{K\phi} \left( \frac{\sqrt{\alpha_1\beta_2} + \sqrt{\alpha_2\beta_1}}{\beta_1\sqrt{\alpha_1\beta_2} + \beta_2\sqrt{\alpha_2\beta_1}} \right) \right) \\ R &= \frac{-2\varepsilon}{\phi} \left( \frac{\sqrt{\alpha_1\beta_2} + \sqrt{\alpha_2\beta_1}}{\beta_1\sqrt{\alpha_1\beta_2} + \beta_2\sqrt{\alpha_2\beta_1}} \right). \end{aligned} \quad (35)$$

The study state conflict efforts are<sup>34</sup>

34. It is worth noting that the term in square brackets in equations (36) and (37) equals unity when  $\beta_1 = \beta_2$ , and we then recover equations (26) and (27). Similarly, equation (35) collapses to equations (23), (24), and (25), respectively, under the same condition.

$$F_1 = \left( \frac{N_1}{2} \right) \sqrt{\frac{\alpha_2}{\alpha_1}} \left[ \frac{\beta_1 \sqrt{\alpha_1 \beta_2} + \beta_2 \sqrt{\alpha_2 \beta_1}}{\beta_1 \sqrt{\alpha_2 \beta_2} + \beta_2 \sqrt{\alpha_1 \beta_1}} \right], \quad (36)$$

$$F_2 = \left( \frac{N_2}{2} \right) \sqrt{\frac{\alpha_1}{\alpha_2}} \left[ \frac{\beta_1 \sqrt{\alpha_1 \beta_2} + \beta_2 \sqrt{\alpha_2 \beta_1}}{\beta_1 \sqrt{\alpha_2 \beta_2} + \beta_2 \sqrt{\alpha_1 \beta_1}} \right]. \quad (37)$$

Next, we study the comparative statics effects of  $\beta_1$  and  $\beta_2$  on conflict. It is clear from equations (36) and (37) that the effects of  $\beta_1$  and  $\beta_2$  on conflict depend on their effects on  $N_1$  and  $N_2$ . To examine these impacts, we rewrite the first level in equation (35) as

$$N_1 = 2r \left( \left[ \frac{\sqrt{\alpha_1 \beta_2}}{\beta_1 \sqrt{\alpha_1 \beta_2} + \beta_2 \sqrt{\alpha_2 \beta_1}} \right] + \frac{2\varepsilon}{K\phi} \left[ \frac{\sqrt{\alpha_1 \beta_2} + \sqrt{\alpha_1 \alpha_2 \beta_1 \beta_2}}{\beta_1 \sqrt{\alpha_1 \beta_2} + \beta_2 \sqrt{\alpha_2 \beta_1}^2} \right] \right). \quad (38)$$

Each of the expressions written in square brackets in equation (38) is decreasing in  $\beta_1$  and  $\beta_2$ . Recalling that  $\varepsilon < 0$ , we see that the impact of an increase in  $\beta_1$  or  $\beta_2$  on  $N_1$  is ambiguous. The same is true for  $N_2$ . It follows from equations (36) and (37) that the effect of changes in the harvesting efficiencies on  $F_1$  and  $F_2$  also are ambiguous. These results are similar to those we derived in the basic model and occur for the same reason: specifically, they are driven by the size of the resource stock. When the resource stock is high, increases in the harvesting efficiency raises conflict. The opposite will be true when the resource stock is low.

## 5. IMPLICATIONS FOR HISTORICAL AND CONTEMPORARY CONFLICT

In our simulation, we have employed parameters for the historical society of Easter Island. In Figure 1, the society exhibited a brief flowering and then declined to a dismal state with low population, resources, and income. In this section, we compare our results with historical accounts of Easter Island. Scholars such as Tainter (1988), Ponting (1991), and Bahn and Flenley (1992) have argued that Easter Island is just one of several examples of historical societal collapse precipitated by conflict over degrading resources. Following our discussion of Easter Island, we discuss other societies that experienced a similar history. These scholars and others argue that contemporary societies face similar risks (although possibly of a weaker strength), particularly in LDCs, where societies are closely dependent on the natural environment. We end this section with a discussion of our model's implications for LDCs.

### 5.1 EASTER ISLAND

Many years ago, abundant forests and a society thrived on Easter Island. By the time Europeans arrived on the island in the early 18th century, they found land without

trees and a small population living in poverty and conflict. Many scholars have puzzled over this story. Recently, several studies have explained the collapse by thinking about the island in the spirit of Malthus ([1798] 1970). That is, the human population overexploited the island's resources, leading to its own decline.<sup>35</sup> Brander and Taylor (1998) have modeled the Malthusian interpretation of the Easter Island story while ignoring conflict over resources. Our model offers the possibility to investigate the history of Easter Island based on the assumption that there was conflict over natural resources on the island.

The foundation of our model captures the general setting of the Easter Island society. A considerable literature argues there was ample conflict over natural resources between well-organized clans on Easter Island (e.g., see Ponting 1991; Keegan 1993; and Lee 2000). As noted by Ponting (1991), the clans were each led by a dominant chief, supporting our modeling of groups as unitary actors.<sup>36</sup> Naturally, conflict in primitive societies such as Easter Island was labor intensive, as we have assumed. Our simplifying assumption that conflict does not kill people or damage the resource is appropriate for Easter Island. Anthropologists who have studied ancient Easter Island skulls found evidence of injuries but not of life-threatening injuries, indicating conflict but not fatal wounds. The loser in the conflict often lost his *property* but not his life (Lee 2000).<sup>37</sup> Also, it is likely that Easter Island's society did not develop efficient property rights institutions.<sup>38</sup> As noted by Brander and Taylor (1998), the assumptions that population rises with income and actors maximize current incomes are reasonable for Easter Island, which was a primitive society.

Turning to the simulation, period 0 in Figure 1 corresponds to the years from A.D. 400 to 700, which is the time range in which settlers are said to have arrived on Easter Island.<sup>39</sup> Conflict intensifies harvesting in the beginning of the simulation. The population then rises, and the resource declines. As a result, the population also declines. The population peaks at 14,000 around period 50 and declines to around 2,000 around period 130 (year 1700). In Brander and Taylor's (1998) study, population peaks at around 10,000 people 25 periods later and then declines to 3,800 around period 130. In our study, the resource reaches a minimum of around 3,000 units around period 80, whereas in Brander and Taylor's study it reaches a minimum of around 5,000 units 25 periods later.<sup>40</sup>

35. See, for example, Ponting (1991), Bahn and Flenley (1992), Van Tilberg (1994), Gowdy (1998), Brander and Taylor (1998), Brown and Flavin (1999), and Reuveny and Decker (2000).

36. Extending our model to include more than two clans does not require changing its structure but will make it less tractable.

37. Conflict of this type also is sometimes observed in other primitive societies. For example, see Keegan's (1993) account of the African Zulus.

38. See Ponting (1991), Van Tilberg (1994), Brander and Taylor (1998), and Luterbacher (2001). It is suggested that the islanders did not develop efficient institutions to deal with the degradation and, because the island's trees grew slowly, people did not grasp the nature of the slow change taking place.

39. The date the island was first settled varies across studies. Brander and Taylor (1998), for example, used the date A.D. 400; Gowdy (1998) and Bahn and Flenley (1992) used A.D. 700; and Brown and Flavin (1999) used A.D. 500.

40. The model becomes less applicable in the early 1800s, when the island is no longer a closed system.

It is hard to compare the resource in the model to the real world. Because both our model and Brander and Taylor's (1998) are stylized, the resource represents an ecological complex consisting of soil, fish species, forestry, water, and so on. Nonetheless, we can discuss the population trajectory. The available information on Easter Island is based on archeological inquiries. The estimated maximum population ranges from 7,000 to 20,000, whereas the timing of this maximum is in the range of A.D. 1100 to 1500.<sup>41</sup> When Easter Island was discovered in the 18th century, the Dutch admiral Rogeven estimated there were 3,000 people on the island, and the British captain Cook estimated there were 2,000 people.

Based purely on simulation results, the model of Brander and Taylor (1998) is plausible. However, their model does not include conflict on Easter Island, which is well documented in the literature. Our simulation results suggest that the inclusion of conflict is consistent with historical and anthropological accounts of the island's society. Thus, our model also is a plausible description of the main social forces operating on Easter Island.

## 5.2 OTHER HISTORICAL SOCIETIES

Although the story of Easter Island is likely the most famous, several examples of societal collapse precipitated by conflict over degrading renewable resources exist. Weiskel (1989, 104) noted that each of these societies exhibited "gradual emergence, brief flowering and rapid collapse of civilization," accompanied by conflicts driven by the desire to control arable land or other essential renewable resources. In this section, we briefly discuss the cases of the Sumerian and the Mayan civilizations.<sup>42</sup>

The Sumerian society, which arose in the fertile valley of the twin rivers Tigris and Euphrates, is generally accepted as the world's first literate society, having attained this status by about 3000 B.C. The society was made up of a number of cities that were often in conflict over the land separating them. The land was valuable because of the innovation of irrigation. With irrigation, the Sumerian society moved from subsistence farming to cash crops and traded within the society and with non-Sumerians for metals and manufactured goods.

Because of the ability to create wealth through cash crops, the Sumerians began to overexploit the land via almost constant irrigation. Traditional agricultural techniques such as crop shifting and allowing lands to lie fallow were abandoned. The constant irrigation eventually led to a complete salinization of a vast majority of the croplands. The early stages of decline saw the loss of cash crops, which weakened the society materially, whereas later stages saw the loss of essential harvests. The Sumerian society experienced increases in the death rate, conflict over resources, and a decline in income and fertility. In a weakened state, the society was conquered in 2370 B.C. by the Akkadian empire.

41. See Ponting (1991), Bahn and Flenley (1992), Van Tilberg (1994), and Brander and Taylor (1998).

42. Our discussion of the Sumerian and Mayan cultures is based on Ponting (1991), and our discussion of the Zulu culture is based on Keegan (1993). Interested readers are directed to these sources for further details of the rise and fall of these societies and others that met a similar fate.

The story of the Sumerians illustrates one implication of our model: advancements in production (in this case irrigation) need not improve the long-term prospects of a society. Although there is little doubt that irrigation increased the short-term wealth of the Sumerians, this wealth allowed the population to grow, which in turn led to the overexploitation of the resource and conflict over the degraded resource base.

The Mayan story provides yet another example of the forces we model. Early theories of the Mayan society, which dates from 2500 B.C. and was located in southern-North and Central America, were at odds with our model. Historians once thought that this great civilization was peaceful. The Mayans were thought to have practiced environmentally friendly agricultural techniques. As a result of this thinking, historians were at a loss to explain the collapse of the Mayan civilization. Much like Easter Island, the civilization went into decline long before European contact. When the “lost cities” (so named because the ancient pyramid temples were lost to the encroaching jungle, having been abandoned for generations) were discovered by American archeologists in the late 1830s, descendants of the Maya had no knowledge of them.

Subsequent research of the Mayan culture has changed scholarly thinking. Mainly due to the translation of the Mayan script, historians now know that, far from being a peaceful culture, the Mayan society was composed of cities that were almost continually in conflict over arable land. As with the Sumerians, Mayan land increased in value as agricultural innovation allowed the society to move beyond the subsistence level. As with Easter Island, a major factor in the Mayan decline appears to have been deforestation and subsequent soil erosion, which occurred as large amounts of land were cleared for agricultural purposes.

### 5.3 CONTEMPORARY LDCs

Although we believe our model captures the underlying tendencies inherent in many LDCs, the model’s implications should be considered carefully. This is true because of the potentially mitigating effects that nonresource-based sectors, demographic transition, property rights institutions, foreign aid and trade, and technological innovation might have on resource-dependent societies, none of which are included in our model. As noted by Reuveny and Decker (2000), although these effects may not have been significant on Easter Island, they could be significant in LDCs.

Dependence on the environment for livelihood is more prevalent in LDCs than in DCs. The buildup of nonresource-based sectors might alleviate the pressures that LDCs place on natural resources. However, since this is a costly and lengthy process, conflict similar to what we have modeled may be plausible for some LDCs in the future, and, as noted, according to some scholars it is already beginning to emerge.

Our model ignores the theory of demographic transition. According to this theory, when income per capita is low, population growth rises with income. As income per capita rises above some threshold, population growth declines with income (Heerink 1994). This theory is not without critics, but it is accepted by many scholars.<sup>43</sup> Demographic transition implies that economic growth may mitigate pressures on the envi-

43. For critics, see, for example, Abernethy (1993) and Dilworth (1994).

ronment in LDCs. However, this approach also entails a cost. Economic growth increases pollution, resource depletion, and often results in deforestation. Moreover, several authors also argue that the biosphere cannot sustain the DCs' current per capita income for all countries.<sup>44</sup>

Similar to all Hirshleifer-type models, this study assumes the absence of a well-developed and enforced system of property rights. With such institutions in place, the model's basic structure becomes less applicable as a basis for analysis. However, property rights institutions are generally defined and enforced less rigorously in LDCs than in DCs.<sup>45</sup> This does not mean that efficient institutions cannot arise in LDCs. Ostrom (1990) observed cases in which such institutions arose in poor societies as well as cases in which they did not. Hence, the emergence of efficient property rights institutions in LDCs cannot be taken for granted and may require intervention from DCs or international organizations.

We have also ignored the role of foreign aid and trade. Of course, resource scarcity may be alleviated by foreign aid. However, we believe our simple model may be of value in gaining insight into the underlying tendencies of the system without aid. As for trade, if a natural-resource-dependent economy has a comparative advantage in a nonresource-based sector, trade prompts the allocation of more labor to this sector, reducing harvesting and raising social welfare. However, LDCs typically have comparative advantage in their resource-based sectors. In this case, trade stimulates resource harvesting. Over time, the resource gets overexploited, and social welfare declines relative to autarky.<sup>46</sup> Consequently, the rising resource scarcity may induce conflict along lines suggested in the introduction.

The model has a Malthusian spirit. The typical argument made against the Malthusian prediction is that it does not consider technological innovation. As argued by Homer-Dixon (1999), conflict may reduce society's ability to innovate to begin with.<sup>47</sup> Ignoring this point for the moment, in our setup innovation could, for example, raise the harvesting efficiency, carrying capacity, and resource growth rate and reduce the death rate. According to our model, raising the resource growth or carrying capacity would not have made societies less conflictive. Additionally, a rise in harvesting efficiency and a reduction in the death rate might lead to systemic collapse. In other words, technological innovation may not be the panacea to Malthusian conflict. At the same time, conflicts over natural resources are currently more frequent and intense in LDCs than in DCs. Hence, it is possible that once resources become plentiful, actors' behavior changes so that conflict is no longer considered a rational option to begin with.

44. See Cohen (1995) for a detailed review of many studies demonstrating this claim.

45. In fact, according to the 2001 Heritage Foundation's Index of Economic Freedom ([www.heritage.org/index/](http://www.heritage.org/index/)), none of the 17 countries we have mentioned in the introduction as experiencing resource conflicts are ranked in the top 30 worldwide with regard to property rights, and only 1 country (Turkey) is ranked in the top 50. Out of the 17, the majority are LDCs. We would like to thank an anonymous reviewer for bringing up this point.

46. Bee (1987), Brown (1995), and Brander and Taylor (1997) have provided empirical examples of the detrimental effect of international trade on resource-dependent economies.

47. This point is controversial. For example, Simon (1996) and Boserup (1981) have argued that these same adverse forces generate more innovation since necessity is the mother of invention.



Finally, in the analytical solution to our model we have abstracted from the potentially destructive effects of conflict on the population and resource base. Some conflicts over resources in LDCs are not intense enough to significantly affect the resource base or the overall death rate. In terms of our model, relatively low-intensity, scarcity-induced conflicts could be, and some say already are, a steady state outcome in LDCs. However, some conflicts in Africa, for example, are said to have already registered a negative effect on population forecasts and the environment. In extreme cases, aided by technological innovation in fighting, the effect of conflict could be so destructive as to eventually drive the system into one of its corner steady states.

## 6. CONCLUSIONS

We have developed a dynamic model of conflict based on Hirshleifer's (1989) initial static, game-theoretic framework. To our knowledge, this is the first model in the economic literature on conflict that makes Hirshleifer's framework dynamic. We have employed the model to study conflict over renewable resources in historical and present-day less developed societies.

Our model has five steady states. Four steady states exhibit no conflict because either one or both groups are extinct. The condition for the breakdown of anarchy in our model is more complicated than in Hirshleifer (1995). In our case, the breakdown depends on parameters of the resource and population, not only on the decisiveness parameter. We focused on a fifth steady state that features conflict. The comparative statics reveal that changes enhancing the resource stock or the population raise conflict. A rise in the conflict efficiency of one group relative to the other raises the group's income and reduces its conflict effort. A rise in the model's decisiveness parameter generates an ambiguous effect on conflict, which also differs from Hirshleifer's static model. Finally, the effect of raising harvesting efficiency on conflict is positive when the resource stock is high.

Turning to the dynamics, our results generally accord with the stories of historical societies that exhibited a relatively brief flowering, followed by decay, all the while exhibiting conflict over the resource base. Finally, we have discussed the model's implications for contemporary LDCs, paying particular attention to the limitations resulting from our modeling approach.

We have employed a relatively simple framework. Several research extensions, therefore, are worth pursuing. For example, the agents in the model maximize their current incomes. Although we find this assumption appropriate in our case, it would be interesting to introduce foresight into the model. Second, given our focus on less developed societies, we ignored demographic transition. Incorporating demographic transition into the model is an interesting extension. It would also be interesting to add more goods and factors of production. These features are expected to remove pressure from the resource, but we believe that the resource-population fluctuations will not disappear in their presence. Third, in the solution, we have ignored the destructive effects of conflict. It would be interesting, although mathematically complicated, to relax this assumption. However, as long as the destructive effects of conflict are not so

strong as to result in system collapse, we suspect that this extension would not change the nature of our findings.

In the end, although the model's trajectory is consistent with the spirit of the history of several ancient societies, contemporary LDCs differ, of course, from these cases. That said, we believe our findings serve as a warning of what the future might look like should societies choose to fight over renewable resources instead of devising the appropriate institutions to control their exploitation.

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# Structural Embeddedness and Intergroup Conflict

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Social structure affects the likelihood of group conflicts, although it has been disregarded by previous explanations. This study extends the intergroup public goods game model and integrates the influence of structural embeddedness and social incentives in the analysis of harmful group conflict. The integrated model explains why intergroup conflicts are often promoted by segregation and describes conditions under which this effect does not occur. The model predicts that a relationship between segregation and the likelihood of conflict can be characterized by an S-shape function. The segregation effect is stronger if local selective incentives are relatively important compared to confirmation from neighbors. Results show that under certain structural conditions, rational individuals are more likely to be trapped in harmful conflict than less rational actors, and rigid assumptions about individual rationality strengthen the effect of clustering on intergroup conflict.

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Situations in which a possible collective action of one group hurts the collective interests of another group are the focus of this study. Examples are supporter behavior in stadiums, competition between pupil groups, and violent conflicts between ethnic groups in neighborhoods or in villages. Collective action of equal strength by both parties in such situations results in a mutually harmful outcome. In this study, a theoretical model is presented that predicts under what structural conditions such harmful outcomes are likely to occur and when peaceful coexistence might be expected. I focus on a factor that has been surprisingly neglected in previous research: the effect of structural embeddedness (cf. Granovetter 1985). Although it is well documented that social networks play an important role in mobilization in collective action (e.g., Oberschall 1973, 1994; McAdam 1986; Chong 1991; Gould 1991; McAdam and Paulsen 1993; Opp and Gern 1993; Sandell and Stern 1998), previous models have not taken into account the fact that individual network ties within *and* between the groups transmit social and cognitive rewards that influence participation in intergroup-related collective action. In particular, although it is widely believed that dense in-group relations help the establishment of collective action (Marwell, Oliver, and Pahl 1988; Marwell

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and Oliver 1993; Gould 1993a, 1993b), in the intergroup context not much is known about why and under what conditions dense in-group and scarce out-group relations (segregation, clustering) support harmful collective action. I will investigate this question, considering competition situations between two distinct groups. A subsequent analysis should include history effects that are quite crucial in many empirical examples but, as a first step, in this study the focus is single-shot situations only.

If individual contributions are costly, group beneficial collective action is difficult to achieve. This is consistent with why lethal conflicts are more exceptions than regularities (Fearon and Laitin 1996; Gould 1999). However, the existence of an out-group could provide an explanation for higher contribution rates, especially if the relation between the groups is competitive. Cognitive incentives for cooperation can be derived from the principles of ethnocentrism or social identity theory (Lewin 1948; Sherif 1966; Tajfel et al. 1971; Tajfel and Turner 1986). Experiments also confirmed that individuals were more inclined to make sacrifices for their group in an intergroup game than for themselves in a two-person game in otherwise identical social dilemma situations (Kramer and Brewer 1984; Bornstein, Erev, and Rosen 1990; Schopler and Insko 1992; Insko et al. 1994; Bornstein and Ben-Yossef 1994). These results implied the conclusion that intergroup competition can be considered as a possible structural solution to social dilemmas (Bornstein, Erev, and Rosen 1990; Erev, Bornstein, and Galili 1993). From another perspective, Caporael et al. (1989) have argued that the solution within the groups creates a social dilemma between the groups. Similarly, Olson (1982) has shown that it is precisely the "self-sacrificial" loyalty to subgroups that can create conflicts between the subgroups.

Until now, however, theories of group conflict hardly made a connection to collective action problems within the groups (see Gould 1999), and theories of collective action also overlooked intergroup aspects. In many situations, collective action is harmful for the out-group and can be considered as defection in the intergroup context. Joining armed bands voluntarily in a tribal war certainly hurts the interests of the other group. If there is a violent outburst, the group that can mobilize more participants wins benefits, such as nationalistic pride, territory, or social identity, and the other group suffers heavy loss of these. Equal strength of violent action leaves no "results" behind, only casualties and expenses for both sides. Since there is no rivalry and no group member can be excluded from consumption, these rewards can be considered as public goods and "bads." The intergroup public goods (IPG) game (Rapoport and Bornstein 1987; Bornstein 1992) gives a comprehensive model for situations in which groups compete for such public good benefits. In the IPG model, intergroup competition is based on the number of contributors.<sup>1</sup> Groups are not considered as unitary entities as in realistic conflict theory. They consist of many consciously acting individuals who care primarily about their own gains and losses.

However, the original IPG model disregards the structural embeddedness of individual actions. Everyone's behavior is to a large extent constrained and influenced by

1. The model simplifies individual decisions to a binary choice, although in many situations it is continuous (for instance, how accurately a warrior shoots).

neighbors, friends, and family, regardless of group membership. In what follows, I will demonstrate the underlying mechanisms behind these network constraints and influences. First, the close social environment is a source of distribution of selective incentives, including social norms (Sandell and Stern 1998). Selective incentives from group members aid the establishment of collective action (Olson 1965), but friends from another group provide incentives that suppress contribution. Second, behavioral confirmation (conformity) that accompanies almost every kind of human interaction (Lindenberg 1986) is also transmitted by network ties. Conformity is an incentive received after an action that is identical to the behavior of others. In collective action that involves many individuals, people are not likely to conform to everyone's behavior or to be fair to everyone (in both a positive and negative sense; cf. Camerer 1997). Conformity is distributed in the social network environment, which appraises expectations about the behavior of friends and neighbors. People do not participate in collective actions in isolation but together with friends and neighbors (for empirical evidence, see McAdam 1986; Gould 1991; Opp and Gern 1993). When they decide to do so, they are assured of the other's participation (Chong 1991; Oberschall 1994). If friends and neighbors do not participate, neither do they. This way, each dyadic relation is subject to playing local coordination games (cf. Ellison 1993; Morris 2000), but in a form that is inseparable from participation choice in collective action. If surrounded by extremists, people are highly constrained to participate. On the other hand, peaceful friends or many friends from a rival group provide enough confirmation pressure to avoid contributing to the harmful collective action. Such a mobilization process is also called "block recruitment" (Oberschall 1973) and can provide the micro foundation for collective actions such as demonstrations, urban gang fights, or civil war.

This study incorporates these different mechanisms to a model of intergroup conflict. Intergroup competition, structural embeddedness, local selective incentives, and behavioral confirmation (the assurance process) are all factors that foster collective action. As a consequence, a social trap of a different kind might arise. If both groups are engaged in collective action, it results in a harmful outcome that should be avoided from the community's point of view. I will demonstrate how the relative size of selective incentives and conformity (normative pressure versus confirmation pressure) influence the effect of segregation on the likelihood of conflict and, hence, the chance that a residential policy can help conflict resolution. Furthermore, for exact model predictions, it is necessary to specify assumptions on individual consciousness and access to information. I introduce four behavioral models and compare the effect of network structure on conflict under the different specifications. Different behavioral models can also be considered as robustness tests to check whether normative pressure in general strengthens the segregation effect on intergroup conflict more than conformity pressure. Examples of typical structures will demonstrate how the success of local mobilization can be dependent on the behavioral assumptions on individual "rationality." Contrary to the common belief, it will be shown that, under certain structural conditions, "rational" individuals are more willing to contribute to collective action.



### THE STRUCTURALLY EMBEDDED INTERGROUP PUBLIC GOODS GAME: A MODEL FOR CONFLICTS BETWEEN GROUPS

There are two exclusive groups  $A$  and  $B$  of size  $n_A$  and  $n_B$  ( $n_A \geq 2$  and  $n_B \geq 2$ ) with contradictory collective interests. Inside both groups, members face a dilemma of provision of a step-level public good (cf. Bornstein 1992). A public good is a step-level good if it is not provided unless a certain level of contribution has been reached. Besides an endogenous threshold (the number of contributors in the other group), I introduce a minimal contributing set (cf. van de Kragt, Orbell, and Dawes 1983) in the game. It means that no provision of the public good that is associated with victory is possible in group  $A$  under a specified number of  $k_A^*$  contributors ( $0 \leq k_A^* \leq n_A$ ).<sup>2</sup>

It is assumed that group members are anonymous and can gain (lose) the same rewards from the intergroup context with identical action. For instance, it can be supposed that everyone is equally proud after a victory and equally ashamed after a defeat.<sup>3</sup> If the number of contributors in group  $A$  exceeds the number of contributors in group  $B$  and is also larger than  $k_A^*$ , then each member in  $A$  receives a reward  $v$  (a piece of a victory cake, temptation reward), and members of  $B$  receive a negative reward of  $d$  (defeat, the sucker's payoff). If the number of contributors is equal and both groups are above the minimal contributing set, then everyone receives a negative reward  $c$  (clash, punishment payoff). It can also be supposed that the clash of collective actions is worse than the outcome of peace.<sup>4</sup> Peace is the collective outcome in which no collective action is established in the groups. For the sake of simplicity, the reward for peace  $p$  is a reference value and assumed to be 0. Hence, the relation between the different payoffs is  $v > p = 0 > c > d$ . If groups were unitary entities and they could choose between collective action and no action, collective action would be their dominant strategy. Following the dominant strategy by both sides would lead to a suboptimal outcome. Throughout this study, all outcomes are called *conflict* if a collective action is established at least in one of the groups.

I assume that a free-riding action results in an extra individual reward of  $e$  (endowment,  $v > e > 0$ ). As an example, consider that a group of Republican voters are all happy if a Republican president is elected, but those who refrain from voting gain more because they could do something else instead of going to the polls (opportunity cost of voting). Table 1 represents the possible outcomes of the intergroup game and payoffs for player  $i \in A$ .<sup>5</sup>

2. For group  $B$ , the minimal contributing set is specified by  $k_B^*$  ( $0 \leq k_B^* \leq n_B$ ). It is a generalization of the intergroup public goods model of Rapoport and Bornstein (1987) that considers the minimal contributing set to be 0.

3. More precisely, since we do not make any interindividual comparison, it is enough to assume that everyone perceives (the utility of) his or her share in the same way compared to other rewards and costs.

4. In the payoff structure specified by Rapoport and Bornstein (1987), these rewards are equal. In their original intergroup public goods model, a public good is distributed among the members of the group in which the number of contributors is higher. In the other group, no public good is distributed. In case of a tie, all players receive a positive reward that is smaller than the share of the public good. There is no exogenous threshold; one contributor can already establish the provision of the public good. Besides, there is no difference between a tie (clash) and no provision (peace).

5. State (5) is the exceptional case and only relevant if  $k_A^* > k_B^*$ . In this state, there is an equal number of contributors in both groups. Collective action is established only in group  $B$ , but the contribution of player

TABLE 1  
Possible Payoffs from the Intergroup Game

	(1) <i>Peace</i>	(2) <i>Unconditional Defeat</i>	(3) <i>One for the Clash</i>	(4) <i>One for Minimal Contribution</i>	(5) <i>From Defeat to Victory</i>	(6) <i>One for the Victory</i>	(7) <i>Unconditional Victory</i>
Conditions	$k_{A-i} < k_A^* - 1$ and $k_B < k_B^*$	$(k_{A-i} < k_B - 1$ or $k_{A-i} < k_A^* - 1)$ and $k_B \geq k_B^*$	$k_{A-i} = k_B - 1$ and $k_B \geq k_B^*$ and $k_{A-i} + 1 \geq k_A^*$	$k_{A-i} = k_A^* - 1$ and $k_B < k_B^*$	$k_{A-i} = k_A^* - 1 \geq$ $k_B \geq k_B^*$	$k_A^* \leq k_{A-i} =$ $k_B \geq k_B^*$	$(k_{A-i} > k_B$ or $k_B < k_B^*)$ and $k_{A-i} \geq k_A^*$
Contribution	0	$d$	$c$	$v$	$v$	$v$	$v$
No contribution	$e$	$d + e$	$d + e$	$e$	$d + e$	$c + e$	$v + e$

NOTE:  $k_{A-i}$  = the number of contributors in group A (excluding player  $i$ );  $k_B$  = the number of contributors in group B.

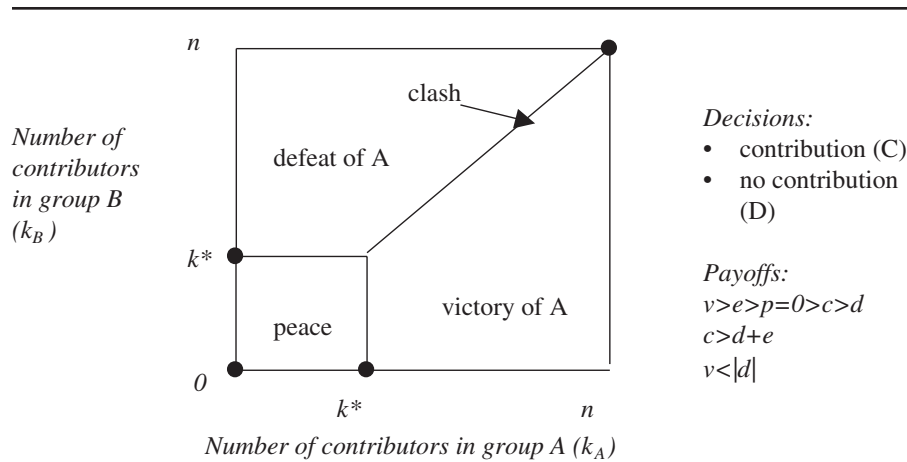


Figure 1: Graphical Representation of an Example and Nash Equilibria (bullets)

A specific example of the game is represented graphically on Figure 1. In this example, group sizes and the minimal contributing sets are equal. Nash equilibria are indicated by bullets. In general (if minimal contributing sets are larger than 1), pure strategy Nash equilibria are the situations in which there are  $\{0; 0\}$ ,  $\{k_A^*; 0\}$ , or  $\{0; k_B^*\}$  contributors. Clash with an overall participation is also a Nash equilibrium if group sizes are equal and  $d + e < c$ . This equilibrium is never Pareto-optimal.

To predict which outcome will be realized, assumptions must be made about how individuals decide in the game. In some states of a step-level public good game, contribution is a better choice (cf. Frohlich and Oppenheimer 1978). In this intergroup game, these states are 3, 4, 5, and 6 in Table 1. The likelihood that the action of  $i$  has an influence on the overall outcome is the sum of critical probabilities (cf. Caporael et al. 1989) that are subjectively ordered to these outcomes by  $i$ . If group sizes are large and the minimal contributing sets are relatively high, then based on realistic calculations, critical probabilities are extremely small, and the game is close to being a pure in-group social dilemma (cf. Bornstein and Rapoport 1988, 127). Consequently, peace is a very likely outcome of intergroup opposition (for empirical evidence, see Fearon and Laitin 1996). However, collective action can be established if effective social control, norms, or selective incentives exist in the group (Olson 1965; Heckathorn 1990). Accordingly, in the next paragraphs I will incorporate three different forms of social control that are transmitted by network ties in the model of intergroup conflict. These are traitor rewards, behavioral confirmation, and social selective incentives. As a consequence of dyadic social control, under certain network structures, harmful collective action might emerge.

$i \in A$  turns the outcome to the victory of group A. State (1) is not relevant if less than two contributors can establish group collective action, and state (4) is not relevant if the minimal contributing sets are 0. This holds for the original Rapoport and Bornstein (1987) model. In that model, only states (2), (3), (6), and (7) are relevant, with the assumptions of  $0 = d < c < v$ . States (6) and (7) are irrelevant if  $k_A^* = n_A$ .

TABLE 2  
Local Coordination Game between Fellow Neighbors

	<i>Neighbor from the Same Group</i>	
	<i>Contribute</i>	<i>Do Not Contribute</i>
Individual <i>i</i>		
Contribute	$b + s, b + s$	$s, 0$
Do not contribute	$0, s$	$b, b$

Individuals are rewarded for not participating in the collective action if their neighbors or friends are from the other group. It is assumed that everyone receives a  $t > 0$  traitor reward in case of no contribution for each tie that connects this person to members of the opposite group. Hence, the traitor payoff is a selective incentive rewarding defection and distributed locally conditionally on the number of ties to the other group. The traitor reward provides an additional incentive to people who live close to members of the opposite group and refrain from participation in the collective action. For instance, supporters surrounded by fans of the other club are rewarded for remaining silent in a stadium.

Ties connecting members of the same group transmit different social incentives. People receive behavioral confirmation ( $b > 0$ ) from each relation by acting the same way as a friend does. This reward is a mutual positive externality, which drives toward uniform action. Regardless of behavioral confirmation, contribution is rewarded by neighbors or friends who appreciate group-beneficial action by social selective incentives. It can be assumed that all contributors receive a selective incentive  $s > 0$  from each neighbor. The provision of these incentives does not require separate decisions; they always accompany choices made in the intergroup game. This assumption is plausible for certain social rewards, such as respect or status, that can be by-products of intergroup relations. The relationship between neighbors or friends can be represented as a local coordination game (see Table 2).<sup>6</sup> All three types of social incentives are received unconditionally on the outcome of the intergroup competition, unlike the public goods ("bads")  $v$ ,  $c$ , and  $d$ .

The structurally embedded IPG game is the extension of the IPG game (Table 1 and Figure 1) with the incentives ( $t$ ,  $b$ , and  $s$ ) from the network environment. Individuals must choose a single action (contribution or no contribution) and cannot tailor their behavior for each neighbor.<sup>7</sup> In the structurally embedded IPG game, contribution can even be the dominant strategy. For this, selective incentives have to exceed rewards for defection in the worst case scenario, when no neighbors are contributing and a single contribution does not change the outcome. That is, contribution is a dominant strategy of player  $i \in A$  if

6. For the sake of simplicity, it is assumed that selective incentives and confirmation payoffs are held constant through all pairwise games. However, it is sufficient to assume that all individuals relate social rewards to other rewards and costs in the same way.

7. It is also the assumption of the literature on local interaction games (see Morris 2000, n. 1).

$$g_i t + e < f_i(s - b), \quad (1)$$

where  $f_i$  denotes the number of neighbors of  $i$  from group A, and  $g_i$  stands for the number of neighbors from group B. Although the decision of  $i$  is not likely to be critical, contribution can be highly beneficial because of social incentives. For instance, many individuals join tribal wars, although the gains from these conflicts are only symbolic, and single contributions do not make any difference. One reason is that warriors can attain high status in the group and become “heroes” easily. A similar argument can be made to explain a redundant contribution choice (Caporael et al. 1989). People seek social rewards when they sacrifice their contribution to the production of a public good that has already been established.

On the other extreme, no contribution is the dominant strategy of  $i$  if defection provides higher rewards than contribution even if all neighbors are contributing and a single additional contribution would change the outcome of the game. That is, defection is a dominant strategy of player  $i \in A$  if<sup>8</sup>

$$g_i t + e > f_i(s + b) + v - d. \quad (2)$$

Nash equilibria in the structurally embedded game can be very different from the original IPG game, depending on the exact network structure. Social networks decisively shape conditions under which social incentives can generate solutions for the in-group collective action problem. In a highly segregated network with dense in-group and scarce out-group relations, overall participation is likely to be an equilibrium. Full contribution can be a dominant strategy equilibrium and a suboptimal outcome in which every individual payoff is smaller than in overall peace. The unusual social dilemma that traps groups in harmful contribution emerges if

$$|c| > f_i s - g_i t - e > f_i b \quad (3)$$

holds for every individual.

### MODEL PREDICTIONS UNDER DIFFERENT INDIVIDUAL DECISION RULES

To derive exact model predictions, further assumptions about individual behavior are needed. Since there is no generally accepted view about what level of rationality can be assigned to individual action and what kind of information people use for their

8. If  $k_B^* \geq k_A^*$ , then the less strict conditions

$$g_i t + e > f_i(s + b) + c - d$$

and

$$g_i t + e > f_i(s + b) + v - c$$

are sufficient to hold for no contribution to be a dominant strategy.

decisions,<sup>9</sup> four models will be considered with different levels of consciousness and access to information. In this section, I introduce these models and describe the effect of segregation on intergroup conflict under the different assumptions. None of these models are claimed to reflect the appropriate view on the logic of individual action. I believe there is no such view: the level of rational consciousness in individual action varies depending on the framing and importance of situations (Lindenberg and Frey 1993). However, in all four models, I assume a certain level of rationality. I also bring strategic thinking back into consideration, which would not be present if I had assumed that people order expected values for actions and maximize this value (cf. Rapoport and Bornstein 1987). On the other hand, the models also deviate from classical game theory by skipping the assumptions of complete information and perfect rationality. I agree with Macy (1991b, 810) that game theory is ideally suited for sociological concerns, not because of its key assumption of rationality but because it provides an adequate model for the interdependence of actions.

By considering four decision models, it becomes possible to analyze the effect of rational consciousness and access to information on the likelihood of contribution and the interaction effect of behavioral assumptions and segregation on intergroup conflict. In model 1, it is assumed that individuals choose their dominant strategy if they have one. In model 2, local information is introduced into the analysis by assuming that individuals are also able to recognize dominant replies to the dominant strategies of their neighbors. In model 3, it is assumed that such obvious actions are common knowledge between neighbors, and optimal replies are chosen accordingly. In model 4, an expected value element is added to all these assumptions. This model still assumes bounded rationality, since the tendency of overestimation of criticalness (Kerr 1989) is controlled. The most rigid assumptions about individual behavior are used in model 4 and the least rigid ones in model 1. All the assumptions will be discussed in detail in this section. I will show that rigid assumptions strengthen the predicted relationship between segregation and the likelihood of intergroup conflict.

#### MODEL 1: DOMINANT STRATEGY RULE

In the first model, only a limited rationality of players is assumed. It is presumed that actors choose their dominant strategy, if they have one. Everyone who lacks a dominant strategy contributes with a fixed probability. These behavioral assumptions allow for a derivation of hypotheses from inequalities 1 and 2. As far as the main payoff parameters are concerned, a smaller difference between victory and defeat and a smaller reward for free riding will increase the likelihood of intergroup clash. With regard to structural effects, extensive connections (larger  $f_i$ s) support contribution; therefore, collective action will be more likely in a clustered population.

9. Assumptions in the relevant literature contain perfect rationality (e.g., Chwe 1999) as well as considerations of motivations that are beyond egoistic incentives (cf. Caporael et al. 1989). There are various models that assume bounded rationality or limited access to information in different forms (e.g., Ellison 1993; Morris 2000; Fearon and Laitin 1996; Gould 1993a; Rapoport and Bornstein 1987; Macy 1991a).

Already this simple model generates empirically plausible implications. However, there are empirical examples that contradict the predictions and show that isolation can sometimes be an effective way to avoid intergroup clash. Isolation in these cases could mean a termination of the interdependent situation (e.g., building a wall in Belfast, destruction of a bridge in Mostar, or blocking a bridge in Kosovska Mitrovica). These are external or artificial solutions of intergroup conflict that might require the deployment of armed forces for monitoring. When there are no external solutions and interdependencies are unavoidable, the model predicts a strong effect of segregation on the likelihood of conflict between groups if selective incentives are relatively more important than behavioral confirmation (see equation [1]).

The model has interesting implications for group size effects. In a physical clash or battle, larger groups can obtain success easily. If the minimal contributing sets are equal in the groups, the larger group has a higher chance to win from the intergroup opposition. The lower the minimal contributing set, the more likely it is that collective action emerges. In this case, a small amount of noise can break down the peaceful equilibrium. Empirical examples of noise are mistakes, misinterpretations, drunkenness, or sudden passions (Fearon and Laitin 1996). It is more remarkable that even if minimal contributing sets are given proportionally to group size, the larger group still has an advantage. It follows from the fact that if group *A* is larger than group *B*, the expected proportion of ties in group *A* is higher than the relative size of group *A*. Hence, the chance of being in a neighborhood in which normative pressure restricts the individual to contributing action is exponentially higher by increasing group proportion. For instance, there is evidence that voting participation (and votes) increases nonlinearly with higher levels of residential segregation (Butler and Stokes 1974). In other cases, this prediction may contradict real life experience. Larger groups tend to be more sparse and less organized (Olson 1965). Furthermore, if there is a big inequality in group strength, the minority may try to avoid intergroup opposition by assimilation (fading group borders), and the majority can reward this process by forms of positive discrimination.

## MODEL 2: DOMINANT REPLY RULE

In the second model, more rigid assumptions are formulated about individual behavior by introducing access to local information. Every actor follows his or her dominant strategy, if there is one. Furthermore, since people know their neighbors to some extent, they can also attain information about their possible actions. Let us assume that people can recognize if some of their neighbors have a dominant strategy and can give an unconditionally best (dominant) reply if there is one.<sup>10</sup> Denote the number of neighbors of *i* who are members of the same group and have a dominant strategy of contribution by  $f_{ic}$  and the number of neighbors from the same group who have a dominant strategy of defection by  $f_{id}$ . From Table 1 and equations (1) and (2), it can be derived that contribution is the unconditionally best (dominant) reply of *i* if

10. We call a strategy an unconditionally best (dominant) reply if it is a pure best reply against all pure strategy profiles that contain the dominant strategies of neighbors. It involves the assumption that every actor is capable of assessing information about the number of ties and about the relative value of social rewards *b* and *s* for all fellow neighbors.



$$g_i t + e < f_{ic}(s + b) + (f_i - f_{ic})(s - b) \quad (4)$$

holds, and defection (no contribution) is the dominant reply if

$$g_i t + e > (f_i - f_{id})(s + b) + f_{id}(s - b) + v - d \quad (5)$$

is satisfied.<sup>11</sup> Everyone who has no dominant strategy or dominant reply is assumed to contribute with a fixed probability.

Model 2 generates further insights into structural effects. Compared to model 1, the existence of relatively closed “ghettos” increases the likelihood of conflict. The periphery of these network segments acts together with the initiators, because they have dominant reactions. The higher the relative size of social incentives ( $s + b$ ), the more likely it is that the periphery will also be encouraged to contribute. A large relative difference between selective incentives and behavioral confirmation ( $s - b$ ) helps key contributors to arise (see model 1), but their additive value ( $s + b$ ) is important for the mobilization of the periphery (model 2). On the other hand, if confirmation rewards are relatively important, peaceful behavior might spread around radical defectors. Hence, in model 2, centralized networks are efficient in spreading both behavioral patterns (cf. Marwell, Oliver, and Pahl 1988; Gould 1993a).

Consider, for instance, the following example. An imaginary map of a small village is represented in Figure 2. Five members of group A (white houses) and seven members of group B (black houses) inhabit the village. In this example, members of group A live at the periphery of the village. Assume that groups are involved in a competition situation that can be described by the structurally embedded IPG game. Suppose that everyone is in close connection only with neighbors to the east, west, south, and north. Group B has the advantage of size but also has a structural advantage, because its members are located mainly in the center of the village. Consequently, collective action is more likely in this group. One player has a dominant strategy of contribution in group B if  $e + 3b < 3s$ . Three other members living in black houses have a dominant reply of contribution in this case if  $e + t < 2s$ . If a stronger condition of  $e + t + 2b < 2s$  is satisfied, then five members of group B have contribution as a dominant strategy. If the condition of  $e + t < s + b$  is also met, then the remaining two members of group B may contribute to the collective action, since it is their dominant reply. In none of these cases does anyone in group A have a dominant strategy of contribution or a dominant reply of contribution. In this village, only high opportunity costs of contribution (high rewards for free riding) and low importance of selective incentives can help to avoid conflict and the exploitation of group A.

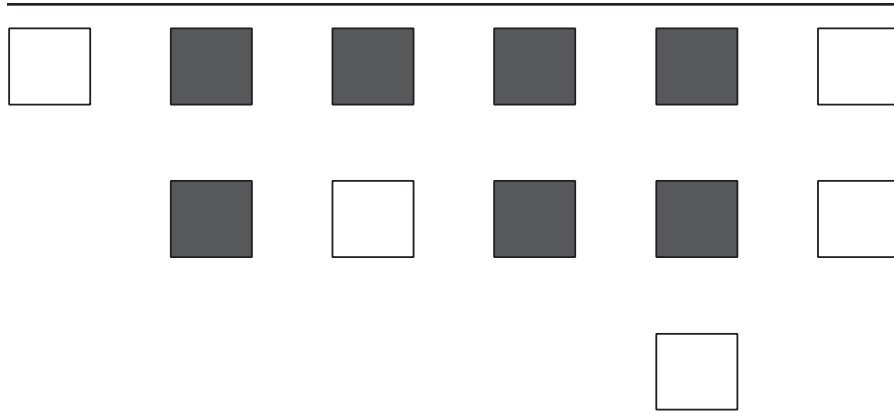
11. If  $k_B^* \geq k_A^*$ , then the less strict conditions

$$g_i t + e > (f_i - f_{id})(s + b) + f_{id}(s - b) + c - d$$

and

$$g_i t + e > (f_i - f_{id})(s + b) + f_{id}(s - b) + v - c$$

are sufficient to hold for defection to be a dominant strategy of  $i \in A$ .



**Figure 2: An Imaginary Map of a Small Village with Mixed Population**

#### MODEL 3: LOCAL COMMON KNOWLEDGE

If extensive contacts in the neighborhood are assumed, it can also be supposed that individuals are not only capable of recognizing dominant strategies of their neighbors but also dominant replies, best replies to dominant replies, and so forth. In model 3, it is assumed that people can anticipate obvious actions of their neighbors but also the neighbors' perceptions about their own behavior and the neighbors' perceptions about their own perceptions. This means that having a dominant strategy or reply of any order is common knowledge between the neighbors. Under this decision rule, it is also assumed that everyone who has a dominant strategy or reply of any order acts in accordance with this strategy. In the lack of such a strategy, individuals are assumed to contribute with a fixed probability. Model 3 goes far beyond the previous models in the sense that it also takes indirect network influence into consideration. In this model, hesitating people can be influenced by neighbors who have been convinced by other neighbors. At high levels of clustering, contribution spreads easier, and at low levels defection does; consequently, in this model, a stronger effect of segregation is expected on the likelihood of conflict. The stronger relationship originates in the more exhaustive recruitment of peripheral areas next to initiators of collective action. Completely isolated individuals are not assured by the action of fellow group members and not rewarded for traitor action. Therefore, they are still indifferent in the intergroup game (their decision is probabilistic).

#### MODEL 4: EXPECTED VALUE CALCULATION

Decision models 1, 2, and 3 allowed individuals to make strategic calculations but involved a purely probabilistic element in the case of the absence of a dominant strategy or a dominant reply. However, under certain circumstances, it is reasonable to presume calculative choice for these individuals. In model 4, it is assumed that everyone who has a dominant strategy or reply of any order acts in accordance with this strategy,

just as in model 3. Those who do not have such a strategy will base their decision on an expected value calculation that involves an estimation of the number of contributing neighbors and attaches subjective probabilities to possible outcomes (similar to Rapoport and Bornstein 1987).<sup>12</sup>

To make the model more realistic, I incorporated a certain tendency in the model that is found in experiments and is in accordance with bounded rationality. Social psychologists often claim that people usually overestimate the severity of their own decisions (e.g., Kerr 1989). Even if their beliefs about critical probabilities are correct, they contribute to the collective action more likely than would follow from expected value calculations based on these probabilities (Rapoport, Bornstein, and Erev 1989). This striking gap is also present in experimental conditions in which confirmation incentives can be excluded (cf. Caporael et al. 1989). Such a positive error can originate in people's preferences about being responsible in a negative sense for a group decision and can be labeled responsibility aversion. This tendency was incorporated in model 4.<sup>13</sup>

In Model 4, collective action might be established in a segregated setup even if rewards of intergroup opposition are not salient. In less segregated settings, not only direct neighborhoods but also fellows at a larger network distance can be enforced to contribute because they might forecast contribution in the close neighborhood of

12. The estimation can be based on the following calculation. Denote the subjective probabilities for  $i$  of the seven states by  $P_z$ s

$$\left( \sum_{z=1}^{z=7} P_z = 1 \right)$$

and the estimated number of neighbors who will contribute by  $\hat{f}_{ic}$ . For the sake of simplicity, assume that rewards are numerical and individual utility is a linear function of rewards. Contribution is a better choice if

$$P_3(c - d) + P_4v + P_5(v - d) + P_6(v - c) + \hat{f}_{ic}(b + s) + (f_i - \hat{f}_{ic})(s - b) > g_i t + e.$$

We have to make further assumptions about how individuals determine critical probabilities. The calculation could be based on an approximation from the binomial distribution. People are, however, unlikely to make calculations in this sophisticated way (cf. experimental results of Rapoport, Bornstein, and Erev 1989), especially if it is problematic to translate rewards into utilities. However, people certainly consider in their decisions what the probable outcome of the intergroup opposition can be and how their neighbors behave. Hence, results are only aimed to highlight tendencies: how the "vision of rational man" can change the predicted likelihood of group conflict and the predicted relationship between clustering and conflict.

13. The decision rule is constructed as follows: all individuals are assumed to choose their dominant strategy or dominant reply of any order if they have any (local common knowledge is assumed about obvious reactions of neighbors). If they do not have such a strategy, they use an expected value calculation based on the formula in footnote 12. Critical probabilities  $P_3$ ,  $P_4$ ,  $P_5$ , and  $P_6$  are obtained from a binomial calculation that sums the probabilities of all possible events for the given outcome:

$$P_3 = \sum_{j=\max(k_A^*, k_B^*)}^{\min(n_A, n_B)} \binom{n_A-1}{j-1} P_A^{*j-1} (1-P_A^*)^{n_A-j} \cdot \binom{n_B}{j} P_B^{*j} (1-P_B^*)^{n_B-j},$$

$$P_4 = \binom{n_A-1}{k_A^*-1} P_A^{*k_A^*-1} (1-P_A^*)^{n_A-k_A^*} \cdot \sum_{j=0}^{k_B^*-1} \binom{n_B}{j} P_B^{*j} (1-P_B^*)^{n_B-j},$$

$$P_5 = \binom{n_A-1}{k_A^*-1} P_A^{*k_A^*-1} (1-P_A^*)^{n_A-k_A^*} \cdot \sum_{j=k_B^*}^{k_A^*-1} \binom{n_B}{j} P_B^{*j} (1-P_B^*)^{n_B-j},$$

initiators. On the other hand, highly mixed networks are still likely to be saved from conflict.

It is also possible to derive predictions about the effect of a certain type of cognitive interdependency between the players. If in at least one group there is a widespread belief that the local area is a leader in the establishment of group collective action (for instance, in many districts of the city, Serbs believe that only “good” Serbs live in that district), then collective action will be more likely. The more people who expect a high level of contribution (conflict), the more likely it is that conflict will happen. On the other hand, expectations of peace will help the occurrence of a peaceful outcome. Hence, cognitive beliefs have an inflating effect in both directions.

## SIMULATION RESULTS

### SIMULATION DESIGN

In the previous section, four models of individual behavior were introduced, and general model predictions under the different assumptions were discussed. It was noticed that segregation increases the likelihood of intergroup conflict in all models, especially in the presence of strong selective incentives. Besides the derivation of transparent analytical results, simulations can be used to derive precise predictions and provide comparative statics for all possible networks in specific settings. In the simulations, network ties represent relations between neighbors.<sup>14</sup> People are seldom able to escape interacting with neighbors and being influenced by them. The empirical relevance lies in the fact that, unlike other ties, neighboring connections are symmetrical (undirected) and easily mapped. Residential structures are visible, and therefore results can be interpreted easily. Furthermore, it is known that residential segregation often goes together with other forms of segregation (e.g., Whyte 1986).

In the simulations, a rectangular grid modeled residential locations. Every location in the grid (each cell) could be in three different states: occupied by a member of group *A*, occupied by a member of group *B*, or empty. No restrictions were applied about the location of the empty cells. For instance, corner areas of the rectangle could be empty. In this way, the model could resemble a cross-shape or amorphous settlements as well. However, simulation could provide only a simplification of residential configurations observed in reality. Simplification was also made with respect to a ceiling on neighbor-

and

$$P_6 = \sum_{j=\max(k_A^*, k_B^*)}^{\min(n_A-1, n_B)} \binom{n_A-1}{j} p_A^{*j} (1-p_A^*)^{n_A-j-1} \cdot \binom{n_B}{j} p_B^{*j} (1-p_B^*)^{n_B-j},$$

where  $p_A^*$  and  $p_B^*$  denote the subjective probability that a representative individual contributes to the group collective action in group *A* and *B*, respectively. It is assumed that people think both groups are homogeneous in the sense that they order the same subjective probability to each actor's action in the given group (cf. Rapoport and Bornstein 1987). Responsibility aversion is incorporated into the decision rule in the form that, if the procedure described does not result in contribution, then people are still allowed to contribute with a fixed probability.

hood size. The usual assumptions of cellular automata-based research were embraced and, at most, four (south, west, north, east) or eight (also SW, NW, NE, SE) adjacent cells were considered to represent neighbors (Von Neumann or Moore neighbors). As in reality, at the edges of the grid the neighborhood was smaller in size. Empty, adjacent cells at central locations could represent uninhabited buildings, squares, parks, and so on.

### MEASURES OF SEGREGATION

Because the central interest of the study is the relationship between structural configurations and the likelihood of conflict, it is important to describe the network structure with appropriate measures under the model settings. Therefore, I briefly summarize the measurements used in computer simulation.

In the limited scope of simulations, ties connect two adjacent cells. Density was measured by the proportion of ties connecting two nonempty cells. This measure of density approaches being a simple quadratic function of the proportion of nonempty cells as grid size increases to infinity, regardless of the definition of neighborhood.<sup>15</sup>

There are two (groups of) widely accepted indexes to measure the relative density of in-group and out-group relations in the empirical literature. The first type measures the extent to which members of one group are exposed only to each other and thus isolated from members of the complementary group. This index is called isolation (or simply clustering) (*I*: Willms and Paterson 1995;  ${}_aP_a^*$ : Lieberman 1980). The second index measures the extent to which members of one group are exposed to members of the other. This index is called exposure ( ${}_aP_b^*$ : Lieberman 1980) or interaction. In empirical research, these indexes are computed from meso-level data (e.g., group proportions in census tracts). As Grannis (1998) stressed, in this way the indexes provide a biased measure of neighborhood compositions. Individual behavior is influenced mainly by contacts embedded in smaller units of residential structure; hence, tertiary residential-type streets or merely the closest neighbors have to receive explanatory focus. Because the simulations include individual-level data, it is possible to rely on

14. Simulation programs were written in Delphi 3 and are available by request from the author.

15. Denote the grid size by  $S$ . The proportion of nonempty cells (population density) is  $\pi = (n_A + n_B)/S$ . The probability of one cell's being empty is  $1 - \pi$ , and the same holds for the adjacent cell. Since the two events are not independent (the locations are filled without replacement), in the calculation of the probability that at least one of the cells that the given tie connects is empty it is necessary to subtract the joint probability of the two events, which is

$$(1 - \pi) \frac{(1 - \pi)S - 1}{S - 1}.$$

The probability that a tie connects two nonempty cells is 1 minus the above probability. Therefore, regardless of the definition of neighborhood (Von Neumann or Moore neighbors), the expected density of network relations  $E(\delta)$  is obtained as

$$E(\delta) = 2\pi - 1 + (1 - \pi) \frac{(1 - \pi)S - 1}{S - 1}.$$

micro-level indexes that are close in interpretation to the empirical isolation and exposure measures.

The proportion of fellow ties (from all nonempty relations) will be used as an index of segregation (clustering). This measure is closely related to the individual  $f_i$  values. As in the empirical isolation index, high values indicate high levels of clustering. As grid size increases to infinity, the expected proportion of fellow ties approaches the sum of squares of the group proportions.<sup>16</sup> If a grid is more clustered than another one under the Von Neumann neighborhood definition, it does not mean that this grid is also more clustered under the Moore neighborhood definition. A striking example is a chessboard-like settlement in which black and white fields represent members of the two groups. In such a residential structure, the segregation index is 0 if neighborhood is defined by Von Neumann neighbors, but it is close to the average level if neighborhood is defined by Moore neighbors.

Similarly, the proportion of opposite ties connecting two individuals from the competing groups could be used as an index of exposure. This measure is closely related to the individual  $g_i$  values. High values of exposure indicate high levels of mixing. It is important to note that extreme mixing is not equivalent to a random residential structure. The proportion of fellow and opposite ties (segregation and exposure) always sums to 1. The constructed segregation and exposure indexes fulfill the proposed criteria and are appropriate for the simulation analysis based on complete information. In the next examples, clustering will be indicated by the value of the segregation index.

#### THE EFFECT OF SEGREGATION UNDER DIFFERENT NEIGHBORHOOD DEFINITIONS AND DECISION RULES

This section aims to provide precise predictions about the effect of segregation on the expected likelihood of conflict under different models of individual decision making. In the simulations, structurally embedded IPG games were played between two groups of equal size. A  $10 \times 10$  grid was considered, in which 90% of the cells were inhabited; hence, there were 450 members in both groups. In each decision model, population was assumed to be homogeneous in the sense that every player used the selected decision rule. The probability element of each decision rule was fixed to 25% of contribution.

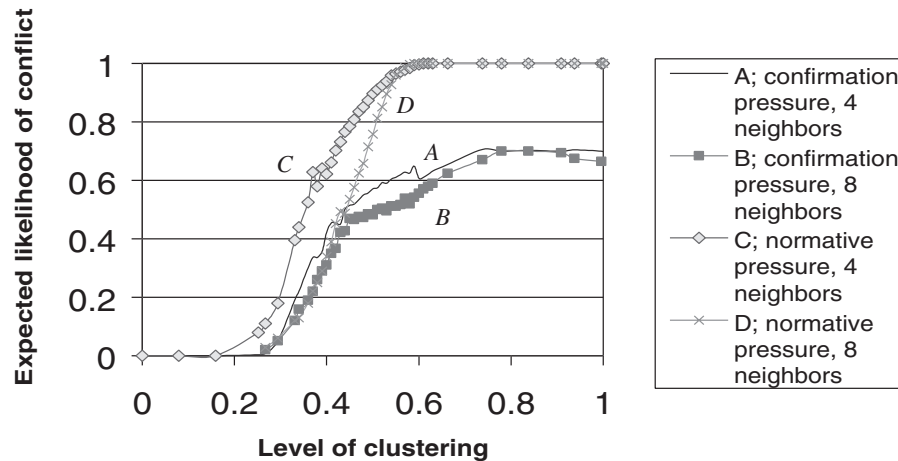
The larger the grid size  $S$ , the closer the expected value is to  $\pi^2$ .

16. The proportion of ties connecting members of the same group will be used as an index of segregation (clustering). For the calculation of the expected proportion of ties connecting two members of the same group, the same argument can be used as for the calculation of the expected proportion of nonempty ties (see footnote 14). Applying this to both groups, it is obtained that regardless of the neighborhood definition, the expected proportion of ties  $E(\phi)$  from all nonempty relations is

$$E(\phi) = \frac{\alpha(n_A - 1) + \beta(n_B - 1)}{n_{A+B} - 1}.$$

By enlarging the grid, the expected value gets closer to  $\alpha^2 + \beta^2$ .

The proportion of opposite ties  $\gamma$  can be used as an index of exposure. The index of segregation (clustering) and the index of exposure sums up to 1. As grid size increases towards infinity, the expected value of exposure gets closer to  $2\alpha\beta$ .



**Figure 3: The Effect of Segregation on the Expected Likelihood of Conflict If Neighborhoods Are Defined Differently**

NOTE: In confirmation pressure condition,  $b = 2$ ,  $s = 1$ . In normative pressure condition,  $b = 1$ ,  $s = 2$ . Other parameter values are  $v = 5$ ,  $e = 2$ ,  $c = -1$ ,  $d = -5$ ,  $t = 2$ . The minimal contributing set is 113 members (25%) in both groups.

Before discussing the effects of segregation and individual decision rules, I will briefly summarize how the definition of neighborhood influences the expected likelihood of conflict. If the same levels of clustering are considered, the expected likelihood of conflict is usually higher in the Von Neumann neighborhood. Figure 3 shows two comparisons in decision model 1. The examples demonstrate that when considering a sparse and a dense network with the same proportion of intergroup contacts, contributions and intergroup conflict will be more likely in the sparse network. The reasons can be found in the structural conditions of having a dominant strategy. In the confirmation pressure condition, only defection can be a dominant strategy. Furthermore, it can be a dominant strategy only under the Moore neighborhood definition, which means a higher likelihood of peace for this case. If local selective incentives are important, then contribution is more likely to be a dominant strategy in dense networks (cf. equations [1] and [2]).

Curves on Figure 3 and on subsequent figures connect discrete cases of clustering levels. It is possible that when the average number of neighbors is higher, the number of people who have enough neighbors to have contribution as a dominant strategy is smaller. This causes quite a big fluctuation, especially for high and low ranges of clustering. To avoid graphic confusion, averages of expected likelihood of conflict are shown by 0.01 interval sizes in the medium range of clustering and by 0.025 interval sizes for extreme cases. However, it could be interesting to investigate what structural configurations are behind these fluctuations and what are the structural conditions that result in a high likelihood of conflict in a mixed setting or, oppositely, in a low like-



likelihood of conflict in a segregated setting. I will come back to this point in the next section.

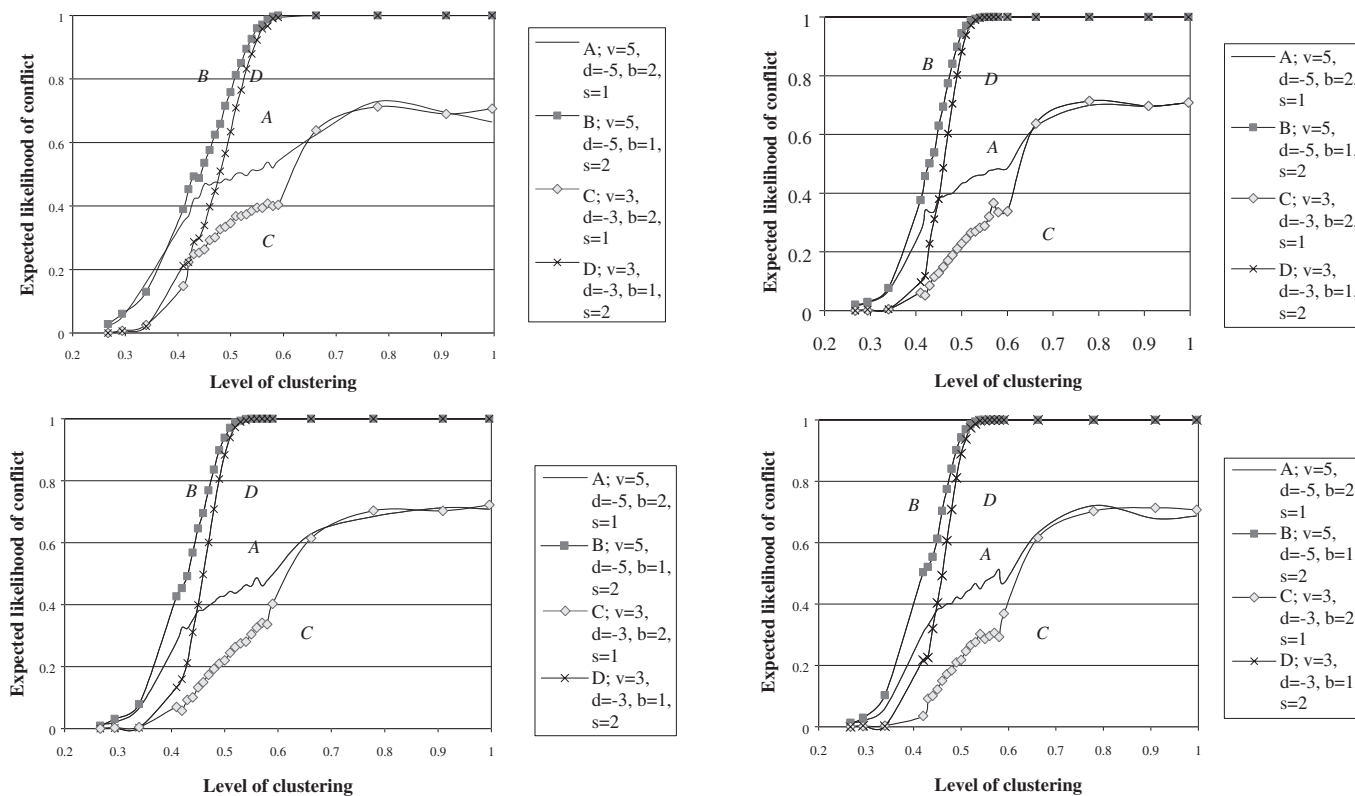
Figures 4 and 5 illustrate how different individual decision rules (models 1-4) influence the effect of segregation on the expected likelihood of conflict. The figures demonstrate this effect for two minimal contributing sets. In these examples, Moore neighborhoods were considered.<sup>17</sup> In both figures, the effect of behavioral models are represented separately. On each figure, curves display the expected likelihood of conflict for four combinations of parameter values: whether rewards from the intergroup opposition are *salient* ( $v = 5, d = -5$ ) or *nonsalient* ( $v = 3, d = -3$ ) and whether behavioral confirmation is more important than selective incentives (*confirmation pressure* condition;  $b = 2, s = 1$ ) or not (*normative pressure* condition;  $b = 1, s = 2$ ). Values of other parameters were fixed in all cases ( $e = 2, c = -1, t = 2$ ).

Figures 4 and 5 show that segregation has a crucial effect on the expected likelihood of conflict in the normative pressure condition.<sup>18</sup> Salient payoff parameters are always associated with a higher expected likelihood of conflict. This effect is never as crucial as the difference between the confirmation pressure and normative pressure conditions. This is not surprising since social incentives are originated from network relations; meanwhile, payoff parameters of the IPG game are independent from social structure. If contribution can be a dominant strategy ( $s > b$ ), then the relationship between segregation and the expected likelihood of conflict is best described by a steep S-shape curve. In the normative pressure condition, clustering has a crucial effect on conflict in a certain critical range. This range *ceteris paribus* moves to the right (compare Figures 4 and 5) if the minimal contributing set for collective action is higher, which means that the overall likelihood of conflict is always smaller. Under certain conditions, there is no critical range. There are examples in which peace is expected with certainty even in a grid of maximum clustering (cf. confirmation pressure on Figure 5).

Within Figures 4 and 5, comparisons can be made between the effects of segregation under different decision models. The segregation effect somewhat increases and the critical range of clustering decreases as we go toward models with more rigid behavioral assumptions. In the low ranges of clustering, the expected likelihood of conflict is lower if a rigid decision rule is applied. In these cases, peace can be achieved more easily if the community consists of "rational" individuals with extensive information attainment. This success of calculative action can be explained by "negative" block recruitment. In the high ranges of clustering, the opposite process (positive block recruitment) can be traced. In the normative pressure condition, more and more people will have a dominant strategy (and a dominant reaction) of contribution in a

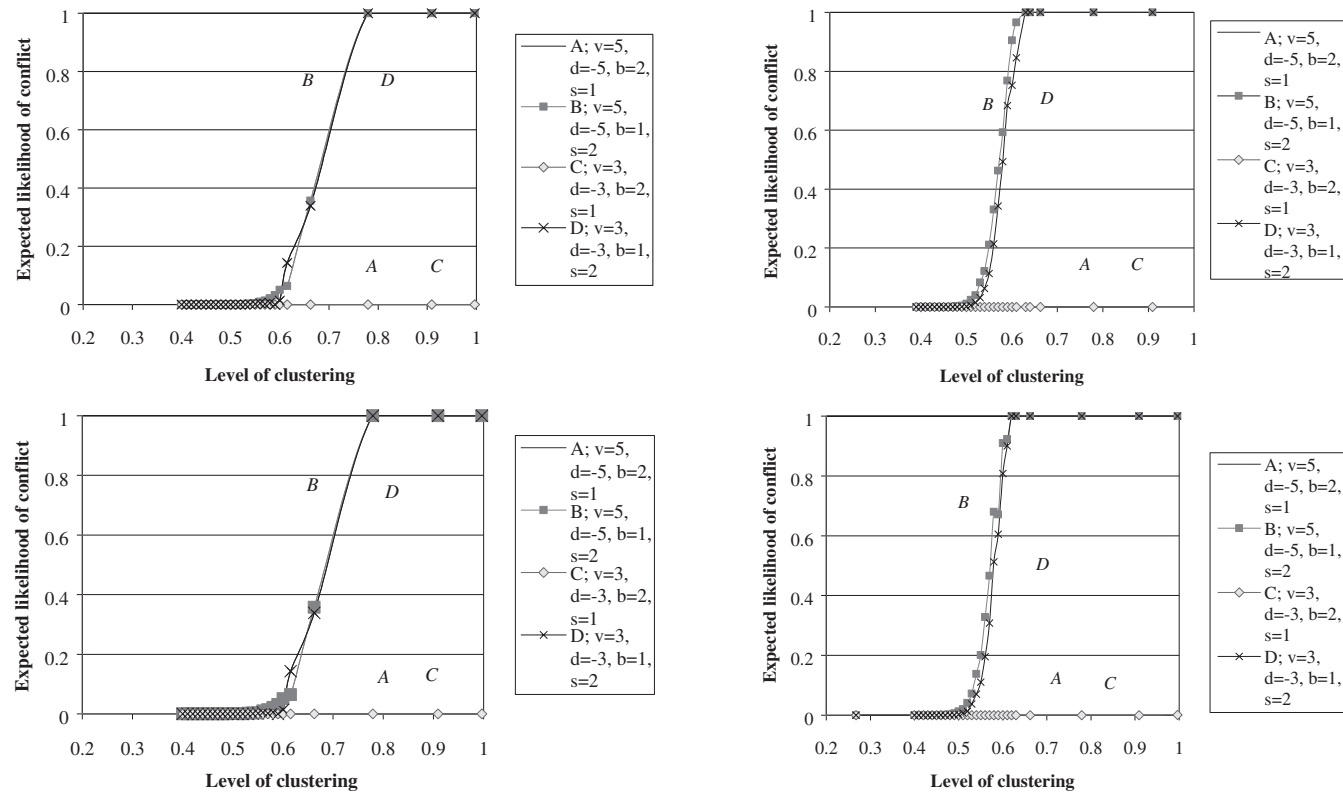
17. In model 4, we assumed both  $p_A^*$  and  $p_B^*$  to be 0.25 (cf. footnote 13). Responsibility aversion is incorporated in the decision rule in the form that if the procedure described does not result in contribution, then people are still allowed to contribute with a 25% chance.

18. In the confirmation pressure condition, contribution cannot be a dominant strategy (cf. equation [1]). In these cases, the expected likelihood of conflict is smaller. If  $b = 1$  and  $s = 2$ , then contribution is a dominant strategy for individual  $i$ , if  $g_i = 0$  and  $f_i \geq 3$ ; or if  $g_i = 1$  and  $f_i \geq 5$ . If rewards from the intergroup opposition are salient ( $v = 5, d = -5$ ), then not to contribute is a dominant strategy for individual  $i \in A$ , if  $f_i = 0$  and  $g_i \geq 3$ ; or if  $f_i = 1$  and  $g_i \geq 4$ ; or if  $f_i = 2$  and  $g_i = 6$ . For nonsalient payoffs, not to contribute is a dominant strategy for individual  $i \in A$ , if  $f_i = 0$  and  $g_i \geq 2$ ; or if  $f_i = 1$  and  $g_i \geq 3$ ; or if  $f_i = 2$  and  $g_i \geq 5$ .



**Figure 4: The Expected Likelihood of Conflict by Clustering If the Minimal Contributing Set Is 113 Members**

NOTE: Curves A and B: salient, curves C and D: nonsalient rewards of intergroup opposition. Curves A and B: confirmation pressure condition, curves C and D: normative pressure condition. Results from decision models 1 and 2 are above, and results from decision models 3 and 4 are below.



**Figure 5: The Expected Likelihood of Conflict by Clustering If the Minimal Contributing Set Is 226 Members (50% + 1)**

NOTE: Curves A and B: salient, curves C and D: nonsalient rewards of intergroup opposition. Curves A and B: confirmation pressure condition, curves C and D: normative pressure condition. Results from decision models 1 and 2 are above, and results from decision models 3 and 4 are below.

segregated network. These two processes of block recruitment result in steeper curves on the figures.

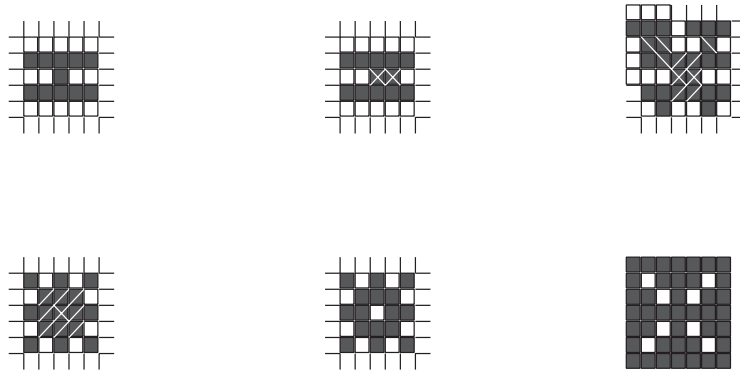
However, curves get only slightly steeper. The processes discussed above are only present in some networks. In most possible network structures, very few individuals have a dominant reply of any order. This implies that assumptions on individual consciousness and local information are not crucial to determine segregation effects on conflict. However, in the next section it will be demonstrated that, in some specific structures, more rigid assumptions about rationality definitely change predictions.

#### **ANOMALIES: WHEN SEGREGATION DOES NOT HAVE THE PREDICTED EFFECT**

In this section, I use examples to illustrate when rational consciousness and access to additional information make a significant difference for our model predictions. I also provide an explanation for the fluctuations in Figures 4 and 5. These curves are constructed by connecting discrete data points. One data point shows the expected likelihood of conflict under a given level of clustering. There is a high variation of how many network configurations belong to the same level of clustering. Furthermore, the expected likelihood of conflict might be very different for two networks with the same level of clustering. Obviously, segregation is not the only network characteristic that influences the likelihood of conflict between groups. As a short illustration, I will deal with the relevance of bridges, minority hostages, and subgrouping.

Bridges are believed to be of central importance in social network analysis (Granovetter 1973). Chain reactions in collective action also require bridges that link socially distant actors (Macy 1991a). A bridge is defined as a connection between otherwise separated units or subgroups of the network. In the intergroup context, bridges connect otherwise separated portions of the same group. The analysis here shows that bridges do not always help to spread contribution or defection and sometimes play no role in intergroup conflict. Whether bridges play a brokerage depends on the importance of social rewards, the width of the bridges, and the environment of bridging ties. The size of social rewards determines which compositions of the individual neighborhood would allow dominant strategies or replies. Consider the normative pressure condition of Figures 4 and 5 with the same parameter values. The first three network segments in Figure 6 are examples of a low level of clustering. In these segments, a single bridge, a double bridge, and a double bridge with bridgeheads (perceptors) are represented in a residential setting in which network ties are assumed to exist between Moore neighbors.

The examples demonstrate that under the given parameter conditions, a single bridge “does not make a summer” (cf. McAdam 1986; McAdam and Paulsen 1993). If mediators are not alone, at least they will be active contributors to collective action. However, they can only influence the connected subgroups if sufficient people receive their message. That is, bridges are capable of transmitting contribution incentives if they are “wide” enough and if bridgeheads are built to receive and forward these incentives. Figure 6 gives an indication of how a flow of contribution can be established



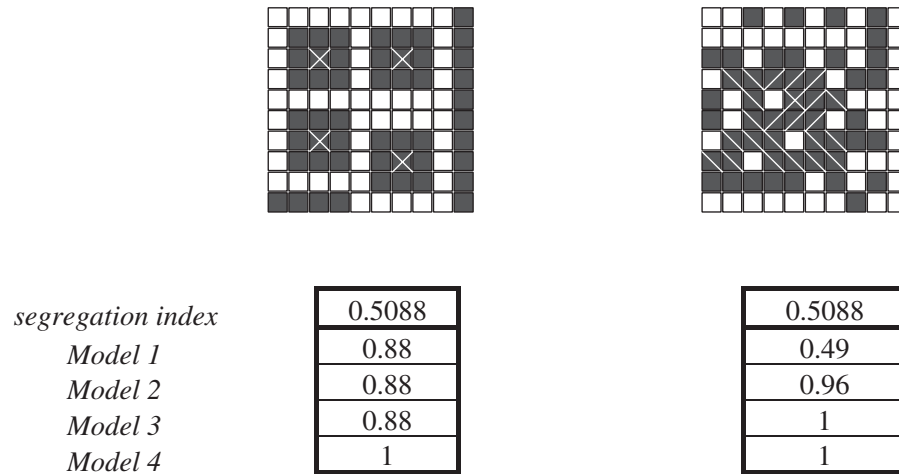
**Figure 6: Examples of a Single Bridge, a Double Bridge, and Bridgeheads (above) and Suppression of Collective Action by Minority Hostages (below)**

NOTE: A white X denotes a dominant strategy of contribution, a white / stands for a dominant reply of a first order, and a white \ indicates a dominant reply of a higher order.

between loosely structured subgroups that are connected by wide bridges and bridgeheads if the local common knowledge rule (model 3) is applied.

Another central issue in social network analysis is the role of structural holes (Burt 1992). In the intergroup context, structural holes are redefined as empty or minority connections in a local environment that is dominated by one group. Empty cells in a homogeneous neighborhood do not harm contribution or defection unless there are not many of them. In a dense structure, abandoning some ties and creating structural holes have low marginal influence on contribution, since dominant strategy and reply are more dependent on the homogeneity than on the size of the neighborhood. However, if structural holes are filled with minority “hostages,” then they form a serious threat to contribution. If they have a central location, they can nip collective action in the bud. As an example, consider the normative pressure condition with the same parameter values as in previous figures. In this case, minority hostages have a good chance to suppress collective action if they are not standing completely alone (see the network on the bottom right of Figure 6). The network on the bottom left of Figure 6 indicates a situation in which the direct influence of a single individual is maximal (all of the neighbors have a dominant reply of contribution). The feature in the middle of the second row shows that contribution is suppressed if a structural hole is inserted at a central location.

For the discussion of anomalies, I would like to emphasize another important point: the role of subgrouping. What helps intergroup collective action more: many small, cohesive, but isolated subgroups or a few large, loosely connected subgroups? The answer depends on the behavioral assumption we apply. If people can recognize only their dominant strategies or have very limited local information (model 2), then isolated but dense subgroups are more efficient in the establishment of collective action. However, if people are capable of assessing high-quality information about their neighbors (model 3), then large, loosely connected subgroups are more effective for



**Figure 7: Expected Likelihood of Conflict in Two Networks with Equal Level of Clustering**  
 NOTE: Expected likelihood of conflict is indicated for salient intergroup rewards in the normative pressure condition with a minimal contributing set of 13 members (Moore neighborhood). Left side: network with small, cohesive subgroups; right side: network with a large, loosely connected subgroup.

mobilizing group members. Individuals at the periphery of the large group can be convinced as participating in collective action. However, key contributors are always necessary to start mobilization. Two networks with an equal level of clustering are represented in Figure 7 as an example. In the network on the left, there are two small, cohesive subgroups of black cells. In the network on the right, there is a loosely connected large subgroup. The expected likelihood of conflict is larger in the left structure under model 1 but smaller under the assumptions of other behavioral models.

## DISCUSSION

The aim of this study was to construct a theoretical model of intergroup conflict that is based on the interdependency of individual decisions and that integrates sociological insight in the analysis. The latter was achieved by focusing on social incentives that influence individual decisions besides the rewards from the intergroup context. Social incentives are transmitted through social ties, and consequently the network structure has a strong impact on the emergence of group conflicts.

Previous research found that intergroup competition, the local assurance process, and the application of selective incentives are possible structural solutions to social dilemmas. By integrating these different ideas into a general model, I showed that a different social dilemma might occur in which overall contribution traps the groups in a mutually harmful outcome. Further investigation of the study concerned structural conditions that can help to avoid lethal conflicts. Particular attention was paid to the

direct and interaction effects of network segregation. Results indicate that segregation is likely to increase the likelihood of conflict, but not under all circumstances. Depending on other parameters, certain ranges of clustering are decisive in determination of the outcome of intergroup competition. This result might have implications for real conflict management, for example, residential policy. In general, the model predicts a strong positive effect of segregation if normative pressure is more important than confirmation pressure of neighbors and friends. This effect was found in all the behavioral models. It was demonstrated that, by assuming a higher consciousness of individual decisions and better access to local information, the segregation effect becomes stronger. On the other hand, more rigid assumptions about "rationality" made a difference only in certain network configurations.

Possible applications of the model include ethnic conflict in neighborhoods, villages, or cities under different residential structures; conflict between football supporters in a stadium or between pupils in a classroom under different seating patterns; or participation in voting in two-party democracies. Empirical evidence from different areas provides support for many of the model predictions. For instance, residential segregation and separate education were found to be highly responsible for repeated conflict in Northern Ireland (Whyte 1986). In studies of voting behavior, the classical work of Tingsten ([1937] 1963) has shown that socialist party choice is disproportionately more likely in working class districts. Further evidence of a nonlinearly increasing effect of segregation on voting was found by Butler and Stokes (1974) and Ragin (1986).

The model provides new insight into intergroup processes and has many important implications. On the other hand, there is valid concern about the limited applicability of the model to empirical situations. The ecological validity would be enhanced significantly if some of the parameter values could be based on empirical data. However, the measurement of payoff parameters (especially social selective incentives and behavioral confirmation) is highly problematic. Numeration of public good rewards (e.g., social identity, nationalistic pride) is also often impossible. Furthermore, the model builds on far too simple assumptions to be competent for the description of complex situations in reality. I will mention some of the limitations here. The focus on single-shot games results in a complete neglect of time. In the model, simultaneous actions of individuals are assumed, although in many empirical situations there are long-term delays, and people can obtain information about the decision of others. The introduced dominant reply and common-knowledge decision rules, however, could also be interpreted as decisions with a certain time lag. By this interpretation, the model brings new insight also to the threshold models of collective action (Granovetter 1978; Oliver, Marwell, and Teixeira 1985; Macy 1991a; Gould 1993a; Chwe 1999). More strikingly, this study did not attempt to include the history of intergroup relations, which is the root of many empirical conflict situations. The neglect of history can be relaxed in subsequent research by iterating the game over time. For instance, the effectiveness of local trigger strategies can be analyzed. Examples of such strategies are numerous in human history.

In the long run, group boundaries may also change or become less visible. Assimilation, for example, can be considered as an optimal long-run strategy to avoid the emergence of harmful conflicts between groups. Individual differences of many forms



can also be incorporated in advanced model building. Examples are the possible distinctions between leaders and followers (asymmetric neighborhood games), aggressive and peaceful players, or social and egoistic types (with different perceptions about the relations between payoff parameters). Payoff restrictions of the present model (e.g., zero reward for peace) and assumption of linear utility functions can be easily relaxed. Besides these possible developments, a major proceeding can constitute a dynamic model in which the feedback effect of conflict is incorporated on the residential structure. Despite these restrictions, the model was able to emphasize the effect of residential structure, social rewards, and individual decision procedures on the likelihood of group conflict that may help conflict resolution in empirical situations along these lines.

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# Choice of Partners in Multiple Two-Person Prisoner's Dilemma Games

## AN EXPERIMENTAL STUDY

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The effect of unilateral and mutual partner selection in the context of prisoner's dilemmas is examined. Participants played simultaneously several finitely repeated, two-person prisoner's dilemma games. Results show that unilateral choice leads to lower defection and fewer exits than mutual choice. In the unilateral-choice setup, intending defectors are more likely to exit than intending cooperators. Implications of these findings in the political context are discussed.

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**T**he central feature of the prisoner's dilemma (PD) is that each player creates and consumes externalities: the externality created is positive if the player cooperates and negative if the player defects. The crux of the standard PD is that no player can escape this externality. Although many situations that have been formalized by the PD certainly have this lock-in feature, there are also many naturally occurring situations in which escape routes arise. Tiebout (1956) pointed at the possibility of "voting with your feet" for the provision of public goods in metropolitan areas. Orbell and Dawes (1993) used university research as a metaphor for PD games with no obligation to play. Firms may choose their suppliers. The firm-supplier relationship is cooperative if firms pay on time and suppliers deliver punctually. People choose their friends. Even criminals choose their partners in crime.

In recent years, the game theoretical literature on partner selection in PD games has mushroomed (see, e.g., Ashlock et al. 1996; Ghosh and Ray (1996); Hauk forthcoming; Hayashi and Yamagashi 1998; Orbell, Schwartz-Shea, and Simmons 1984; Orbell

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and Dawes 1991, 1993; Peck 1993; Schluessler 1989; Stanley, Ashlock, and Tesfatsion 1994; Tesfatsion 1997; and Vanberg and Congelton 1992). Although these studies examine different types of partner selection mechanisms (either theoretically or with simulations), they all use mutual choice: the PD game is played between two players if and only if both players mutually agree to play the game. In this article, we additionally study unilateral choice: the PD game has to be played if at least one partner chooses to do so. Firms might be bound to their suppliers by long-lasting contracts, which can only be terminated at any (earlier) stage by mutual agreement.

In this article, we study the effect of unilateral and mutual choice of partners in finitely repeated PD games. We will compare three experimental treatments: the *lock-in* setup, that is, the classical PD game with no possibility to choose the partner; the PD game with *unilateral choice*; and the PD game with *mutual choice*. Partner choice is modeled by adding a “matching” stage to the classical PD game; in this matching stage, each player is given an exit opportunity with a sure payoff (as in Orbell, Schwartz-Shea, and Simmons 1984; Orbell and Dawes 1991, 1993; Morikawa, Orbell, and Runde 1995; Orbell, Runde, and Morikawa 1996; Hauk 1999; Mulford et al. 1998).

In the experiments, we are interested only in the situation in which the exit option yields higher payoffs than mutual defection. Hence, to remain unmatched is better than to be paired with a defector. This implies that the decision to enter or not will be critically influenced by a player’s prediction about a potential partner’s intention of how to play the PD game. Whatever one’s own intentions between cooperation and defection, it is worthwhile to enter the PD game only if the probability to encounter cooperation is high. Indeed, we observe that within-match cooperation levels (i.e., cooperation levels given a PD match) are much higher in the choice treatments than in the lock-in PD. At the same time, overall defection levels, that is, the ratio of defection levels out of all possible choices (including exit choices), are much lower in the choice setups (lowest under mutual choice).

However, overall cooperation levels are indistinguishable in the standard PD game and the unilateral-choice setup but are lower in the game with mutual choice. This shows that there might be some benefit to being locked in, in the sense that reluctant participants usually end up cooperating. But there is also some cost to being locked in: another of our experimental findings indicates that exit is more often chosen by intending defectors than by intending cooperators. Since exit is not possible in the lock-in setup, overall defection levels are highest in that setup.

Hirschman (1970), in a different context, has already pointed to the curse of exit. He contrasts exit with the costly voice option, “defined as any attempt at all to change, rather than to escape from an objectable state of affairs” (p. 30). Although Hirschman did not explicitly refer to PD situations, we can interpret voice in the present context as a costly attempt to reach cooperation.<sup>1</sup> If exit is too easy, as in our mutual-choice setup, voice is used very little. If exit is impossible, as in our lock-in PD, voice is the only way to possibly avoid mutual defection. If exit is possible but not too easy, as in our unilateral-choice PD, both exit and voice will be used. This mix between exit and voice makes

1. Voice can take different forms. For example, to start cooperation with a defecting partner for one or several periods can be interpreted as voice in the present context.

unilateral choice the most attractive system among the studied setups: persistent defectors exit, whereas voice allows some reluctant participants to learn to cooperate. In the Conclusion, we discuss this tension between lock-in and exit in political contexts.

Orbell, Schwartz-Shea, and Simmons (1984) and Orbell and Dawes (1993) already pointed out the benefit of exit and tried to test the hypothesis that intending defectors exit more frequently than intending cooperators in experiments with one-shot PD games. However, they used the mutual-choice setup, in which intentions in the PD phase cannot be observed if exit is chosen.<sup>2</sup> Orbell, Schwartz-Shea, and Simmons circumvented this problem by “turning around” the structure of the game. First, participants are asked to choose between cooperation and defection, and then they have to decide whether to enter the game. The drawback of this design is that for someone who decides to exit, the PD choice is inconsequential; participants who exit might therefore lack incentives to reveal their true intention in the PD phase. In contrast, in our unilateral-choice setup, an exit player might be forced to play the game by his partner. We observe that, in general, exit players defect 81% of the time if forced to play. Exit players who have not yet played any PD game with a particular partner defect in 75% of the cases when forced to play. Since those players have no experience with their potential game partner, we can conclude that they always intended to defect but preferred to opt out. Our unilateral-choice setup makes the true intention of some exit players observable.

Besides the new unilateral-choice setup, we also use a rather new technique of multiple plays within a period.<sup>3</sup> In each treatment, each player plays simultaneously several two-person supergames at the same time and has an the opportunity to repeat supergames. As in Hauk (1999), each player has to make separate decisions for several partners in the same period. Given the wide variety of situations that have a PD structure, it is reasonable to assume that in real life, we usually play several PD games with different partners at the same time. The following example nicely fits our setups: in many universities or schools, the same course is offered by different teachers. Some universities require coordination between the professors and, thus, they have to play a game that resembles a PD game. Some universities encourage coordination whereas others leave it to the professors to coordinate or not, in which case unilateral or mutual agreements are necessary to enter a PD game. Moreover, professors usually teach several different courses and hence play multiple simultaneous PD games with different partners. Additional games occur outside their professional sphere (e.g., with their friends and sentimental partner).

With the help of the multiple game technique, we can see whether a player is a pure defector or a pure cooperator. Most participants do implement different choices with

2. Orbell and Dawes (1993) extrapolated the number of intending defectors and cooperators when exit occurred from the number of defectors and cooperators in an experiment on the classical one-shot PD game. However, these two games differ, and a player who cooperates in one might want to defect in the other, which casts serious doubts on this method.

3. Mulford et al. (1998) also used multiple play within a period in a one-shot lock-in PD and a one-shot mutual-choice PD. However, the underlying PD matrix is not the same with different partners. In our experiment, subjects play multiple two-player games with the same underlying PD matrix.

different game partners even in the first period of a supergame, where everybody is the same *ex ante*.<sup>4</sup> Probabilistic behavior is common.

But are our results robust to the multiple game method? Could it not be that the probabilistic behavior is directly caused by the multiple games, for example, because players learn or experiment across games? When comparing our lock-in PD setup of multiple matching to single game experiments (using the data set by Andreoni and Miller [1993]), we find that there is no difference in aggregate behavior over time. This strongly suggests robustness. This is an important result, since it implies that the multiple game technique might be useful for running experiments in which probabilistic behavior might matter, for example, games with a unique mixed equilibrium. This technique would offer participants a natural way to implement probabilistic choices without having to explain the concept of probability.

The robustness of the multiple game technique is also confirmed in experiments on the dictator game by Bolton, Katok, and Zwick (1998). In their experiment, a dictator is matched with only 1 recipient or with 10 recipients. In both treatments, he has to divide the same amount of money. They find that the distributions of the total gift are statistically indistinguishable. As in our experiments, the multiple game treatment reveals probabilistic behavior: in the 10-recipient treatment, the dictator does not give the same amount to every recipient.

Ochs (1995) also used multiple game technique for  $2 \times 2$  normal games with a unique mixed equilibrium. The main difference is that his subjects played 10 simultaneous games against the same opponent within a period and then switched opponents. Playing simultaneous games with the same opponent does not make sense in the PD context, so we believe that our method is useful for more general contexts.

The remainder of the study is organized as follows. In the next section, we describe the different games that are studied experimentally. The third section states the experimental design; the fourth describes the experimental results. The final section concludes with some political implications and discusses future research.

## THE GAMES UNDER CONSIDERATION

### THE THREE SETUPS

We add two design features to the classical PD supergame. The first feature contains two ways of partner selection before a PD game is played. The second feature is that each player is matched with multiple partners at the same time and has to make separate decisions for each partner. Thus, we study behavior in series of finitely repeated two-person PD supergames with multiple partners with or without prepartner selection.

4. In Mulford et al. (1998), different opponents are never identical *ex ante*: participants get to see their opponent and are supposed to evaluate his or her physical attractiveness. Mulford et al. examined the effect of physical attractiveness on players' decisions whether to enter the PD game and how to play it.



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	<i>cooperate</i>	<i>defect</i>
<i>cooperate</i>	5	7
	5	-6
<i>defect</i>	-6	-1
	7	-1

### Prisoner's Dilemma

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**Figure 1: Prisoner's Dilemma Matrix**

In the two prepartner selection setups, every period consists of at most two phases: in the first phase, a player has to decide separately for each potential partner whether he or she wishes to enter to play a PD game or exit. In the potential second phase, the PD game is played. All in all, we distinguish three setups:

1. *Lock-in*: PD game without a prepartner selection phase.
2. *Unilateral-choice*: PD game with a prepartner selection phase such that if at least one of the two potential partners agrees to enter, they go to the second phase and play a PD game. If both exit, the game ends.
3. *Mutual-choice*: PD game with a prepartner selection phase such that if two potential partners mutually agree to enter, they go to the second phase and play a PD game. In the other cases, they do not enter the second phase and the game ends.

We will sometimes refer to setups 2 and 3 as "selection setups." A single game setup (each player has only one partner within a finitely repeated two-person PD game) will serve as our control experiment. This setup is taken from Andreoni and Miller (1993).

#### THE PAYOFF MATRICES

In all setups, the same two-person PD game with the bimatrix of the one-shot game (see Figure 1) is implemented.<sup>5</sup>

The difference between the two selection setups is illustrated in Figure 2. The bimatrices present the reduced normal forms of the one-shot game of the unilateral-

5. During the experiment, defection was coded by *a* and cooperation by *b*.

	<i>entry</i>	<i>exit</i>		<i>entry</i>	<i>exit</i>
<i>entry</i>	<i>PD</i>		<i>entry</i>	<i>PD</i>	0
<i>exit</i>	<i>PD</i>	0	<i>exit</i>	0	0
	unilateral choice			mutual choice	

**Figure 2: Payoff Matrices in Unilateral- and Mutual-Choice Prisoner's Dilemma (PD) Games**

choice PD and of the mutual-choice PD. When *PD* appears in a cell of the matrices, it means that the PD game is played and the payoffs depend on the decisions in that game. If there is no second phase, then both players get the outside-option payoff of 0, which is higher than the payoff of mutual defection in the second phase. The 0 payoff is chosen because we know from prospect theory that it serves as a status quo from which people evaluate their gains and losses and does not affect the evaluation of their final wealth.

#### GAME THEORETIC ANALYSIS

##### The Finitely Repeated PD Supergame

In the finitely repeated PD game, there is only one Nash equilibrium in which both players choose their strictly dominant strategy: defection in every period.

##### The Finitely Repeated Unilateral-Choice PD Supergame

In the unilateral-choice PD, a player can force the potential partner to enter the PD phase but he or she can also be forced to play the PD game. In this setup, if a player enters, the other player's participation constraint becomes irrelevant, resulting in several Nash equilibria in the one-shot game, two of which are subgame perfect, namely,

1. both players exit and defect in the unreached game, and
2. both players enter and defect.

Both equilibria are subgame perfect equilibria of the finitely repeated-choice PD. Additional equilibria exist, some of which can sustain cooperation. In particular, in a 10-period supergame, mutual cooperation until period 7 (inclusive) followed by

mutual exit (and defect in the unreached game) until the end of the supergame can be sustained by the following out-of-equilibrium belief: defection in the cooperative phase is going to be punished by entering and defecting forever.

### **The Finitely Repeated Mutual-Choice PD Supergame**

In the mutual-choice PD, players are able to avoid unwanted matches and obtain a secure payoff of 0. If one player chooses the outside option, the other player's participation decision becomes irrelevant. Hence, even the one-shot game has several Nash equilibria. These equilibria are characterized by at least one player's opting out (and, if the player's strategy is subgame perfect, by the intention to defect in the unreached game). Given that these multiple equilibria of the one-shot game all have the same outcome (outside option), the subgame perfect equilibria (SPE) of the finitely repeated game also lead to the outside option outcome.

## **EXPERIMENTAL DESIGN**

Participants were recruited via notice board from the 1st-year undergraduate student population of the economics, business, and humanity faculties of Universitat Pompeu Fabra in Barcelona, Spain. Every student participated in only one session. The students met in the experimental laboratory LEEEX. The experiment was computerized. Written instructions were read aloud always by the same person (see the appendix). For the different experimental setups, the wording of the instructions was identical except for the minimal necessary changes due to design differences.

For each of the three setups, lock-in PD, unilateral-choice PD, and mutual-choice PD, three sessions were run. The experiments were run over two different time periods lasting 2 weeks each. The time gap between these periods was 9 months.<sup>6</sup> In the first period, the data for all three mutual-choice setups and for two sessions of the lock-in setup were collected, whereas the data for one lock-in setup and all three unilateral-choice setups were collected in the second time period. In each time period, experimental sessions that belonged to different conditions were randomly ordered.<sup>7</sup> Every session consisted of 7 participants. In every period, each player had 6 partners. This means that in every period, each subject played six simultaneous two-person games. Participants made their choices period-by-period and for each of the six simultaneous two-person games separately. A supergame lasted 10 periods. In total, every player played 6 partners  $\times$  10 periods  $\times$  10 supergames. Within a supergame, each participant was identified by a player number between 1 and 7 and was introduced by that number to each of his or her partners. In each subsequent supergame, the computer randomly

6. This gap was due to a lack of funding for running more experiments in the first time period. There was no major economic change in these 9 months. Hence, participants' attitudes toward experimental pay-offs should not have been affected by this break.

7. In the same time period, other experimental setups were run that are reported in a companion article (Hauk 1999), and the order among all these different experimental conditions was random. The data of our lock-in PD and mutual-choice PD is shared with Hauk (1999).

reassigned participants' identities. This way, a player received information about a particular partner for every period within the same supergame, but without knowing what that partner had done in previous supergames against him or her.

After each period, each player was informed about his or her payoff and partner's payoff for each match and also about his or her partner's choice if the PD game was played. Information about the prepartner selection phase was reduced to whether the second phase was entered, but no explicit information about the partner's decision in the first phase was given. The entire history of past play was available to participants at any point in time.

#### PAYMENT

The following payment rules were used for all experimental sessions and setups: participants were given a starting capital of 1,000 pesetas to ensure them against bankruptcy since some of the payoffs in the PD game were negative. Each player was additionally paid what he or she earned in two randomly chosen<sup>8</sup> supergames ( $2 \times 6 \times 10$  interactions). Each point of the matrices was converted into 15 pesetas. This kind of payment seemed sensible since each player participated in a total of  $6 \times 10 \times 10 = 600$  interactions. To pay each single interaction would have required 1 point to be converted into 1 peseta to equate the average payoff of 1,500 pesetas an hour. We believe that this small conversion rate would not have given participants sufficient incentive to take every single decision seriously. All participants were paid privately.

#### CONTROL EXPERIMENT

The single game control experiment is taken from Andreoni and Miller (1993). We use their data of the so-called partners condition: in this setup, 14 participants were randomly paired to play a 10-period repeated PD game with their partner.<sup>9</sup> They were then randomly rematched for a total of 20 ten-period games. The information structure of Andreoni and Miller was essentially the same as for our lock-in PD setup. Since our sessions lasted for 10 supergames, we use only the data of their first 10 supergames. We will refer to the control setup as A&M.

### RESULTS

In the present experiments, we compare setups in which playing the PD game can be avoided (unilateral- and mutual-choice PD) with a setup in which the PD game has to be played (lock-in PD). How much cooperation or defection occurs can be measured in two ways: the number of cooperative (defective) choices out of all possible choices (including exit) or in PD games that are actually played. We will refer to these two dif-

8. Each student drew a number from each of two urns, which contained supergames 1 through 5 and 6 through 10, respectively.

9. The following payoff matrix was used: payoffs 7, 7 for  $c, c$ ; 0, 12 for  $c, d$ ; and 4, 4 for  $d, d$ .

TABLE 1  
Summary Data of Cooperation, Defection, and No Match  
in All Treatments (in percentages)

	<i>Cooperation</i>	<i>Defection</i>	<i>No Match</i>
Overall (including exit)			
A&M	37.71	62.29	—
Lock-in	35.56	64.44	—
Unilateral	38.44	25.02	35.67
Mutual	26.33	19.96	53.7
Within match			
Unilateral	60.43	39.57	
Mutual	53.97	46.03	

NOTE: A&M is the control setup taken from Andreoni and Miller (1993). In A&M and in the lock-in treatment, overall and within-match percentages coincide.

ferent measures as *overall* and *within-match* cooperation (defection) levels, respectively.<sup>10</sup> Overall cooperation (defection) levels are interesting if we want to study the total amount of cooperation (defection) that arises in the population, whereas within-match cooperation (defection) levels tell us how much cooperation (defection) is chosen within those PD games that are actually played.

Table 1 reports within-match and overall cooperation levels, defection levels, and the proportion of cases in which no match occurred for the lock-in PD, the unilateral-choice PD, the mutual-choice PD, and our control setup A&M. The data are aggregated over all participants, periods, and sessions within each treatment. Table 1 therefore gives a first impression of the different outcomes in the no-choice (lock-in), unilateral-choice, and mutual-choice treatments.

This first impression can be stated as follows:

*Observation 1:* Cooperation and defection levels in our lock-in setup with multiple games are similar to the lock-in setup with a single game (A&M) taken from Andreoni and Miller (1993).

*Observation 2:* (Overall) defection levels are much higher in the lock-in treatment than under partner choice.

*Observation 3:* Within-match cooperation (defection) levels are lower (higher) in the lock-in PD than in the selection setups.

However,

*Observation 4:* Overall cooperation levels are lower if choice is mutual than under unilateral choice or no choice (lock-in).

*Observation 5:* There are more people who remain unmatched under mutual choice than under unilateral choice.

10. In the lock-in PD and in A&M (the control setup taken from Andreoni and Miller 1993), these two measures coincide since exit is not possible.

TABLE 2  
Per-Session Aggregates of Overall Defection Levels

	<i>Lock-in Sessions</i>				<i>Unilateral Sessions</i>			<i>Mutual Sessions</i>		
	<i>1</i>	<i>2</i>	<i>3</i>	<i>A&amp;M</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>1</i>	<i>2</i>	<i>3</i>
Overall defection	50.67	67.33	75.29	62.29	22.88	19.26	35.52	22.64	17.33	19.9
Overall cooperation	49.31	32.67	24.71	37.71	37.40	38.45	39.45	30.88	11.20	36.9
No match					39.71	42.29	25.02	46.48	71.47	43.2
Within-match cooperation	49.31	32.67	24.71	37.71	62.05	66.63	52.62	57.7	39.26	64.96

NOTE: A&M is the control setup taken from Andreoni and Miller (1993).

Observation 1 will be confirmed graphically (see Figures 3a, 4, and 5). For observations 2, 3, 4, and 5, the Wilcoxon-Mann-Whitney test is performed. For the Wilcoxon-Mann-Whitney test, we have three observations (sessions) for each of the choice setups and four observations (sessions) for the lock-in PD. The latter includes the Andreoni-Miller (1993) data since it is very similar to our lock-in data (observation 1). Table 2 provides the underlying per session aggregates for the test statistics. We will always use the null hypothesis that the two setups under comparison are equal.

For observation 2, we will use as the alternative hypothesis that overall defection levels in the selection setups are lower. The  $p$  value for getting the observed results given the null hypothesis of equal defection levels between unilateral choice and lock-in and mutual choice and lock-in is  $p = .0286$  in both cases.

For observation 3, we will use as the alternative hypothesis that within-match cooperation levels in the selection setups are higher than under lock-in. The Wilcoxon-Mann-Whitney test leads to a  $p$  value of  $p = .0286$  when comparing the unilateral-choice PD and the lock-in PD and a  $p$  value of  $p = .0571$  for the comparison of the mutual-choice setup and the lock-in PD setup. A comparison between the unilateral-choice and the mutual-choice PD leads to  $p = .35$ .

For observation 4, the Wilcoxon-Mann-Whitney test leads to  $p = .3143$  for a comparison of the lock-in PD and the unilateral-choice PD. In contrast, the overall cooperation levels in the mutual-choice setup are lower: the Wilcoxon-Mann-Whitney test leads to a  $p$  value of  $p = .2$  for a comparison of the lock-in PD and the mutual-choice PD and to  $p = .05$  for a comparison between the two preselection setups.

Observation 5 requires a comparison of the selection setups only. Given the null hypothesis of equal no-match outcomes, the  $p$  value is  $p = .05$ .

Observation 5 is not surprising. In the mutual-choice PD, a no-match situation arises as long as at least one of the potential game partners decides to opt out. Under unilateral choice, no match requires both potential partners to agree not to play the game. Therefore, it is easy to understand why no-match situations are less frequent under unilateral choice. Observations 2, 3, and 4 are more surprising and linked to the reasons why exit occurs. To understand why mutual choice reduces overall cooperation levels compared to the no-choice situation whereas within-match cooperation is

much higher, we have to examine the data in more detail, looking at individual behavior and behavior over time.

### BEHAVIOR OVER TIME

Figure 3 shows the relative frequencies of overall cooperation, defection, and no match in each of the 100 periods separately for each treatment. The vertical dividing lines in each part of the figure separate one supergame from the other. Figure 3a presents the relative frequency of cooperation of our lock-in PD and of the A&M PD setup. Figures 3b and c show the relative frequencies of overall cooperation (gray area), defection (white area), and no matches (dotted area) for the mutual- and unilateral-choice PD, respectively.

Figure 3 nicely illustrates observations 2, 4, and 5. The dotted area (no matches) in Figure 3c is considerably bigger than in Figure 3b. The gray areas representing overall cooperation frequencies are very similar in Figure 3a (lock-in PD) and Figure 3b (unilateral-choice PD) in the first supergames and in the last supergames; these gray areas are hill shaped, and their peak increases slightly from supergame to supergame. In contrast, although overall cooperation frequencies are also hill shaped in Figure 3c, the peak hardly changes, and overall cooperation levels are rather constant from supergame to supergame. In the mutual-choice setup, participants do not manage to increase overall cooperation over time.

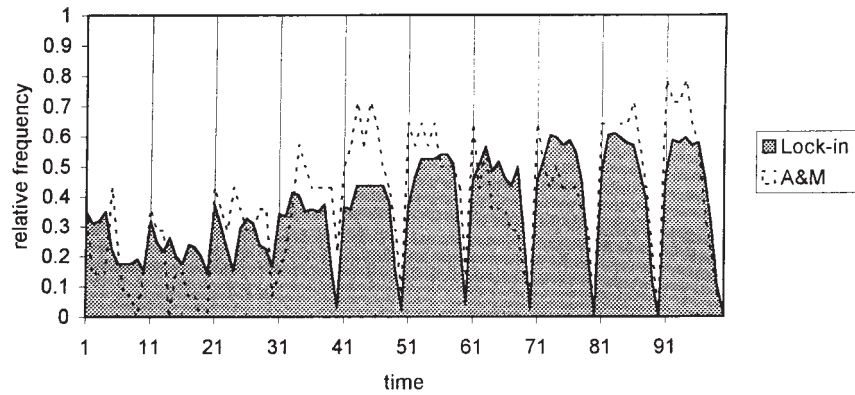
*Hypothesis 1:* There can be some benefit to being locked in, as some reluctant participants learn to cooperate.

Hypothesis 1 suggests an explanation for the difference in overall cooperation levels. The lock-in setup and the unilateral-choice setup share the feature that there are some players who have to play the PD game against their wishes. Locking participants into the game entails the possibility that participants learn to cooperate who would not have interacted otherwise. Some participants choose exit over voice too early, which leads to a no-match situation under mutual choice. These early quits can be avoided in the unilateral-choice setup if the potential partner chooses to enter the game.

In our selection setups, no-match situations are reversible from period to period. Players can repent later on and try to choose voice again. This is hardly possible under mutual choice, since both players would have to repent simultaneously, but it is very easy under unilateral choice. Unilaterally choosing to play again after some no-match period(s) and cooperating in the PD phase can be a strong signal for changed intentions.<sup>11</sup> It might therefore be the case that the higher overall cooperation levels under unilateral choice compared to mutual choice are really the result of reestablishment attempts and not of being locked in. However, reestablishment attempts under unilateral choice were rare: the probability that a no-match period is followed by another no-match period was 0.82. In total, there were only 328 reestablishment attempts. Moreover, only 29% were cooperative, and only 22 (6.7%) of these attempts were suc-

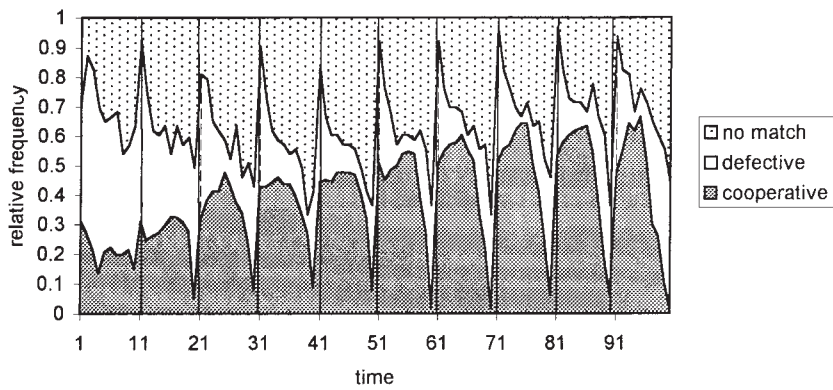
11. We are grateful to an anonymous referee for pointing this out.



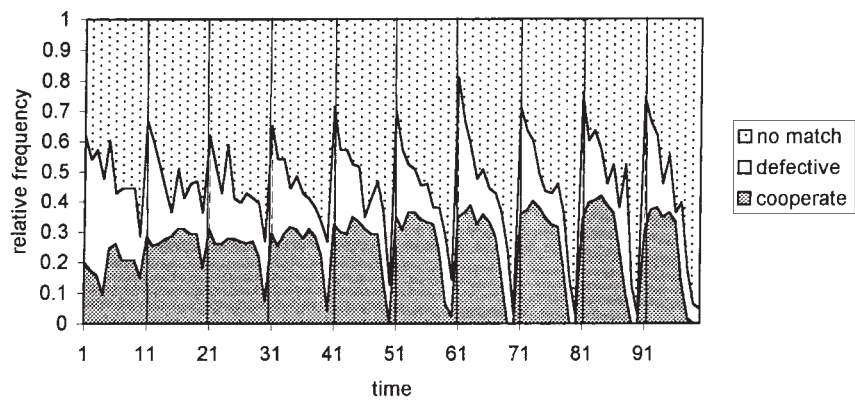


**Figure 3a: Lock-in and A&M, Pooled over All Sessions (relative frequencies of cooperation)**

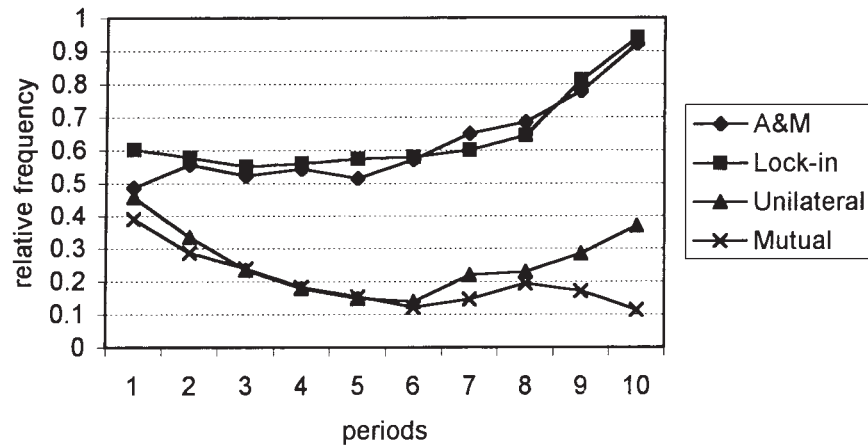
NOTE: A&M is the control setup taken from Andreoni and Miller (1993).



**Figure 3b: Unilateral Choice, Pooled over All Sessions**



**Figure 3c: Mutual Choice, Pooled over All Sessions**



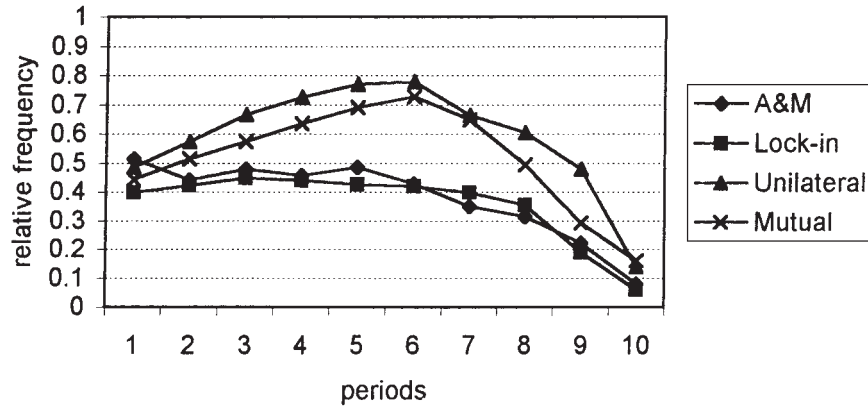
**Figure 4: Overall Relative Frequency of Defection per Period, Pooled over All Supergames**

NOTE: A&M is the control setup taken from Andreoni and Miller (1993).

cessful (leading to mutual cooperation). Moreover, in 6 (27%) of these successes, the potential game partners had not played a single PD game among themselves in an earlier period of the supergame; in 13 (60%) of these successes, the no-match period(s) was provoked by initial miscoordination (alternative play of cooperate/defect and defect/cooperate), whereas in only 3 (13%) of these successes was the no-match period(s) preceded by mutual defection. This very small increase in overall cooperation levels due to reestablishment attempts favors hypothesis 1, which, moreover, is consistent with similar overall cooperation levels of lock-in and unilateral choice, whereas the reestablishment theory cannot explain this similarity between lock-in and unilateral choice. Hence, if exit is too easy, voice is foregone too early.

However, exit also has beneficial effects by reducing overall defection levels. The areas representing overall defection levels in each period (white areas) are much bigger in the lock-in treatment (and in A&M) than in the choice treatments. Moreover, overall defection levels are very similar in the selection setups. This is better seen in Figure 4, which shows overall defection levels per period averaged over all supergames.

The difference in defection levels between the lock-in and selection treatments is smallest in the first period and increases over time. In the selection setups, overall defection levels consistently drop until period 6, whereas they stay rather constant in the lock-in setups. In periods 7 and 8, overall defection levels slightly increase in all setups. This increase is accelerated in the final periods in the lock-in treatments and also continues at a lower speed under unilateral choice. In contrast, under mutual choice, overall defection levels drop. The change in overall defection levels from period 7 to 10 is easily explained by so-called end-effect behavior. In the final periods, players who previously cooperated stop cooperation because they know that the supergame ends (end effect). In the lock-in treatment, the only possible end-effect behavior is to defect. In the choice treatments, players can additionally choose not to



**Figure 5: Relative Frequency of Cooperation per Period within a Match, Pooled over All Supergames**

NOTE: A&M is the control setup taken from Andreoni and Miller (1993).

play. Therefore, it is not surprising that overall defection levels are much higher in lock-in treatments during the end-effect periods. Overall defection levels are higher during the last periods in the unilateral-choice PD than in the mutual-choice PD since it is easier to stop playing under mutual choice. What remains to be explained is why overall defection levels in the lock-in setups and selection setups drift apart.

*Hypothesis 2:* Partner selection reduces defection levels because

1. Participants do not want to play with defectors.
2. (Intending) defectors themselves are more likely to exit than (intending) cooperators.

Part 1 of hypothesis 2 is confirmed by what participants actually do within a match. Figure 5 shows the within-match average cooperation levels per period within a supergame, aggregated over all supergames for each treatment, separately.

Although, in the lock-in PD, within-match cooperation rates are rather stable until period 8, within-match cooperation levels in the preselection setups are hill shaped, increasing to 80% in periods 5 and 6. Given that overall cooperation levels in the unilateral-choice PD and in the lock-in PD are very similar, this steep increase in within-match cooperation levels in the unilateral-choice PD seems to be because participants opt out if cooperation cannot be established after the opening periods of a supergame, whereas, in the lock-in PD, they defect. Indeed, in the unilateral-choice PD, a player who experiences mutual defection exits with probability 0.68. Cooperation against a defector provokes an exit rate of 48%, whereas defection against a cooperator provokes an exit rate of 49%. After mutual cooperation, the exit rate is only 2%.

These transition probabilities indicate clearly that exit is caused by an expectation of defection in the PD game, as was suggested by Orbell and Dawes (1993). However, Orbell and Dawes examined only the one-shot context with mutual choice in which a player's exit decision could not be conditioned on his personal experience with a spe-

cific game partner and the causes for exit could not be observed. Orbell and Dawes argued that people project their intentions onto others and believe that their opponent will play the PD game as they do. This theory implies that intending defectors are more likely to exit than intending cooperators, as we also postulate in part 2 of hypothesis 2. Whereas Orbell and Dawes had to speculate how the PD game would have been played in case of exit, our unilateral-choice setup allows us to observe some PD choices of an “exit” player directly, since this player might be forced to play the PD game because only one “entry” player is needed for a match. We observe that 81% of the exit players defect when they are forced to play. After an “in” choice, on the other hand, only 24% defect.

The observation that people defect more when forced to play against their will does not tell us why people defect if forced to play. There are three possible histories of play that might lead to a player’s desire not to match: (1) players defected earlier on and either met a cooperator and now fear his retaliation or met a defector and want to avoid the bad outcome of mutual defection, (2) players cooperated against a defector and opted out to avoid continued exploitation, and (3) players have not interacted with this opponent before.<sup>12</sup> Only players who opt out because of (1) and players in (3) who are forced to play and defect should be labeled as intending defectors. The probability to opt out if one has defected in the previous period (regardless of what the other does) is 0.76 whereas cooperators who met a defector in the previous period opt out only with a probability of 0.48 (as mentioned above). Hence, exit is more likely for players who belong to category (1) than (2). Separating the observations of participants belonging to (3) allows us to observe players’ initial intentions that are not influenced by the individual history of play. Seventy-five percent of exit players belonging to (3) defect when they are forced to play and are therefore true intending defectors. Hence, intending defectors are more likely to opt out than intending cooperators. Hypothesis 2 is corroborated and explains why we observe lower defection levels in selection setups. Participants choose no match as an alternative to defection. This can also be seen in Figure 3 when comparing the lock-in setup with unilateral choice; the sum of no match and defection in the unilateral-choice treatments is similar to defection in the lock-in PD treatment.

#### FIRST-PERIOD BEHAVIOR

A further advantage of our experimental design is that participants play multiple games. The multiple-game technique reveals more about the true intention of each participant than standard, single game setups: the experimenter receives more information in each time period, and participants can transmit probabilistic choices. Probabilistic behavior is observed if a participant does not use the same strategy in the same period with identical game partners (same history of play). Although it is very likely that the history of play evolves differently with distinct partners, in the first period of each supergame all game partners are identical. To get a better understanding of participants’ true intentions, we therefore examine first-period behavior.

12. For this case we have 295 observations.

The multiple-game technique allows us to examine whether initial intentions of a player are pure, that is, whether he or she always chooses the same actions in the selection stage and in the PD stage against all game partners or whether he or she mixes, that is, enters only some of the six possible matches or sometimes defects and sometimes cooperates. As in Hauk (1999), we observe

*Observation 6:* First-period behavior is very heterogeneous within a participant and across participants: mixed types are very common.

In the lock-in PD, 43% of the players mix, 38% always defect, and 19% always cooperate. In the unilateral-choice setup, 65% of the participants mix in at least one of the stages of the game. Sixty-three percent of the participants mix in the selection stage, and 39% mix in the PD stage. Under mutual choice, 71% of the participants mix in at least one of the stages of the game: 30% mix in the selection stage and 47% in the PD stage.

Probabilistic behavior might be a way to balance the possible negative payoffs from cooperating against a defector with the high positive payoff from defecting against a cooperator. At the same time, at least some cooperative signals are sent that might lead to a stable cooperative behavior.

#### ROBUSTNESS OF THE MULTIPLE-GAME TECHNIQUE

Hauk (1999) has already shown that mixing behavior is not due to learning or experimentation, since it does not disappear with more experience. To be sure that our observations on probabilistic behavior are not caused by the multiple game setup, we check the robustness of our results by comparing them with a single game setup.

*Observation 7:* The multiple-game technique is robust.

1. There is no significant difference in aggregate behavior over time between our control experiment (Andreoni and Miller 1993) and the PD setup (observation 1). This is immediately seen in Figures 3a, 4, and 5.
2. All treatments share the typical characteristics of finitely repeated single game PDs as studied in Selten and Stoecker (1986):
  - a. cooperation levels increase from supergame to supergame, and
  - b. defection and/or no match increase in the last period(s) from supergame to supergame (end effect).

Table 3 provides a simple measure for these two observations in our data sets by showing the average overall cooperation levels in each period within the first five supergames and within the last five supergames, for each treatment separately.

We compare behavior of the first 5 supergames with those in the last 5 supergames. The cooperation levels up to period 5 of supergames 6 through 10 is higher than in the same periods of the first 5 supergames in all the nine sessions (significant at a 2% level; for periods 6 and 7 it is still significant on a 10% level, using a binominal test). Thus, players have to learn to cooperate. On the other hand, cooperation levels in period 9 (seven out of nine sessions, significant at the 10% level) and period 10 (in all nine ses-

TABLE 3  
Overall Cooperation Levels within Each Period across Supergames

Period	<i>A&amp;M Supergames</i>			<i>Lock-in Supergames</i>			<i>Mutual-Choice Supergames</i>			<i>Unilateral-Choice Supergames</i>		
	<i>1-5</i>	<i>6-10</i>	<i>All</i>	<i>1-5</i>	<i>6-10</i>	<i>All</i>	<i>1-5</i>	<i>6-10</i>	<i>All</i>	<i>1-5</i>	<i>6-10</i>	<i>All</i>
1	.36	<b>.67</b>	.51	.35	<b>.44</b>	.40	.28	<b>.34</b>	.31	.36	<b>.51</b>	.43
2	.31	<b>.57</b>	.44	.31	<b>.54</b>	.42	.25	<b>.38</b>	.32	.36	<b>.54</b>	.45
3	.36	<b>.60</b>	.48	.32	<b>.58</b>	.45	.25	<b>.39</b>	.32	.36	<b>.57</b>	.47
4	.34	<b>.57</b>	.46	.32	<b>.56</b>	.44	.26	<b>.39</b>	.33	.35	<b>.59</b>	.47
5	.43	<b>.54</b>	.49	.30	<b>.55</b>	.43	.29	<b>.38</b>	.34	.38	<b>.62</b>	.50
6	.34	<b>.51</b>	.43	.29	<b>.55</b>	.42	.29	<b>.34</b>	.32	.38	<b>.58</b>	.48
7	.27	<b>.43</b>	.35	.30	<b>.50</b>	.40	<b>.28</b>	.26	.27	.35	<b>.48</b>	.42
8	.27	<b>.36</b>	.31	.28	<b>.43</b>	.35	<b>.27</b>	.14	.20	.32	<b>.36</b>	.34
9	.21	<b>.23</b>	.22	.19	<b>.19</b>	.19	<b>.22</b>	.01	.12	<b>.26</b>	.21	.24
10	<b>.10</b>	.06	.08	<b>.10</b>	.02	.06	<b>.09</b>	.00	.05	<b>.09</b>	.03	.06
Average	.30	.45	.38	.28	.43	.36	.25	.26	.26	.32	.45	.38

NOTE: A&M is the control setup taken from Andreoni and Miller (1993). Numbers in boldface indicate higher cooperation levels when comparing supergames 1 through 5 with supergames 6 through 10.

sions) are lower in the later supergames than in the first supergames, which shows that players learn the end effect: to defect or not to match.<sup>13</sup>

The robustness of the multiple-game technique was also found by Bolton, Katok, and Zwick (1998), who observed that in dictator games pooled over all subjects, the same average fraction is given to a single receiver as when faced with several receivers. As in our experiments, however, the behavior of a participant in the multiple receiver case can be very heterogeneous.<sup>14</sup>

## CONCLUSION

The results of the present experiments show both the blessing and the curse of exit: on one hand, intending defectors are more prone to choose the exit option, which leads to lower overall defection levels; on the other hand, lock-in can be beneficial since many reluctant participants end up cooperating if they are forced to play sufficiently long. Using Hirschman's (1970) terminology, if exit is too easy, as in our mutual-choice setup, voice is used very little. If exit is impossible, as in our lock-in PD, voice is the only way to possibly avoid mutual defection. If exit is possible but not too easy, as

13. Selten and Stoecker (1986) used a more sophisticated method to show that players learn to play the end effect. They examined each participant's choice in the final periods and observed that for each player, both the actual and intended end-effect periods moved to earlier periods over supergames. Selten and Stoecker introduced a directional learning model, which has been applied in many subsequent studies, for example, Nagel (1995), Nagel and Tang (1998), and Selten and Buchta (1998). Here, we use only an aggregate measure that we believe to be sufficient to show the similarity of our results to Selten and Stoecker's.

14. About half of the population gives sometimes more and sometimes less to the single receivers they face. The other half never give anything.

in our unilateral-choice PD, both exit and voice will be used. This mix between exit and voice makes unilateral choice the most attractive system among the studied setups: persistent defectors exit, whereas voice allows some reluctant participants to learn to cooperate. Indeed, average per subject payoffs were 2,501 pesetas under lock-in, 3,023 pesetas under mutual choice, and 3,875 pesetas under unilateral choice.<sup>15</sup>

Unilateral choice is equivalent to some long-term contracts that can only be terminated by mutual agreement, whereas mutual choice models a contractual situation in which one-sided exit is possible. Our experimental findings suggest that the former contractual form is superior, leading to more long-lasting cooperative relationships and consequently higher payoffs. On the other hand, contracts that can be terminated unilaterally at an earlier stage (mutual choice) are superior to long-term contracts that have to be continued no matter what.

Although our experiments are one-to-one situations, our results are consistent with the following one-to-many situation analyzed by Hirschman (1993) and Colomer (2000): they describe the behavior of citizens under a government in conflict with a neighbor state. Hirschman (1993) looked at the two Germanys during the period from 1949 to 1990, whereas Colomer (2000) studied the Cuban and the U.S. governments since 1959. If an authoritarian government chooses to close its borders unilaterally to preclude permitting its citizens' choosing under which government to live (as the East German and Cuban governments did), it can reduce the number of people choosing exit, that is, emigrating to the neighboring country. But it can also increase the level of cooperation with the government: in both lock-in and unilateral closing of borders, some people adapt and learn to cooperate with the government. In contrast, with mutually open borders, the level of exit is higher and cooperation is lower.

Our experimental findings can also guide the organizers of collective actions: exit has to be possible to exclude permanent defectors, but exit should not be too easy in order not to reduce overall cooperation levels. The exit possibility should be designed in such a way that people conceive it as a complement and not as a substitute to voice. It might be interesting to look at different variations of unilateral choice in  $n$ -player PD games by introducing a minimum number  $m$  of exit players necessary for exit to be effective and to try to find, for different  $ns$ , the  $m$  that makes overall cooperation levels highest and overall defection levels lowest.

Another direction for future research might be to study our unilateral-choice setup in the one-shot game since it allows for the study of players' intentions in the PD game when they choose the outside option by examining their behavior in undesired matches. In the one-shot game, players' exit decisions are not caused by past experience, and it is therefore the natural environment to study whether people tend to project their own intentions onto others (false consensus idea) as suggested by Orbell, Schwartz-Shea, and Simmons (1984) and Orbell and Dawes (1993). By studying the mutual-choice setup, these studies could not directly observe players' intentions when no match occurred. Studying the unilateral-choice setup would correct for this shortcoming and allow a better understanding of whether the false consensus idea is valid. If

15. This is the expected payoff of a participant at the end of the experiment, before the random draw of two supergames that are actually paid.



it were valid, moderate cooperators, that is, players who cooperate sometimes but not always, would have an evolutionary advantage even in the one-shot game with exit.<sup>16</sup>

Prepartner selection might be a reason why cooperation levels in real-world PD are surprisingly high. Nevertheless, it cannot be the only reason, since experimental participants also learn to cooperate when they are forced to play, as has been shown in many experiments on the finitely repeated PD game. From a theoretical point of view, no cooperation should arise in the lock-in PD unless players expect to meet an altruistic or irrational opponent. Kreps et al. (1982) have shown that if there is a small chance to meet an irrational or altruistic player (a cooperator), it might be in a player's interest to cooperate during several periods. In that case, cooperation would be rational. Thanks to the use of the multiple game technique, we have found that most experimental participants behave probabilistically. Once some cooperation is observed, it is indeed rational to cooperate. Participants' initial probabilistic behavior might therefore explain cooperation in the finitely repeated PD game.

The multiple-game technique was an important tool in our analysis, and we expect it to be an important tool in future experiments, since it seems to be a reliable way to capture probabilistic behavior. At least in the present experiments, aggregate behavior in the multiple-game setup was indistinguishable from the behavior in a single game setup. This means that our results are insensitive to the use of multiple games. If this is true in general, the multiple-game technique will be an important tool for testing if experimental participants play mixed equilibria.

16. See Orbell and Dawes (1991), Orbell, Runde, and Morikawa (1996), and Morikawa, Orbell, and Runde (1995).

## APPENDIX

### Instructions

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#### INTRODUCTION

You are about to participate in an experiment about decision making. The instructions are simple, and, if you follow them carefully, you will be able to earn a considerable amount of money. You will be given some starting capital of 1,000 pesetas, which you can increase or reduce depending on your activity. Should you go bankrupt, you will earn nothing and, of course, you will have to pay nothing.

#### DURATION AND SETUP OF A SESSION

##### A Session

- A session consists of 10 periods.
- Each session involves 7 participants.
- In a session, every participant will be identified by a number from 1 to 7 that is randomly chosen.
- You will keep this identity for the 10 periods of the entire session.

## Decisions

In each period, you are asked to make two decisions:

1. Your first decision is with which of the other participants you would like to interact in a two-person decision problem. This can be done with 0 to maximally 6 participants. Everybody will make this decision simultaneously.  
After everybody has made the first decision, you will be told with whom you are matched. A match occurs between 2 people if both have chosen to interact with each other. Thus, you can have 0 to 6 matches.
2. Your second decision is to choose an action for every match you are having.
  - In each case, you have two possible actions: *a* and *b*. So does the other person.
  - Both of you decide simultaneously which action to choose without knowing the decision of the other.
  - Given that you can only choose between *a* and *b*, there are four possible combinations of actions. Depending on the combination that occurs, you and the other person will get the following points for a match according to the table below.

<i>Your Decision</i>	<i>His Decision</i>	<i>Your Points</i>	<i>His Points</i>
<i>a</i>	<i>a</i>	−1	−1
<i>a</i>	<i>b</i>	7	−6
<i>b</i>	<i>a</i>	−6	7
<i>b</i>	<i>b</i>	5	5

The table is interpreted as follows:

- if you chose *a* and your match chose *a*, you will get −1 point and your match gets −1 point;
- if you chose *a* and your match chose *b*, you will get 7 points and your match will get −6 points;
- if you chose *b* and your match chose *a*, you will get −6 points and your match will get 7 points;
- if you chose *b* and your match chose *b*, you will get 5 points and your match will get 5 points;
- if you were not matched with a particular participant, you get 0 points and so does he.

## REPETITION OF A SESSION

Each of you will be given a number that identifies you over a session (10 periods). In these 10 periods, you have to make the decisions described above. Once the 10 periods are over, you will get a new number, chosen randomly, which identifies you over a 2nd session of 10 periods in which you will repeat the above procedure. In total, there will be 10 sessions of 10 periods with a new identification number in each session.

## EARNINGS

The 10 sessions are split into two groups of 5 sessions. The total payoff you will receive is calculated as follows:

1. Two sessions will be chosen at random, one out of each of the two groups mentioned above. The probability that a session is selected, given the group to which it belongs, is  $1/5$ . Thus, it is in your interest to do well in every single session because two of them will be chosen to calculate your final payoff.
2. The points you obtained in the chosen sessions will be converted into pesetas. One point is equivalent to 15 pesetas. Thus, for example, 50 points equal 750 pesetas.
3. Your total payoff will be the payoff (loss) from the two sessions chosen plus the fixed starting capital (1,000 pesetas).

### THE USE OF THE COMPUTER

#### THE TWO DECISION PROBLEMS

##### 1. Partner Selection

For your first decision, the computer will display a screen asking you to indicate with whom you would like to interact. It also communicates to you your identification number, the current period, and your total points in the session so far. You have to indicate using *y* for yes and *n* for no if you want the match. Here is an example:

	1	2	3	4	5	6	7
offer	x						

The *x* under 1 means that you are participant 1. Because you cannot be matched with yourself, there is no empty space below the 1. In the “offer” line, you have to answer whether you want a match. To input your answer, you have to jump to the field you want to modify using the arrows of the cursor. Once you are on the field, press ENTER, write your answer—*y* or *n*—and press ENTER again. Notice that you have to press ENTER twice.

Once you have made all decisions, press F10 to communicate them. Once F10 is pressed, your decisions can no longer be revised. Therefore, make sure you have written what you wanted to write before pressing F10.

##### 2. Choice of an Action

Any time you have to choose an action, the computer will display the table of points that the different combination of actions yield. It will also tell you with whom you are matched, using the following table:

	1	2	3	4	5	6	7
match	x						
action	x						

Again, you are participant 1. The “match” line indicates with whom you have been matched. If an *n* occurs, this means that you are not matched with this participant. If a *y* occurs, you have to fill in the empty space in the “action” line by choosing action *a* or *b*. The following table displays all possible combinations that can occur.

	1	2	3
match	x	n	y
action	x	x	

Notice that you only have to make a decision in the last case. To input your decision, jump to the field you want to modify using the arrows of the cursor, press ENTER, enter your decision, and press ENTER again. You can use different actions in different matches. Once you have made all decisions, press F10 to continue the experiment.

Notice that you have to press F10 when you are not asked to make any decisions because no match has occurred. Do not forget to do so or you will keep everybody else waiting.

### THE HISTORY

After every period, you will be told your payoffs in that period and shown the history of the experiment. The following table will teach you all possible results that can be registered in the history and how to interpret them.

Period		1	2	3	4	5	6	7
1	o\s	x x x	n x x	y x x	y a a	y a b	y b a	y b b
	pay	0 0	0 0	0 0	-1 -1	7 -6	-6 7	5 5

o = offer, s = action chosen, pay = points received.

You are again participant 1. Behind o\s, you are told whether you made an offer (y\n), your own action, and your partner's action. An x indicates that no match took place with this participant. *Pay* tells you the points you and your partner received in a match. They are 0 if you were not matched.

In the first three cases, you are not matched, first because you cannot be matched with yourself, second because you did not want the match, and third because the other did not want the match.

In the remaining four cases, you are matched. They just reproduce the content of the points table.

You are able to look into the history any time you have to make a decision and while waiting for the others to make their decisions. You have only to press the corresponding keys. F1 through F9 will show you the histories of the 1st through 9th sessions, respectively, and Q will show you the history of the 10th. If you look into the history while waiting, you will not be aware when the others have finished. Therefore, please do not keep the history window open if you are not consulting it. Notice that if you want to look into the history while waiting, the computer reacts fairly slowly. After you press F1 through F9 or Q, it will take some seconds before the history window appears.

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# Attracting Trouble

## DEMOCRACY, LEADERSHIP TENURE, AND THE TARGETING OF MILITARIZED CHALLENGES, 1918-1992

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Otherwise powerful, formidable democracies are tempting targets for international violence because they have leaders who, on average, have been in office for shorter periods of time than leaders of autocracies. Domestic incentives may make resistance more costly than offering concessions for *inexperienced* leaders of both democratic and authoritarian states. Over time, however, resistance may become domestically less costly, causing *experienced* leaders to be more likely to prefer resistance. Anticipating this response, potential challengers may be more likely to target inexperienced leaders. Because democracies generally have high rates of leadership turnover, they are tempting targets for international violence. Statistical analysis of crisis initiation between 1918 and 1992 confirms the perception that democracies are more likely to be targets of militarized challenges. Results are also consistent with the proposition that the relatively short tenure in office served by democratic leaders helps to account for the observed pattern of democratic attraction of foreign challenges.

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**D**uring the past century, the United States and its democratic allies participated centrally in the defeat of two bids by Germany for the domination of Europe and one such bid by Japan for hegemony in Asia. America and her democratic friends then contained the Soviet Union and won the cold war. Systematic studies of military effectiveness have shown that democracies are formidable military actors in the international system (Lake 1992; Reiter and Stam 1998a, 1998b; Choi 2001; Gelpi and Griesdorf forthcoming; Grieco 2001). And yet, contemporary autocratic opponents—Iraq, Iran, North Korea, Serbia, and an increasingly powerful China—continue to challenge America and her allies. Moreover, this pattern is not unique to the United States. Existing research suggests that, during the past century, democracies were disproportionately the targets of militarized challenges even though they were highly successful in meeting those challenges (Rousseau et al. 1996; Grieco 2001). Why does this occur? Why do otherwise powerful, formidable democracies disproportionately attract serious political-military challenges by authoritarian regimes?

We offer what may be at least a partial answer to these questions. We begin with the premise that challenger states evaluate the attractiveness of potential target states, in



part, on the basis of their estimates of the incentives of the leaders of those potential targets to resist challenges or to make concessions. We then suggest that domestic political incentives may make resistance costly relative to concessions for *inexperienced* leaders in both democratic and authoritarian states. Over time, however, resistance becomes relatively less costly for both democratic and authoritarian leaders. Recognizing this pattern, potential challengers may have a preference, other things being equal, to target countries with inexperienced leaders. Finally, because democracies generally have greater leadership turnover than authoritarian states, at any given moment democracies tend to have leaders who have served less time in office than their authoritarian counterparts, and, by consequence, they may be especially tempting targets for international violence.

We undertake a preliminary empirical assessment of this line of inquiry through an analysis of militarized disputes between 1918 and 1992. Our findings indicate that the length of time a leader was in office is negatively related to the probability that his or her country was the target of a militarized crisis. Moreover, this pattern of targeting relatively inexperienced leaders does appear to help account for the greater trouble that democracies attract from abroad.

### DEMOCRACIES IN THE INTERNATIONAL SYSTEM: STRONG BUT PRONE TO TROUBLE

Recent literature has shown that democracies are highly efficacious actors in the political-military domain.<sup>1</sup> One branch of this literature suggests that democracies are likely to be successful in militarized crises that end without war. Fearon (1994), developing a line of analysis anticipated by Schelling (1960, 28), has argued that democracies are likely to prevail in crises because of their stronger ability to generate domestic audience costs. Although authoritarian leaders may suffer similar (or even more severe) domestic audience costs (Goemans 2000), they have difficulty signaling those costs to other leaders.<sup>2</sup> As a result, comparable escalatory bargaining moves will generate greater credibility and coercive leverage for democratic than for autocratic leaders. Bargaining theory suggests that these demonstrations of resolve are critical for successful crisis bargaining (Schelling 1960), and they have been found to have a material impact on the outcomes of international crises (Gelpi and Griesdorf forthcoming).

1. The democratic efficacy literature builds on and extends the most important argument about democracies and world affairs, namely, the "democratic peace thesis" that democracies rarely fight one another. Helpful entry points into the large literature on this subject include Doyle (1983a, 1983b, 1997); Russett (1993); Ray (1995); Russett and Oneal (2001); Owen (1994); and Bueno de Mesquita et al. (1999a, 1999b). For criticisms of the thesis, see Layne (1994); Spiro (1994); see also Correspondence on essay by David Spiro 1995; Farber and Gowa (1995); Mansfield and Snyder (1995); see also Correspondence on essay by Edward Mansfield and Jack Snyder 1996; Oren (1995); Thompson (1996); Gowa (1999); and Green, Kim, and Yoon (2001); for responses, see Maoz (1997); Owen (2000); Schwartz (2000); and Oneal and Russett (2001).

2. Goemans (2000) concluded that oligarchic authoritarian leaders may have the highest domestic costs. As his analyses indicated, however, they are unable to make these costs publicly credible and, thus, are unable to translate them into coercive leverage.

In a related vein, Schultz (1998) has suggested that if opposition parties in a democracy express public support for the government's position in a crisis, this will buttress the credibility of the government in the eyes of a foreign adversary. Moreover, because opposition parties are not required to support the national government, the latter will enter into a crisis only when the nation's security interests are truly at stake. Nondemocratic adversaries will recognize that if a democratic state elects to respond to a challenge, its leader must have strong grounds to believe that truly vital matters are at stake, and may be less likely to challenge that leader.

Democracies are also likely to be efficacious in full-scale wars. Lake (1992) prompted much of this inquiry with his claim that democracies are likely to win wars against authoritarian countries because they impose fewer efficiency costs on their economies and thus enjoy a superior base from which to extract resources. Reiter and Stam (1998b) have cast doubt on this explanation, suggesting that democracies are likely to achieve military victories because they are careful in choosing their adversaries. They also have suggested (1998a) that democracies, at least at the outset of wars, are likely to be more effective than nondemocracies in the particular matters of battlefield initiative and battlefield leadership. However, Reiter and Stam have confirmed Lake's finding that democracies have been more likely to win wars. Choi (2001) has also found that democracies are efficacious in wars against authoritarian states. She contended that democracies are successful because they are faithful and efficient partners with one another.

More generally, and as we discuss in greater detail below, Bueno de Mesquita et al. (1999a, 1999b) have suggested that democratic leaders are generally more dependent on public policy successes to stay in office than are autocrats. Because of this need for more general public policy successes, democratic leaders may be especially careful about choosing the military conflicts in which they become involved. Moreover, democratic leaders who do become embroiled in war may be more motivated to win than nondemocratic leaders and will work harder than nondemocratic rulers to bring about the necessary exertion by their countries to achieve victory.

Thus, both theoretical and empirical studies yield the conclusion that democracies are formidable military competitors if challenged by authoritarian states. Yet, notwithstanding their actual superior performance, democracies appear to attract trouble from authoritarian challengers. For example, Rousseau et al. (1996) found that fully democratic states are 20% more likely to experience militarized threats or the use of force in the context of militarized crises than are states that are fully authoritarian. By way of comparison, they pointed out that the change in the balance of military forces needed to bring about a similar increase in the likelihood of a country's being a target of militarized violence is to go from parity to a 3:1 level of inferiority. In a similar vein, Grieco (2001) found that after the completion of a low-intensity conflict, a democratic defender suffers a greater risk of experiencing a subsequent challenge than does a nondemocratic defender. The magnitude of this effect changes over time, but, for example, during the 3rd year after a low-intensity conflict, a democratic defender has about a 67% greater risk of being rechallenged than does a nondemocratic defender.

This effect is comparable to electing to pursue a strategy of conciliation rather than reciprocity.<sup>3</sup>

### DEMOCRACY, LEADERSHIP EXPERIENCE, AND ATTRACTING TROUBLE FROM ABROAD

Democracies may be at increased risk of militarized challenges for a variety of reasons.<sup>4</sup> One possible causal pathway concerns the experience levels of national leaders. There is anecdotal evidence that new leaders are likely to be tested by foreign adversaries: Nikita Khrushchev's bellicose tone and assertive actions during the early 1960s, for example, have been attributed (Beschloss 1991) to his intention to test an inexperienced John Kennedy's resolve. It is possible that new leaders of both democratic and authoritarian states become by consequence frequent targets of international challenges. Although the logic of this expectation differs slightly for democratic and authoritarian leaders, we believe that the domestic contexts within both types of states should cause leaders to be less likely to offer resistance to a challenge soon after they take office. Over time, however, resistance should become relatively less costly for both democratic and authoritarian leaders, making them less attractive targets for potential challengers.

Although they may not base their actions solely on the anticipated reaction of the defenders, holding other conditions constant, challenging leaders may be more likely to select targets they believe will offer less resistance to their challenge (Gartner and Siverson 1996). In turn, a defending leader faced with a challenge may face a trade-off between resisting the challenger's demands and offering concessions and, in part, will make these trade-offs with a view toward maximizing his or her chances of remaining in office.<sup>5</sup> Because the incentive structures for retaining office differ between democratic and authoritarian states, we suggest below that leaders in the two institutional contexts will view these trade-offs somewhat differently. Nonetheless, we believe that inexperienced leaders in democratic *and* authoritarian states will view the net utility of resistance as low relative to the utility of concessions. As leaders' tenures in office grow, however, resistance will become more attractive relative to making concessions. Anticipating these defender calculations, challengers may have a preference, other things being equal, to target inexperienced rather than experienced defender-country leaders.

3. Bennett and Stam (1998) also found that the effects of democracy fade over time.

4. Democracies might be the victim of their own success: they are successful in world affairs and may attract trouble because they possess what others covet. Moreover, nondemocratic leaders may have an irrational tendency to discount the military prowess of democracies. For example, Weinberg (1964) reported that Hitler ascribed very little significance to the United States as a potential adversary during the 1930s or as an actual foe even through late 1944.

5. Leaders undoubtedly face costs and benefits of resistance generated by the international environment as well (e.g., relative military capabilities), but these factors are unlikely to vary with experience. Moreover, we address many of these costs and benefits through our use of control variables.

### CONCESSIONS VERSUS RESISTANCE: CALCULATIONS OF DEMOCRATIC DEFENDERS

We begin by exploring the possible calculations of democratic leaders as a function of time in office. We base our argument on the assumption that leaders seek to retain office. Our understanding of how democratic and authoritarian leaders seek to do so is drawn from Bueno de Mesquita et al. (1999a, 1999b). They noted that any type of state contains a selectorate composed of the constituents who are relevant to the selection of a leader. To attain and retain office, the leader must first build and then maintain a winning coalition of supporters drawn from the selectorate. Winning coalitions within democratic states generally have to be quite broad. This relative breadth of democratic winning coalitions makes it difficult to attract and keep the necessary number of constituents for a winning coalition through payments of such private goods as money, desirable work, housing, or other preferential treatment. Instead, to build a sufficiently large coalition, democratic leaders will generally have to provide public policy benefits that are more widely consumable by the public. These benefits may entail material gains, such as economic growth, or symbolic successes, such as perceived international prestige.<sup>6</sup>

#### The Net Utility of Resistance

In general, democratic leaders may risk relatively high political costs if they resist an external challenge through the use of military force (Bueno de Mesquita and Siverson 1995). Such employment of force may cause numerous members of the winning coalition to suffer directly, such as fearing the loss of one's own life or the actual or feared loss of the life of a family member. People also suffer if combat casualties are sustained among members of their community (Gartner, Segura, and Wilkening 1997), and they suffer from the social and economic dislocation caused by military mobilization itself. This suffering is likely to be translated into a loss of political support for the national leader.

At the same time, however, democratic leaders may also achieve benefits by successful resistance in international crises. Success in such crises may allow democratic leaders to provide symbolic goods, and it allows leaders to demonstrate or signal their competence (Downs and Rocke 1995; Richards et al. 1993; Smith 1996, 1998). Alternatively, in some circumstances the use of force may "rally" the public to support leaders against an external foe (Ostrom and Job 1986; Russett 1990; Hess and Orphanides 1995; Gelpi 1997). Thus, successful crisis bargaining may help democratic leaders retain office.

If resistance entails the possibility of both costs and benefits for democratic leaders, how might the net utility of these costs and benefits vary over time? We suggest that, for several reasons, the benefits of resistance may be short-lived relative to the costs. First, the literature on the "rally 'round the flag" effect suggests that public support

6. These goods must be widely consumable but need not be "public goods" in the technical sense. That is, the goods need not be nonrival and nonexcludable. For example, the poor may be excluded from the benefits of economic growth if the leader can build an adequately large coalition of the rich.

achieved during a militarized crisis is likely to be short-lived (Russett 1990). Similarly, the value of foreign policy successes as a signal of competence is likely to fade over time as the public turns its attention to other issues as indicators of successful leadership. Finally, prospect theory (Kahneman and Tversky 2000; Levy 1997) suggests that individuals quickly incorporate gains into their understanding of the “status quo” on an issue. Losses, on the other hand, are not assimilated in this manner. Thus, there may be a tendency for the individuals who have been hurt by the use of force to retain their dislike for the leader they hold responsible for their losses, whereas those who benefited may become less grateful to that leader.<sup>7</sup>

One can think of a number of apparent examples of this kind of behavior by democratic constituents. George H. W. Bush, for example, delivered decisive military victories in Panama and the Gulf War early in his term and was rewarded for these successes with tremendously high approval ratings in 1990 and 1991. Within only a 12-month period, however, the American public seemed to take those successes for granted as Bush’s approval ratings slid from nearly 90% in the summer of 1991 to barely 30% in the summer of 1992 (Burbach 1995). By November of that year, voters appear to have focused not on Bush’s military prowess abroad but rather his more recent and less favorable handling of the economy at home. President Truman, on the other hand, found that the public does not forget foreign policy losses very quickly. Early in 1949, Truman’s approval ratings had consistently run over 50%. After being held responsible for “losing China” in October 1949, however, Truman’s approval ratings dropped below 40% and never recovered (Burbach 1995). Even Truman’s success with the invasion at Inchon could not rescue his popularity with the public, and it is possible that his success in defending South Korea was forgotten or discounted in the wake of his failure to unify the peninsula.

These arguments suggest that, from the viewpoint of the reelection of oneself or one’s party, the benefits of resistance for democratic leaders may be relatively low soon after they take office. However, these benefits are likely to increase over time, especially as the leader approaches reelection. The costs of using force, on the other hand, may influence a leader’s chances of reelection even very early in his or her term in office. Of course, the costs of resistance may increase somewhat as reelection approaches; but if constituents have long memories regarding losses, then the benefits of resistance might increase much more sharply over time than do the costs. According to this logic, we would suggest that the net utility of resistance for democratic leaders should increase over their term in office.

### **The Net Utility of Concessions**

There might be grounds to expect that the utility of making concessions may change for democratic leaders over their term in office. If successful resistance provides a symbolic good, then making concessions under coercive pressure may inflict

7. Importantly, our use of prospect theory here refers to the behavior of democratic constituents. As noted above, we assume state leaders to be rational decision makers. Their constituents, however, may lack the information or motivation to make such decisions. Thus, it would not be surprising to find that constituents relied on computational shortcuts, such as those described by prospect theory.

both material and psychological costs on the democratic leader's constituents and, more generally, may be a signal of incompetence on the part of the leader.<sup>8</sup> As was the case with the costs of resistance, constituents may remember these losses and hold the leader accountable for them for some time. The experience of President Truman, noted above, would appear to be an example of this behavior. The utility of making concessions should decrease somewhat as a democratic leader approaches reelection, since he or she will have less time to appease angry constituents and provide evidence of competent leadership. Nonetheless, like the costs of resistance, we would expect the costs of concessions to increase moderately rather than sharply over time. That is, we would expect the net utility of concessions to decline moderately as reelection approaches.

Overall, we would expect that the net utility of resistance for democratic leaders may tend to increase over time, whereas the net utility of concessions might decline. Consequently, we would expect that, all else being equal, democratic leaders may be relatively more likely to make concessions to a challenging state early in their term of office, whereas those with more time in office will be relatively more likely to resist.<sup>9</sup> Anticipating this response, potential challengers may prefer to target inexperienced democratic leaders.

#### **CONCESSIONS VERSUS RESISTANCE: CALCULATIONS OF AUTHORITARIAN DEFENDERS**

As with democratic leaders, we assume that autocrats will weigh the net utility of resistance and concessions and choose the policy that maximizes their chances of retaining office. However, the nature of the relevant costs and benefits for autocratic leaders differs somewhat from that for democratic leaders.

In authoritarian states, as Bueno de Mesquita et al. (1999a) suggested, the breadth of the selectorate may vary widely. Compared to democracies, however, authoritarian systems are consistently characterized by small winning coalitions. Moreover, because leadership competition is neither routinized nor institutionalized, relatively small groups are capable of seizing and holding power, particularly if they control the use of force. Thus, the military is often part of the winning coalition in these states.

Because authoritarian leaders need to satisfy only a relatively narrow winning coalition, it will often be possible for them to retain office through the provision of private goods to their supporters (Bueno de Mesquita et al. 1999b). Such leaders may (and some do) retain office through the provision of widely consumable public policy benefits. Yet, there may be a bias on the part of authoritarian leaders in favor of using private goods as a basis for retaining power. Public policy success, for example, economic growth, requires coordination with many elements of society, which is unattrac-

8. There are, of course, exceptions to this rule, but research on democracy and the use of force suggests that conciliatory gestures do not generate the "rally effect" that more aggressive actions often do (Russett 1990).

9. An alternative logic would suggest that leaders should resist early in their tenure to deter future challenges. Successful resistance might deter an individual challenger, but empirical studies suggest that states do not draw broad inferences about credibility and resolve (Huth 1997; Hopf 1994; Mercer 1996). Thus, the deterrent benefits of resistance are likely to be relatively limited.

tive to authoritarian leaders. The provision of domestic advantages to particular supporters, however, is generally under the direct control of the authoritarian leader and can be provided with relatively little sharing of power with society. Moreover, the provision of widely consumable benefits such as economic growth may actually be *dangerous* for authoritarian leaders, since resources accrue to the leaders' *opponents* as well as to his or her supporters. These resources may be turned toward efforts to remove the leader so that a different coalition can hold power and extract resources from society. Consequently, authoritarian leaders may benefit most from being able to reward in a direct and discriminatory manner those who support them, while simultaneously punishing opponents, often through violence or intimidation and seeking to undermine their future influence in the political process.

### The Net Utility of Resistance

Because the winning coalition for most authoritarian leaders is usually quite small, they do not face the same level of domestic costs for using force as do democratic leaders. Neither the casualties suffered in combat nor the social dislocations caused by military mobilization are likely to have as intense an impact on an autocrat's constituents as they do on a democratic leader's constituents. However, using force is not without costs for authoritarian leaders. Using military force always carries some level of financial strain, but using force may be particularly costly for authoritarian leaders soon after they take office. As we noted above, leadership transfer is unregulated in most of these systems, and transitions are often settled through the use, threat, or implicit threat of force. Consequently, unlike newly elected democratic leaders, autocrats will often be most unsure of their ability to retain office shortly after they gain it. It is at this time that authoritarian leaders are most vulnerable to challenge and least secure in the stability of their winning coalition. The use of military force in an international crisis will be costly for relatively new authoritarian leaders because such military actions require a diversion of military resources away from their most urgent task: defending the leader's hold on office. Over time, however, autocrats should be able to use the powers of office to undermine potential challengers for their office. Consequently, the diversion of military resources to cope with an international crisis will become less costly over time.

Whereas the costs of resistance decline for authoritarian leaders over time, the potential benefits of resistance remain relatively constant. As we discussed above, successful resistance in an international crisis can be viewed as a public policy success for a leader. Such public successes, however, should be of relatively little consequence for an autocratic leader's ability to retain power. For example, foreign policy success should be of relatively little value as a signal of competence for authoritarian leaders. Unlike democratic systems, the winning coalitions in these states will generally be composed of elites who are relatively attentive to the behavior of the leader and need not rely on such "low information" signals to judge competence. Of course, successful resistance may be beneficial for an authoritarian leader if the gains to be made in the dispute involve private goods that exclusively benefit the members of the leader's winning coalition. However, because the leader can often substitute other private goods for



international success, there is little reason to believe that the value of such benefits will vary systematically over time. Because the costs of resistance decline over time while the benefits remain constant, the net utility of resistance for authoritarian leaders should increase over time.

### **The Net Utility of Concessions**

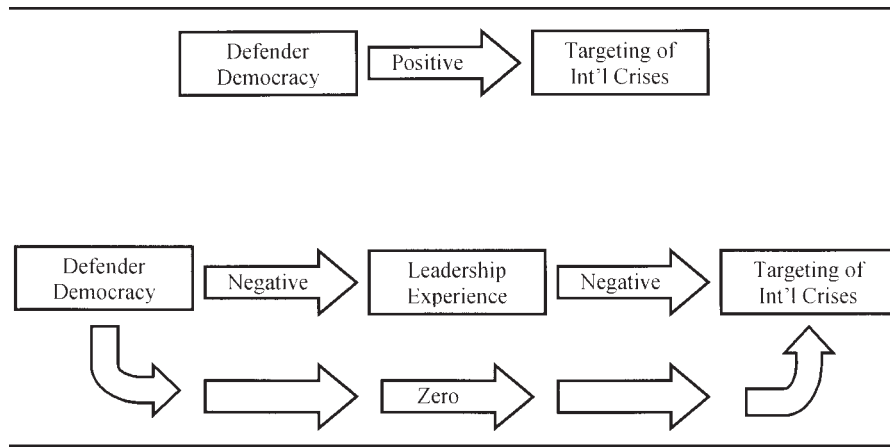
For autocrats, concessions to a foreign challenger may not be very significant for the maintenance of a domestic winning coalition, for such losses can be offset with payments of private goods newly extracted from society. Saddam Hussein, for example, has been able to survive massive international defeat because of his ability to make other kinds of payments to his supporters. Although making concessions may be costly for an authoritarian leader, the ability to make payments to immediate supporters to compensate for these losses mitigates their impact. As with the benefits of resistance, these costs may vary quite little over time.

As we discussed above, the net utility of resistance should increase over time as an autocrat becomes more able to divert military resources away from the domestic scene. The utility of concessions, on the other hand, should remain relatively constant, since side payments can generally ameliorate their impact. Once again, this logic leads us to the expectation that inexperienced authoritarian leaders will tend to be more likely to make concessions to a challenging state, whereas more experienced autocrats will prefer to resist. Anticipating this response, potential challengers should prefer to target inexperienced authoritarian leaders.

### **LEADERSHIP EXPERIENCE, DEMOCRACY, AND THE TARGETING OF CRISES**

If inexperienced leaders of *all* stripes should be disproportionately targeted in international crises, why do democracies attract so much trouble? One possible reason is that democratic states tend to have higher rates of leadership turnover than do nondemocracies (Bienen and van de Walle 1992). As we describe in greater detail below, we drew a random sample of leader dyads between 1918 and 1992. Among the defending leaders in this sample, the correlation between democracy and the leader's tenure in office is  $-.28$  ( $p < .00$ ). More specifically, we found that the democratic defenders on average had been in office for approximately 4 years. Autocratic defenders, on the other hand, had been in office an average of just more than 10 years. This difference of means is both substantively and statistically significant ( $t$  ratio = 18.07,  $p < .00$ ). The relationship between democracy and leadership tenure was virtually identical for the challenging leaders as well.

Democracies, then, appear to be characterized by leaders who, on average, have less time in office at any given moment than do leaders of nondemocracies. This generally more limited tenure of their leaders could be one pathway causing democracies to attract disproportionate trouble in spite of their military prowess. This proposed causal process is illustrated in Figure 1, along with the empirical effects that we expect to observe.



**Figure 1: Causal Process Generating the Targeting of Crises**

The first half of Figure 1 illustrates our expected results when we do not account for the impact of leadership experience: we expect to find that the defender's level of democracy is positively related to the probability that it will become the target of an international crisis. The second half of Figure 1 illustrates the changes we expect to observe once we account for the impact of leadership experience. We expect to observe a negative relationship between the defender's leadership experience and the probability that it will be targeted in an international crisis. As noted above, we have observed a negative relationship between the defender's level of democracy and its leader's tenure in office. Therefore, once we account for this negative relationship, we expect to find that the relationship between the defender's democracy and the risk of being the target for a crisis will cease to be empirically significant. That is, we expect to find that leadership tenure-in-office represents an intervening variable between defender democracy and the risk of being the target of a challenge. In sum, we propose the following:

*Hypothesis 1:* Democratic leaders will be at greater risk of experiencing militarized challenges than will their authoritarian counterparts.

*Hypothesis 2:* Leaders with more time in office will be at lower risk of experiencing militarized challenges than will less experienced leaders.

*Hypothesis 3:* Once the influence of leadership experience is accounted for, democracy will no longer have a systematic impact on the risk of experiencing militarized challenges.

### CONTROL VARIABLES

We have included a number of control variables in our analysis. We selected these variables because they are causes of conflict that may be correlated with democracy or leadership experience or they are important causes of international conflict that can serve as benchmarks for judging the substantive importance of democracy and leadership experience as a source of international conflict.

**RELATIVE MILITARY CAPABILITIES**

Military conflict is more likely between states that have relatively evenly matched capabilities (Blainey 1973; Organski and Kugler 1980). The occurrence of a military conflict indicates that the two parties disagree on the likely outcome of the engagement, for if the two sides could foresee the outcome, they should simply agree to settle on that same outcome peacefully to avoid the costs of fighting (Fearon 1995). When states are relatively equal to each other in terms of their capability, it will be more difficult to foresee the outcome of a military engagement. As a result, militarized disputes should become more likely. Moreover, because democratic states are militarily among the most powerful states in the world, we must control for this preponderance.

**MAJOR POWER STATUS**

Major powers are much more likely to engage in military conflict (Bremer 1992). These states have wide-ranging interests that potentially bring them into conflict with a large number of states. Moreover, they have the military capability to escalate those conflicts to the level of a militarized dispute. Over the past half century, the major powers have been disproportionately democratic, and thus many of them have also had a great deal of leadership turnover. Thus, it is important that we distinguish between the impact of democracy and leadership experience on the risk of being challenged and the impact of major power status.

**CONTIGUITY**

Contiguous states are more likely to engage in military hostilities than are states that do not share a border (Bremer 1992). In addition, because democracy is geographically clustered rather than randomly distributed around the globe, it is important that we control for this effect in evaluating our hypotheses.

**DISTANCE**

Distance has been shown to have a substantial impact on the likelihood of military conflict (Bremer 1992; Oneal and Russett 1997). States that are distant from each other are less likely to interact and therefore are less likely to have any reason to use military force against one another. Moreover, projecting military capabilities over large distances is expensive and logistically difficult. Many smaller states are incapable of such substantial force projection. Once again, the geographic clustering of democracy also makes it important that we control for this effect.

**REGIME TRANSITION**

Domestic political upheaval is associated with an increase in the risk of international conflict (Maoz 1989; Mansfield and Snyder 1995; Walt 1996). Political upheaval that results in the collapse of a government is also likely to bring to power a

leader with little experience in office. Our argument about the impact of experience is related to, but conceptually distinct from, an argument about the collapse of regimes. Hence, to distinguish between the general effect of leadership experience and the specific effect of regime change, we control for regime collapse and transition.

#### DAYS OF INTERACTION

As we discuss below, our analysis focuses on leader dyads that may have a varying length of interaction. By consequence, we control for the length of time that leaders are able to engage in international conflict.

#### PEACE YEARS

As suggested by Beck, Katz, and Tucker (1998), we cope with the temporal dependence in our time series data by controlling for the effect that elapsed years of peace may have on the probability of renewed conflict.

### RESEARCH DESIGN AND MEASUREMENTS

Because our central hypotheses focus on the behavior of leaders rather than states, we rely on a slightly different unit of analysis than do many of the standard analyses of international conflict. Electing to focus on interstate dyad-years has become one of the standard approaches to studying international conflict because of its tremendous flexibility in simultaneously testing hypotheses from differing levels of analysis. Nonetheless, the concept of an interstate dyad-year is ill suited for distinguishing between the actions of different leaders who hold office in the same state during the same year. Such distinctions are critical, however, for testing the impact of leadership experience. For example, from the perspective of the dyad-year, a challenge by Saddam Hussein against the United States on January 15, 2001, looks very much the same as a challenge on February 15, 2001. Yet, if one is interested in the impact of leadership experience on the outbreak of conflict, then these two cases are extremely different: the first scenario involves a challenge against a leader who has held office for 8 years, whereas the latter would represent a challenge against a leader with less than 1 month of experience.

To capture these important differences, we constructed our data set on the basis of the concept of a the *leader dyad-year*. We operationalize this concept in the following manner: for each interstate dyad-year, we recorded a separate case for each distinct pair of leaders. If only one leader is in office in each state in the dyad for the entire year, then the leader dyad-year is the same as the standard dyad-year. In a variety of situations, however, this is not the case. For example, Winston Churchill was removed as prime minister of the United Kingdom in July 1945 and replaced by Clement Attlee. Thus, in our data set, Britain is involved in at least two leader dyad-years with each opposing state in 1945. For example, the U.K.-USSR dyad for 1945 becomes two cases: Churchill-Stalin and Attlee-Stalin. The U.K.-U.S. dyad, on the other hand, becomes *three* separate cases for 1945 because Truman replaced Roosevelt in April

1945: Churchill-Roosevelt, Churchill-Truman, and Attlee-Truman. Of course, since we are interested in estimating the probability of conflict within each leader dyad-year, we control for the number of days each pair of leaders was able to interact during the year.

Our effort to identify the population of leader dyad-years between 1918 and 1992 resulted in nearly 1 million observations with approximately 0.06% of these leader dyad-years engaged in an international crisis. Because of the very large number of cases and the highly skewed distribution of our dependent variable, we used the rare events estimation procedure developed by King and Zeng (2001). That is, we included 100% of the observations that involved international crises and drew a small random sample of the remaining dyads. The result was a sample of 2,418 leader dyad-years, 403 of which involved the initiation of an international crisis.<sup>10</sup> Our logit estimates are corrected for this oversampling on the dependent variable and the skewed distribution on the dependent variable in the manner suggested by King and Zeng.<sup>11</sup>

#### CRISIS INITIATION

Our dependent variable is the initiation of an international crisis. Criteria for the initiation of an international crisis are drawn from the International Crisis Behavior Project (ICB) data set (Brecher and Wilkenfeld 1997), which covers the period from 1918 to 1994. We relied on these data rather than the more frequently used Correlates of War (COW) Militarized International Dispute (MID) data set because the ICB data set provides researchers with a historical summary of each dispute and a bibliography of sources used for each dispute coding. This information was essential to determine which leaders were responsible for particular actions that occurred immediately before or after leadership transitions and substantially improved our confidence in the codings of crisis challengers and defenders.<sup>12</sup>

#### LEADER'S TENURE IN OFFICE

The identities of national leaders and their dates in office were drawn from the leaders data set developed by Bueno de Mesquita and Siverson (1995), which covers the period from 1815 to 1992. Thus, the overlap of Brecher and Wilkenfeld's (1997) data

10. Leader dyad-years that consisted entirely of ongoing international crises were excluded from the sample.

11. To check the robustness of our results, multiple samples were drawn with this technique. Results across the samples did not vary. The sample of leader dyad-years drawn for the analysis is available from the authors at <http://www.duke.edu/~gelpi/data.htm>.

12. Because our focus is on the targeting of international crises, it was centrally important that we correctly identify crisis challengers and defenders. The identities of the challengers and defenders in each crisis were independently reviewed by each of us and by two research assistants based on the criteria identified in Brecher and Wilkenfeld (1997). We made identical codings of the challenger and defender for the overwhelming majority of cases. In those cases in which there was some ambiguity regarding the identity of the challenger and defender, we examined the case together and reached a consensus. It is important to note that any random errors in identifying challengers and defenders should only serve to dampen the effects we observe (King, Keohane, and Verba 1994).

with Bueno de Mesquita and Siverson's yields our period under review: 1918 to 1992. For leader dyad-years in which an international crisis occurred, we recorded the number of days that each leader had been in office until the date on which the crisis began. For observations in which no crisis was initiated, we recorded the number of days that each leader held office on the final day of that leader dyad-year. We recorded the number of days elapsed since a leader *most recently* took office. We employed this coding rule because our argument focuses on the domestic requirements of coalition building and maintenance: a leader's previous ability to construct such coalitions in the past does not alter this requirement in the present. Operationally, if a leader was removed from office and then returned to power, our measure of tenure in office began counting again at zero for the new term in office.

After determining the number of days that each leader held power, we employed the natural log of this value for both the challenger and defender. We have chosen this approach because we do not expect experience to have a linear impact on crisis behavior. Specifically, we expect that the impact of experience should be large at first and dissipate over time. A logarithmic transformation roughly fits this functional form.<sup>13</sup>

#### CHALLENGER'S AND DEFENDER'S DEMOCRACY SCORES

These variables measure the challenger's and defender's respective levels of democracy. We employed the Polity IV data set compiled by Marshall and Jaggers (2000). We constructed our index by subtracting the Polity IV autocracy index from the democracy index to produce a variable that ranges from -10 to 10. To facilitate interpretation of the statistical results, this variable was rescaled from 1 to 21.

#### BALANCE OF CONVENTIONAL MILITARY CAPABILITIES

Data for this variable were drawn from the COW data set on national material capabilities, and the values were calculated through the use of the EUGene data generation program (Bennett and Stam 2000). EUGene provided a calculation of the proportion of global composite military capabilities controlled by each crisis participant during the year that the crisis was initiated. We then calculated the proportion of the capabilities within each crisis dyad that was controlled by the challenging state.

Much of the literature on international conflict suggests that the challenger should be less likely to initiate a crisis *either* if it is much more powerful than the defender *or* if it is much less so (Blainey 1973; Organski and Kugler 1980; see also Oneal and Russett 1997, 1999). Thus, we transformed our measure of relative capabilities into a measure of the military balance by subtracting 0.5 from this measure and taking the absolute value of the result. Consequently, a score of 0 would represent an evenly balanced dyad, whereas a score of 0.5 would indicate that one state possesses *all* of the military capabilities in the dyad.

13. Sensitivity analyses revealed that the impact of leadership tenure was significant regardless of the functional form specified. However, a logarithmic transformation showed a better fit to the data.

**CHALLENGER AND DEFENDER MAJOR POWER STATUS**

We coded separate major power status variables for each of the leaders in the dyad. For each leader, the variable takes on a value of 1 if his or her state is a major power during that year and 0 otherwise. Major powers were identified on the basis of the COW data set on national material capabilities. The United States, Russia/Union of Soviet Socialist Republics, the United Kingdom, and France were coded as major powers throughout the period between 1918 and 1992; Italy, Germany, and Japan were coded as major powers between 1918 and 1945; and the People's Republic of China was coded as a major power between 1950 and 1992.

**CONTIGUITY**

This variable takes on a value of 1 if the states in the dyad shared a border (including colonial borders) or were separated by less than 250 miles of water and 0 otherwise.

**DISTANCE BETWEEN CAPITALS**

This variable is the distance between capital cities of the two states in the dyad. Because of their tremendous size and their access to both the Pacific and Atlantic Oceans, distances to the United States, Canada, and Russia/Union of Soviet Socialist Republics were calculated to the nearest major port city in those countries. Data for this variable were obtained from EUGene (Bennett and Stam 2000).

**CHALLENGER AND DEFENDER REGIME TRANSITION**

We coded separate dummy variables to identify whether the challenging or the defending regime in a leader dyad-year was in transition. For either the challenger or defender, these variables were assigned a value of 1 if Polity IV was unable to assign a democracy or autocracy score because the state's domestic political institutions were in flux and 0 otherwise.

**DAYS OF INTERACTION FOR THE LEADERS**

This variable simply codes the number of days that the two leaders in the leader dyad-year were able to interact. That is, it records the number of days during that year that both leaders were simultaneously in power.

**PEACE YEARS**

Statistical studies employing binary time series cross-sectional data, as in the present analysis, often encounter problems of temporal dependence. Consistent with Beck, Katz, and Tucker (1998), we corrected for this problem by accounting for the number of years that elapsed since the previous conflict. We modeled the impact of time with a series of coefficients that created a spline function. We chose this method rather than



TABLE 1  
Rare Event Logit Analysis of Democracy, Leadership Tenure,  
and International Crises—Sample of All Dyads, 1918-1992

<i>Independent Variable</i>	<i>Democracy Model</i>		<i>Leadership Tenure Model</i>	
Democracy and leadership variables				
Longer defending leader's tenure	—		−0.274**	(0.078)
Defender democracy score	0.027**	(0.011)	0.016	(0.012)
Longer challenging leader's tenure	—		−0.222**	(0.081)
Challenger democracy score	−0.061**	(0.013)	−0.069**	(0.014)
Control variables				
Balance of military capabilities	−1.251*	(0.58)	−1.224*	(0.581)
Defender major power	2.188**	(0.254)	2.153**	(0.255)
Challenger major power	2.919**	(0.297)	2.938**	(0.297)
States are contiguous	2.985**	(0.309)	2.903**	(0.308)
Distance between capitals	−0.0003**	(0.00001)	−0.0003**	(0.0001)
Defender regime transition	0.521	(0.374)	0.353	(0.362)
Challenger regime transition	1.195**	(0.365)	0.913**	(0.357)
Days of interaction for dyad	0.005**	(0.001)	0.008**	(0.001)
Peace years	−0.280**	(0.046)	−0.255**	(0.047)
Peace years spline 1	−0.002**	(0.0004)	−0.002**	(0.0004)
Peace years spline 2	0.001**	(0.0004)	0.001**	(0.0003)
Peace years spline 3	−0.0002	(0.0001)	−0.0002	(0.0001)
Constant	−7.802**	(0.585)	−4.895**	(0.853)

NOTE: Number of observations = 2,345. Standard errors of coefficients appear in parentheses. Huber-White robust standard errors allowed for clustering on each leader dyad.

\* $p < .05$ . \*\* $p < .01$ .

the use of dummy variables for each elapsed year of peace because it is more efficient than the latter method. The use of dummy variables, however, yields identical results.

## DATA ANALYSIS

Our analysis proceeds in two steps. We estimate in one model the impact of the defender's democracy score on the probability that it will be challenged. We then estimate a second model that contains all the variables employed in the first model as well as the variable for the defending leader's tenure in office. If our argument has merit, the coefficient for the defender's democracy score should be positive and significant in the first model. But, in the second model, the coefficient for the defender's democracy variable should be smaller than it is in the first model and statistically insignificant. In addition, the coefficient for the defending leader's tenure should be negative and statistically significant.<sup>14</sup> The results of our analyses are displayed in Table 1.

14. For a more detailed discussion of testing for intervening variables, see King, Keohane, and Verba (1994).

The first model in Table 1 is consistent with Hypothesis 1: the coefficient for the defender's democracy score is positive and statistically significant. This result suggests that democracies are disproportionately likely to become targets for the use of force. Moreover, consistent with Hypothesis 2, the coefficient for the defending leader's time in office in the second model is negative and statistically significant. That is, the longer a defending leader has held office, the less likely he or she is to become the target of a militarized challenge. These results are consistent with our suggestion that leadership tenure levels that are associated with democratic structures may place democratic countries at a disproportionate risk of being challenged in world politics.

Finally, consistent with Hypothesis 3, the coefficient for the defender's democracy score becomes substantially smaller and statistically insignificant once we account for the impact of leadership experience. The statistical insignificance of the defender's democracy score in the second model in Table 1 does not appear to be due to problems of colinearity created by the introduction of leadership tenure. Supplementary regression analysis revealed that the auxiliary  $R^2$  for defender democracy in the second model is less than .14.<sup>15</sup> Moreover, we can see that the substantive size of the coefficient for the defender's democracy score changes substantially from .027 in the first model to .016 in the second, whereas the standard error for this coefficient remains virtually unchanged across the two models. This pattern of results is consistent with the view that leadership experience represents the intervening variable that produces an enhanced risk of military challenges for democracies (King, Keohane, and Verba 1994).<sup>16</sup>

The challenger's level of leadership experience also has a significantly negative impact on the probability of an international crisis. This result indicates that leaders who want to alter the international status quo are likely to try to do so relatively soon after assuming office.<sup>17</sup> It may be noted, however, that accounting for the challenger's leadership experience has no impact on the relationship between challenger democracy and crisis initiation. The coefficient for challenger democracy actually becomes slightly larger in terms of its substantive size and statistical significance. This result

15. In fact, auxiliary regression revealed that colinearity did not create estimation problems for any of our variables. The highest level of colinearity for any variable was .35 for the leader dyad's days of interaction. This level of colinearity should not represent a problem for such a large number of cases. Moreover, this variable remained statistically significant despite the colinearity. All other variables generated auxiliary  $R^2$  of .30 or less. The only other variable that was not statistically significant was the defender's regime transition. The auxiliary  $R^2$  for this variable was only .03.

16. To determine whether the impact of leadership experience varied by regime type, we interacted the defender's regime type with the defending leader's level of experience. The coefficient for the interaction term was substantively and statistically insignificant while leaving the other variables essentially unchanged in terms of their size and statistical significance. This result supports our contention that inexperienced leaders in *both* democratic and authoritarian states are more likely to be targeted.

17. This result may seem somewhat anomalous, given our claim that inexperienced democratic and authoritarian leaders generally face higher costs for using force. The differing impact of the challenger's leadership experience may lie in the differing domestic incentives faced by challenging and defending leaders. That is, leaders may decide to initiate international crises because of strong pressures from their domestic constituents to do so. In these cases, our arguments regarding the relatively high costs and/or low benefits of using force early in one's term may not apply. However, absent such strong domestic pressures to challenge—as is the case in the defending states—our argument about the utility of resistance and concessions appears to be supported.

holds despite the fact that the correlation between challenger democracy and the challenger's leadership experience ( $r = -.28, p < .00$ ) is virtually identical to the correlation between defender democracy and the defender's leadership experience ( $r = -.27, p < .00$ ). This result provides further evidence that the coefficient for defender democracy becomes insignificant because leadership experience links democratic institutions to the risk of being targeted for military challenges. On the other hand, the introduction of the challenger's leadership experience has no impact on the coefficient for challenger democracy because leadership experience is *not* one of the (many) causal mechanisms posited for the democratic peace.

The control variables perform largely in the manner reported in other studies of international conflict. The coefficient for the balance of military capabilities is negative and statistically significant, indicating that states that are unequal in military capabilities are less likely to become involved in international crises. The coefficients for defender and challenger major power are positive and statistically significant, replicating the well-known finding that major powers are more likely to become involved in military conflict. Similarly, states that are contiguous are more likely to become involved in international crises, whereas those that are distant from one another are much less likely to clash. Perhaps our only anomalous result is that states are not more likely to become the targets of international crises while their domestic regimes are in transition. That is, states do not generally appear to prey on those suffering from internal change and upheaval. However, states that are undergoing such upheavals are themselves more likely to become the initiators of international crises. This result is consistent with the findings reported by Maoz (1989), Mansfield and Snyder (1995), and Walt (1996). Finally, according to our analysis, the longer a pair of leaders was able to interact during a particular dyad-year, the greater the chance that they became involved in an international crisis.

The results in Table 1 are consistent with our suggestion that leadership experience may account in part for the tendency of democracies to be disproportionately targeted in international crises. But how important are these effects? As with the study of rare diseases, international crises are unusual but extremely undesirable events.<sup>18</sup> Consequently, we believe that changes in relative risk are the most appropriate benchmark for judging the substantive importance of our predictive variables. Relative risk is calculated as the ratio of the new probability of an event (i.e., an international crisis) to the prior probability of that event. Thus, if the probability of a dispute between a pair of autocratic states is .01 and the probability of a dispute between a pair of democracies is .005, then the change in regime type in the pairs would account for a 50% reduction in the relative risk of a dispute. The results of our analysis of relative risk, based on generating predicted effects for each of the significant variables in the second model in Table 1, are presented in Table 2.

The results in Table 2 suggest that leadership tenure has a substantial effect on the risk of international crises. Most important for our purposes, defending leaders with more time in office are substantially less likely to become the targets of international crises. A leader who has served just 1 year in office is at an 80% lower risk of being tar-

18. The mean probability of an international crisis across the population of leader dyad-years is .0006.

TABLE 2  
Marginal Effects of Leadership Tenure on the  
Relative Risk of an International Crisis

<i>Change in Leader's Tenure in Office (years)</i>	<i>Change in Relative Risk of International Crisis (%)</i>
Defending leader	
0 to 1	-80
1 to 3	-26
3 to 5	-13
5 to 10	-17
10 to 15	-10
Challenging leader	
0 to 1	-73
1 to 3	-21
3 to 5	-11
5 to 10	-14
10 to 15	-8

NOTE: Marginal effects were calculated by generating predicted values from the logit model while changing the values of selected variables and holding the others at their means/modes. The predicted values were transformed into changes in relative risk.

geted than a leader who has just taken office. The accumulation of additional experience beyond 1 year continues to reduce the defending leader's risk of being challenged, but it does so at a much lower rate. Specifically, a defending leader with 3 years' experience is at an additional 26% lower risk of being challenged than a defender with 1 year's experience. Additional increases in the defender's tenure in office to 5, 10, and 15 years reduce his or her risk of being challenged by 13%, 17%, and 10%, respectively. This pattern of effects suggests that the first few years of experience in office are particularly critical for a leader in developing a reputation for resolve.

The challenger's level of leadership experience has a similar impact on the likelihood that it will initiate a crisis. Specifically, the risk of a challenger with 1 year in office initiating an international crisis is 73% lower than the risk of such behavior from a challenger who has just taken office. Once again, the impact of leadership tenure for the challenger abates substantially over time. An increase in the challenging leader's experience from 1 to 3 years in office, for example, reduces the risk that he or she will initiate a crisis by an additional 21%. Further increases in the challenging leader's tenure to 5, 10, and 15 years reduce the risk of a crisis initiation by 11%, 14%, and 8%, respectively. As we discussed above, this effect indicates that leaders who wish to alter the international status quo are likely to try to do so relatively soon after taking office.

The impact of leadership experience appears to be substantial, but how does it compare to the impact of other variables in the model? The effects of the other significant variables in the second model are presented in Table 3.

The first section of Table 3 indicates that our results are consistent with those in the democratic peace literature. Specifically, the risk that a challenger with a mixed

TABLE 3  
Marginal Effects of Significant Control Variables on the  
Relative Risk of an International Crisis

<i>Change in Independent Variable</i>	<i>Change in Relative Risk of International Crisis (%)</i>
Challenger democracy score	
Autocracy (1) to mixed regime (11)	-50
Mixed regime (11) to democracy (21)	-50
Relative military capabilities	
Even to 2:1 ratio	-19
2:1 to 3:1 ratio	-10
3:1 to 10:1 ratio	-17
Defender major power	
Yes to no	-89
Challenger major power	
Yes to no	-95
States are contiguous	
Yes to no	-95
Distance between capitals (miles)	
250 to 2,000	-46
2,000 to 4,000	-50
4,000 to 6,000	-50
6,000 to 8,000	-50
Challenger regime transition	
Yes to no	-59

NOTE: Marginal effects were calculated by generating predicted values from the logit model while changing the values of selected variables and holding the others at their means/modes. The predicted values were transformed into changes in relative risk.

regime (democracy score = 11) will initiate a crisis is 50% lower than that of a fully authoritarian challenger (democracy score = 1). Moreover, the risk of a democracy (democracy score = 21) initiating an international crisis is 50% lower than that of a mixed regime. The balance of military capabilities has a significant but surprisingly modest effect. A dyad in which one state holds a 2:1 military advantage over the other is only at a 19% lower risk of suffering an international crisis than is a dyad composed of equally matched states. A shift from a 2:1 imbalance to a 3:1 imbalance reduces the risk of a crisis by only an additional 10%. And finally, a shift from a 3:1 imbalance to an extreme 10:1 advantage for one of the states reduces the risk of a crisis by only an additional 17%.

Major power status, contiguity, and distance, on the other hand, have very substantial impacts on the risk of an international crisis. Potential defending states that are minor powers are at an 89% lower risk of actually being targeted for an international crisis than are major powers. Similarly, the risk of a minor power potential challenger initiating an international crisis is 95% lower than that of a major power. These results replicate the established finding that the wide-ranging interests of great powers may draw them into a disproportionate number of crises both as challengers and as defend-

ers (Bremer 1992; Grieco 2001). States that do not share a border are also at a 95% lower risk of becoming involved in an international crisis than are contiguous dyads. In addition to the simple issue of contiguity, the distance between the states in a dyad also has a substantial impact on the risk of a conflict between them: each increment of 2,000 miles between the states in a dyad reduces the risk of a crisis by approximately 50%. This result indicates that the risk of a dispute between states that are 8,000 miles apart is 93% lower than the risk of a dispute between states that are only 250 miles apart.<sup>19</sup>

Regime transition in the potential challenging state also has a significant impact on the risk of a crisis, although it is not as large as the effects of distance, contiguity, or major power status. Specifically, the risk that a stable regime will initiate an international crisis is 59% lower than that of a state undergoing a regime transition.

The impact of the control variables is rather substantial. However, it is important to note that none of these effects overwhelms the impact of leadership experience. Even when compared to the well-established effects of major power status and distance, the impact of leadership experience continues to be substantial.

Finally, we evaluated our argument by considering some of its auxiliary implications. For example, we contend that new leaders are targeted because challengers accurately perceive that such leaders will face relatively higher costs of resistance and, thus, will be more likely to make concessions. Is this true? Are new leaders more likely to make concessions in international crises? Fortunately, the ICB data set codes outcomes for each of the crises it records. Specifically, ICB places crisis outcomes into four categories: (1) defeat for the challenger, (2) stalemate, (3) compromise, and (4) victory for the challenger. The third and fourth categories involve concessions being made by the defender, whereas the first two outcomes do not. Examining the 403 crises in our data set, we found that 42% of crises targeting defenders with less than 5 years of experience resulted in a compromise or a victory for the challenger. Only 33% of the crises targeting more experienced defenders resulted in such outcomes. This difference is substantial and statistically significant at the .10 level ( $\chi^2 = 2.1$ ,  $df = 1$ ,  $p < .087$ ). Similar results are generated by examining defending leaders in their 1st year in office: crises targeting a defending leader with less than 1 year of experience resulted in a compromise or challenger victory 48% of the time, but after the defender has had more than a year in office, this rate drops to only 36% ( $\chi^2 = 4.2$ ,  $df = 1$ ,  $p < .04$ ). Thus, challengers would appear to be correct in anticipating that inexperienced leaders will be more willing to make concessions. This auxiliary finding provides further support for our suggestion that leadership experience may help account for the disproportionate targeting of democratic states in international crises.

## CONCLUSION

We began with an apparent problem in the literature on democracy and international conflict: it finds that democracies are highly effective crisis bargainers and mili-

19. We compare the impact of 8,000 miles to 250 miles rather than to 0 miles because doing so would conflate the impact of distance and contiguity. States that are separated by less than 250 miles of water are coded as contiguous, so we rely on 250 miles as our baseline for assessing the impact of distance.

tary combatants, but it also finds that democracies are disproportionately targeted in international crises. As a partial solution to this problem, we have suggested that challengers may tend to target leaders who have recently taken office, and, because democratic leaders generally have had substantially less time in office than their authoritarian counterparts, this relative inexperience may create a substantial problem of early tenure foreign challenges for democratic leaders. Our statistical analysis of international crisis initiations between 1918 and 1992 indicated that leadership experience helps to account for the disproportionate trouble that democracies attract. Moreover, our analysis of crisis outcomes during this period also indicated that inexperienced leaders were more likely to make concessions in international crises. We believe, therefore, that our analyses may point to a promising avenue for research on the problem of international conflict.

In terms of the policy implications of our results, we would *not*, of course, suggest that democratic states should make it more difficult to remove their leaders from office as a way of preventing international challenges. Instead, we suggest that it is important to recognize that inexperience may create a serious foreign policy problem for democratic leaders. Future research should seek to address how democratic leaders can mitigate the negative effects of their inexperience and reduce the risk of early tenure external military challenges.

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# Exploring the Dynamics of the Democratic Peace

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In quantitative models of international conflict, the variables' causal effects are generally assumed to be constant over historical time. Yet, qualitative liberal theorizing, especially that of Immanuel Kant, has tended to emphasize a dynamic perspective based on the theme of progress. To bridge this gap between method-imposed stasis and theoretical dynamics, a framework featuring time-varying parameters is applied to the democratic peace hypothesis. The model strongly confirms a dynamic reinterpretation of Kant's theory. Results show that dispute probabilities decline steadily among democratic states over time, and the democratic peace hypothesis is not just a transient cold war effect. This result is robust to statistical control involving geopolitical and liberal control variables, including alliances, capabilities, and economic development.

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Statistical methods play an important role in contemporary international relations (IR) research. With their help, scholars have been able to identify general patterns and causes of interstate conflict that elude ideographically framed explorations. Yet, these gains have usually been attained at the cost of making static assumptions. This applies especially to the now well-established democratic peace hypothesis. Due to methodological limitations imposed by conventional statistical techniques, time tends to drop out of contemporary operationalizations of liberal theory.

By contrast, qualitative IR theorizing knows no such bounds. Liberal thought has traditionally adopted a process-oriented perspective emphasizing the theme of progress. Immanuel Kant's famous peace plan is a case in point. Rather than envisaging the democratic peace as a static causal nexus, Kant postulated a macrohistorical process that would gradually pacify the international system.

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We claim that the lack of dynamics characterizing liberal quantitative research stems primarily from methodological constraints. Thus, the goal of this article is to bridge the gap between method-imposed stasis and theoretical dynamics. We do so by employing regression analysis with time-varying parameters to the problem of interstate conflict. Although familiar to statisticians, to our knowledge this tool has not yet been applied to IR problems.

Our findings strongly confirm a dynamic interpretation of the democratic peace. Based on popular data sets, we show that dispute frequencies among liberal states decrease over the past century and a half. This result is robust to a number of control variables, the effect of which we also presume to be time varying.

This study is organized as follows. The next section sketches the theoretical background of the main argument. The third section explicates the dynamic methodology followed by an introduction of the simple bivariate framework. The fourth section widens the explanatory scope to the more complex multivariate version. The concluding section summarizes the results and discusses the theoretical repercussions of our analysis.

### STATIC AND DYNAMIC INTERPRETATIONS OF THE DEMOCRATIC PEACE

Liberal thought in IR comprises an eclectic set of assumptions and hypotheses relating to various aspects of individual and societal freedom (Keohane 1990; Stein 1990). Beyond these normative dimensions, the recurrent theme is progress (Bull 1972; Nisbet 1969). In contrast to the realist belief in the perpetually conflictual nature of world politics, liberals assert that the international system can, and will, be transformed by peaceful and wealth-inducing cooperation:

(1) Since the late eighteenth century, liberals have believed that international relations are evolving (or probably will evolve) gradually and irregularly along lines that will promote *greater human freedom* conceived in terms of increases in physical security, material welfare, and opportunities for free expression and political influence. . . . (2) International liberals believe that peace, welfare, and justice are realized significantly through *international cooperation*. . . . (3) Liberals believe that peace, welfare, justice, and cooperation are being driven by a number of interdependent forces that we view as aspects of the *process of modernization*. (Zacher and Matthew 1995, 117; see also Keohane 1990, 174)

According to Zacher and Matthew (1995), this postulated macrohistorical process expresses itself in terms of liberal democracy, interdependence, cognitive progress, interaction, and international institutions. Although these mechanisms of “modernization” are present in republican, commercial, cognitive, sociological, and institutional strands of liberalism, respectively, we will here take the republican notion of liberal democracy as the starting point because it is the one that bears most directly on the democratic peace.

Most contemporary IR specialists acknowledge that it was Immanuel Kant who originated the republican-liberal case for peace. In his famous three-step argument,

based on three definitive articles, Kant (1970a, 1970b) outlined how perpetual peace would take root successively by spreading from one or a few strong democracies to the whole globe. The first step requires a republican domestic constitution. Once in place, the superior resource-extracting performance combined with defensive arrangements in the shape of a peaceful confederation secures the cooperative gains among democracies. Finally, a web of norms of “hospitality” can be expected to stabilize the entire state system.

Even from this capsule summary of the Kantian conjecture, it is clear that the famous philosopher had a dynamic process in mind rather than a set of invariant causal laws. According to Huntley (1996, 58), Kant suggested that “the violence inherent in the structure of anarchy actuates a transformational dynamic independent of the intentions of states themselves” (see also Russett, Oneal, and Davis 1998; Cederman 2001). More specifically, Kant’s diachronic theory rests on both “hard” and “soft” Darwinism (Kahler 1999) in the sense that the democratic security community prevails thanks to systemic selection effects and internal learning, respectively (Modelski 1990). Whereas evolution takes place through turnover of units in the former case, learning operates through actors’ adapting their behavior in response to their own experiences (Levy 1994). In the case of the democratic peace, conquest and externally imposed regime change represent prominent cases of selection effects. To the extent that democracies are more pacific and become more numerous, the overall effect will be a more peaceful international system. But, democratization does not necessarily require such violent shocks because peaceful change toward democratic rule also occurs on a voluntary basis through normative learning.

Despite this evolutionary logic, the vast majority of today’s scholars who have set out to evaluate Kant’s scenario empirically have lost track of the dynamic dimension and, thus, the central theme of progress. To a large extent, this static bias derives from implicit or explicit metatheoretical commitments to Hempelian covering laws (e.g., Ray 1995). The democratic peace proposition has even been equated theoretically with a constant causal effect of democracy on interstate behavior. For example, Farber and Gowa (1997, 456) contended that “dispute rates of members of democratic dyads relative to members of other country pairs vary across time. This is what casts doubt on the link many have drawn between politics and peace” (see also Gowa 1999). Moreover, for reasons of tractability and convenience, research practices among quantitative scholars have come to rely heavily on standard regression models with constant causal effects. It is, thus, commonly assumed that causation boils down to a set of fixed, causal relations operating uniformly across historical cases (Abbott 2001, 285–86). Whether the theorists intend to confirm or disconfirm the democratic peace, joint regime type almost always enters the equation as a standard independent variable in dyadic regression analysis (for reviews, see Chan 1997; Russett and Oneal 2001).

Recently, however, some IR scholars have attempted to factor in the dynamic aspects of the democratic peace into their statistical analysis. For example, Gaubatz (1996) traced the share of resources and territory controlled by democratic states over the past two centuries and came to a skeptical conclusion about the Kantian scenario. Yet, his study was limited to descriptive inference. To find studies that employ statistics in explanatory mode, we need to turn elsewhere. Mitchell, Gates, and Hegre

(1999) applied Kalman filter analysis to systemic data on war and democracy. Their findings confirm Kant's dialectical hypothesis, which states that warfare promotes democratic dominance in the international system. This dynamic reinterpretation represents an important innovative step toward temporally flexible modeling of the democratic peace. At the same time, however, it entails theoretical and methodological restrictions. Whereas most studies in the literature feature dyadic analysis, Mitchell, Gates, and Hegre's analysis focused on the systemic level.<sup>1</sup> Moreover, the Kalman filter allows for bivariate analysis only, which makes it difficult to capture the multidimensional nature of Kant's original conjecture.

In another statistical effort to investigate the dynamics of the democratic peace, Cederman (2001) introduced an explicit measure of calendar and relational time into a standard logit model. Even in the presence of control variables, the findings indicate that the causal impact of dyadic democracy increases with historical time, as would be expected from a Kantian perspective. In addition, democratic dyads become more pacific as these relationships mature. To simplify the analysis, the model represents temporal variations according to a simple decaying exponential function, which is derived from a simple behavioral learning framework. Although these results appear to confirm a dynamic liberal perspective within the commonly used dyadic framework, they do hinge on the assumption of functional form.

It would be desirable to move beyond this limiting methodological assumption, because there is no guarantee that the Kantian learning effect conforms with any specific functional form. The remainder of this study attacks this methodological problem by offering a more flexible way to express the temporal aspect of the democratic peace.

### A DYNAMIC MODEL OF THE DEMOCRATIC PEACE

The fundamental assumption of classical regression analysis is that the underlying relationships are invariant across observations and over time. Even though such invariant relationships rarely, if at all, exist in political science, scholars continue to assume parameter constancy in applying regression analysis to models. This is especially troubling since the models are derived from weak theories that rarely provide functional forms to rule out parameter variation with any degree of confidence.

On the other hand, qualitative liberal theories take a dynamic, process-oriented perspective in which causal effects are variant with respect to time and, in fact, contribute to a transformation of the entire system over time. This gap between theory and testing can be attributed, to a large extent, to the lack of appropriate statistical methods suited to dynamic models. The discrepancy is getting smaller in recent years, due to the development of a class of flexible estimating techniques that allow variation in coefficients to capture the dynamics of changes in causal relationships. One such technique is the generalized varying coefficient model proposed by Hastie and Tibshirani (1993) and more recently implemented by Cai, Fan, and Li (forthcoming). A varying coefficient model can be described by

1. See Beck, King, and Zeng (2000) for a critique of the standard dyadic format.

$$g\{m(\mathbf{u}, \mathbf{x})\} = \sum_{j=1}^p a_j(\mathbf{u})x_j \quad (1)$$

for some given link function  $g(\bullet)$ , where  $m(\mathbf{u}, \mathbf{x})$  is the mean regression function of a random variable  $\mathbf{Y}$  given covariates  $\mathbf{U} = \mathbf{u}$  and  $\mathbf{X} = \mathbf{x}$ . In this formulation,  $\mathbf{X}$  is just the standard set of covariates.  $\mathbf{U}$  is an *effect modifier* where  $U_1 \dots U_p$  change the coefficients of  $X_1 \dots X_p$  through functions  $\beta_1(\cdot), \dots, \beta_p(\cdot)$ . If  $\beta_j(U_j) = \beta_j$ , then we simply have the standard linear model or generalized linear model (GLM)

$$g\{m(\mathbf{u}, \mathbf{x})\} = \sum_{j=1}^p a_j x_j.$$

$U_j$ s could be variables such as time or age that could modify the effects of  $X_1 \dots X_p$ .  $U$  could also be multivariate in principle, but the extension to more than two dimensions could be computationally prohibitive due to the curse of dimensionality (Cai, Fan, and Li forthcoming). We use *calendar time* as the effect modifier. This approach provides a flexible way to map the trajectory of parameters within a well-understood GLM framework (see McCullagh and Nelder 1989). This approach also allows for a simple, especially graphical, interpretation of the results and is particularly well suited to longitudinal studies in which we can explore the variation of coefficients of the model over time (for more details, see the appendix). Another important advantage of the method is that standard errors can be computed along with the coefficient functions in the conventional way. On the other hand, the main drawback is that it is computationally intensive and unavailable in existing statistical packages.<sup>2</sup> However, although the implementation curve for the generalized varying coefficient model is steep at present, we hope the benefits of the method will become apparent in the two models we estimate in this and the following sections.

Formally expressed, we propose the following bivariate model as a conceptual starting point:

$$\text{MID}_{ij} = \beta_0(t) + \text{DEM}_{ij}\beta_1(t) + \varepsilon, \quad (2)$$

where  $\text{MID}_{ij}$  is a militarized interstate dispute that takes on the values 1 and 0 and  $\text{DEM}_{ij}$  is a dummy variable capturing a mutually democratic dyad. MID data are from the Correlates of War (COW) project at the University of Michigan (Gochman and Maoz 1984). The original MID measure covers any event involving the threat to use force or the actual use of force on a scale of 1 to 5. We recode this scale as a binary variable indicating the presence or absence of a militarized conflict between two states (the dyad) in a given year.<sup>3</sup> Democracy measures are from POLITY III data (Jaggers and

2. Each run took more than 200 CPU minutes on a fast SUN SPARCstation. The estimation time increases quite a bit for a bandwidth selected via cross-validation (see discussion in the appendix).

3. We also have coded the MID variable to include only disputes that have reached a higher level on the 1 to 5 scale and/or those that involved fatalities. Estimations based on more severe militarized interstate disputes produced qualitatively similar results to those reported in this study. We adopt the more conventional



TABLE 1  
The Static Effect of Democracy on  
Militarized Interstate Disputes (MIDs) ( $N = 68,764$ )

Variable	Dependent Variable ( $MID_{ij}$ )	
	Parameter	Estimate (SE)
Intercept	$b_0$	-3.83 (0.03)*
Mutual democracy ( $DEM_{ij}$ )	$b_1$	-1.00 (0.12)*

NOTE: Bivariate static logit results of MIDs from 1837 to 1992, excluding world wars. Results indicate that two democratic states have a lower propensity for involvement in conflict.

\*Significant at the .01 level.

Gurr 1994). Following standard practice, we code as democracies countries that have a score of 6 or higher on the democracy scale in POLITY III.

Both the MID and DEM measures are available from 1816 to 1992 for a large cross-section of countries. The first democratic dyad appears in 1837 in these data, and hence we use the 1837 to 1992 period in our estimation. Given the very complicated nature of MIDs during the two world wars, we exclude the subperiods 1914 to 1918 and 1939 to 1945 from our analysis (cf. Oneal and Russett 1998; Gowa 1999). Finally, following conventional practice, we use "politically relevant" dyads (Bremer 1992; Maoz and Russett 1993) as our case selection filter. Politically relevant dyads are those that actually have an opportunity to interact (due to geographic proximity or global reach in the case of major powers) and hence are likely to become involved in militarized disputes. Based on these criteria, we include 1,974 out of 2,430 MIDs, which we convert into the dyad-year format (leading to between 52,276 and 68,764 observations in the two models we estimate in this study). Because the dependent variable is binary, we use a GLM estimator with a logit link.<sup>4</sup>

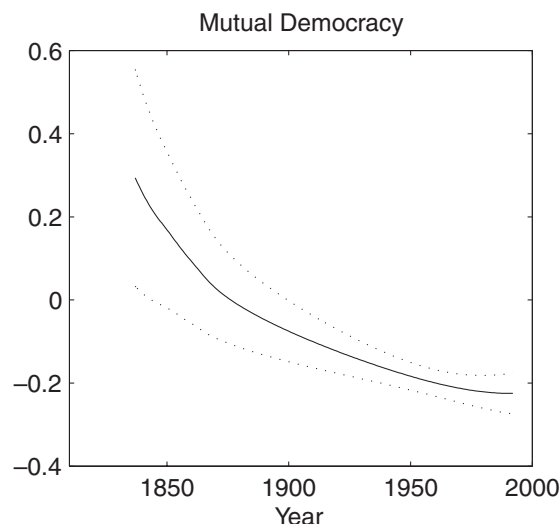
Before assessing the validity of our dynamic analysis, we consider the static findings. In accordance with the quantitative literature, Table 1 indicates that mutual democracy appears to have a strongly negative effect that is significant. Yet, in itself, this result does not allow us to trace the differential effect of democracy.

In keeping with the theme of this study, we therefore apply regression with time-varying parameters to the simple bivariate framework. The best way to evaluate the findings of the dynamic model is to inspect Figure 1, which plots the impact of interdemocratic relations. It immediately becomes clear that mutual democracy exhibits strong time variance, thus offering preliminary justification for our theoretical elaboration. In light of this evidence, the static analysis stands out as seriously inadequate.

More important for our dynamic argument, however, is the observation of an increasingly negative effect of democracy on militarized interstate conflict. Although it should be noted that no controls have been carried out so far, the democracy curve in

coding of militarized interstate disputes to focus attention on the time-varying aspects of the model rather than new coding rules.

4. All results reported in this article were estimated in MATLAB on a SPARCstation running Solaris. Data and code used in these estimations are available from the authors upon request.



**Figure 1: The Dynamic Effect of Democracy on Militarized Interstate Disputes**

NOTE: Bivariate varying coefficient logit results of militarized interstate disputes from 1837 to 1992, excluding world wars. Dotted lines are the estimated functions plus or minus twice-estimated standard errors. The results indicate that democracy has an *increasingly* negative effect on interstate conflict over time.

Figure 1 conveys a powerful message confirming the idea of progress. Democracy starts out being conflict inducing, but its influence becomes firmly pacifying from the turn of the century and descends steadily as the 20th century progresses. It is hard to conceive of more compelling preliminary evidence for a dynamic approach.

Note that the descending trend starts well before the shift to bipolarity or, for that matter, to nuclear weapons. Thus, the curve undermines realist attempts to explain away the democratic peace as a spurious phenomenon driven by the geopolitical determinants of the cold war (e.g., Mearsheimer 1990; Gowa 1999). That the curve starts out above the zero line suggests that, at least for the early to mid-19th century, democratic relations featured more conflict than other dyads. What explains this surprising phenomenon? First, the broad error bands indicate that the democracies' initial belligerence could be partly due to the very small number of observations for those early years. Second, and more substantive, we should not forget that the early democracies also were disproportionately involved in colonial squabbles. In fact, many of the 19th-century disputes pitted the United States against the United Kingdom.

### A MULTIVARIATE MODEL OF THE DEMOCRATIC PEACE

Before drawing any further conclusions, it is necessary to expose our basic findings to sensitivity analysis featuring control variables. It could well be that this particular,

dynamic version of the democratic peace fades away once confronted with competing hypotheses of geopolitical extraction. In addition, this section assesses whether there is a reinforcing influence of wealth-driven liberalism. To capture these theoretical possibilities, we extend our bivariate model to

$$MID_{ij} = \beta_0(t) + CAPSYM_{ij}\beta_1(t) + ALLY_{ij}\beta_2(t) + DEVEL_{ij}\beta_3(t) + DEM_{ij}\beta_4(t) + \varepsilon, \quad (3)$$

where  $CAPSYM_{ij}$  is a measure of the balance of power within the dyad,  $ALLY_{ij}$  flags the existence of at least one mutual military alliance between the two states in the dyad, and  $DEVEL_{ij}$  is the minimum level of economic development within the dyad. All three measures are from the COW project data sets (Gochman and Maoz 1984).  $CAPSYM$  is a measure of the share of system resources belonging to each side of the country pair. The share is a composite of six variables—military expenditure, military personnel, iron and steel production, energy consumption, total population, and urban population.<sup>5</sup> A score of 1 on this measure indicates a perfectly symmetrical dyad, and a score of 0 indicates a perfectly asymmetrical dyad. Therefore, a positive sign on the associated coefficient indicates that balance of power increases the propensity for conflict, and a negative sign indicates that balance of power reduces the propensity for conflict. Data for the capability shares (CapA and CapB) were taken from the EUGene program (Bennett and Stam 1998).  $ALLY$  is a dummy variable with 1 indicating the existence of a military alliance and 0 otherwise. This is our recoding of the original COW measure, which codes different levels of military alliance from 1 to 3 (Small and Singer 1990).

If  $CAPSYM$  and  $ALLY$  are our realist control variables,  $DEVELOP$  serves as a liberal alternative hypothesis. As per our discussion above, liberal thinking posits that as two countries develop economically, their propensity for getting involved in militarized conflicts will decrease. However, it is difficult to obtain a direct measure of economic development, such as per capita income over the past two centuries for a large set of countries. Instead, we adopt per capita energy consumption—an indicator closely related to per capita income—as a proxy for development (Bremer 1992). The two components of this measure—energy consumption and total population—are available in the national capabilities data from the COW project. The per capita energy consumption ranges from a minimum of 0 to a maximum of 34 for the period from 1816 to 1992 with a mean of 1.4 and a standard deviation of 2.4. Within this range, we needed to choose a cutoff level for classifying countries as developed. We selected a cutoff value of 2, which corresponds roughly to the classification of developed and developing countries reported in the World Bank's *World Development Indicators* (1998). By this measure, the United Kingdom reached a per capita energy consump-

5. From these shares, Ray and Singer (1973) have developed a measure of capability asymmetry where

$$Asymmetry = \sqrt{2 \left( \left( \frac{CapA}{CapA + CapB} \right)^2 + \left( \frac{CapB}{CapA + CapB} \right)^2 - 0.5 \right)}.$$

$CAPSYM$  is simply 1 minus the asymmetry measure.

TABLE 2  
The Static Determinants of Militarized Interstate Disputes (MIDs) ( $N = 52,276$ )

Variable	Dependent Variable ( $MID_{ij}$ )	
	Parameter	Estimate (SE)
Intercept	$b_0$	-4.27 (0.05)*
Symmetry of capabilities ( $CAPSYM_{ij}$ )	$b_1$	2.14 (0.10)*
Mutual alliance ( $ALLY_{ij}$ )	$b_2$	-0.34 (0.08)*
Level of development ( $DEVEL_{ij}$ )	$b_3$	-0.26 (0.11)*
Mutual democracy ( $DEM_{ij}$ )	$b_4$	-1.05 (0.13)*

NOTE: Multivariate static logit results of MIDs from 1837 to 1992, excluding world wars. Results indicate that mutual democracy, alliance, and development all contribute to a lower propensity for involvement in conflict. On the other hand, balance of power *increases* the propensity for conflict.

\*Significant at the .01 level.

tion of 2 around 1854, whereas the United States reached this level around 1887. Newly industrialized countries, such as Singapore and South Korea, reached 2 around 1973 and 1989, respectively.<sup>6</sup> At the lower extreme, countries such as China and India have per capita energy consumption of only 0.80 and 0.32, respectively, in 1991, and are therefore classified as developing. At the upper extreme of per capita energy consumption are oil-rich countries, such as Qatar (34 in 1991), the United Arab Emirates (22), and Brunei (16), which have among the highest per capita incomes. Finally, we also tried other cutoff values for development from 1 to 5, and these yield qualitatively similar results.<sup>7</sup> Our theoretical expectation here is that the higher the measure of DEVELOP, the lower the propensity for conflict. Finally, DEM remains our main liberal explanation and its operationalization is the same as described in the previous section.

Following the example of the previous section, we start by considering the static results (see Table 2). These suggest that the democratic effect remains almost entirely unchanged despite the introduction of control variables. In addition, both of the geopolitical factors have an important impact. The alliance variable points in the expected, negative direction and is significant. On balance, members of the same alliance appear to be less prone to engage in conflict, a result that confirms our intuition and the prevailing findings in the literature (Bremer 1992). Likewise, as shown by many quantitative studies of conflict, capability symmetry increases the likelihood of disputes. Although this finding contradicts conventional balance-of-power thinking, it corroborates the idea of power transition (Kugler and Organski 1989; for statistical

6. Per capita gross national product of Singapore in 1973 was U.S.\$3,070. For South Korea in 1989, it was U.S.\$3,230. Both are close to the commonly used cutoff of U.S.\$3,500 for development (World Bank 1998).

7. We also used the degree of urbanization—an indicator closely related to development—as a proxy for development. In that formulation, the DEVELOP measure is simply the minimum level of urbanization (share of urban population in total population) in the dyad. We found that both measures produce remarkably similar results. We retain the per capita energy consumption proxy, given its conceptual closeness to the per capita income measure.

evidence, see also Oneal and Russett 1997; Russett, Oneal, and Davis 1998). Consistent with liberal expectations, the proxy for development is negative and significant (cf., Ray 1995, 171-72).

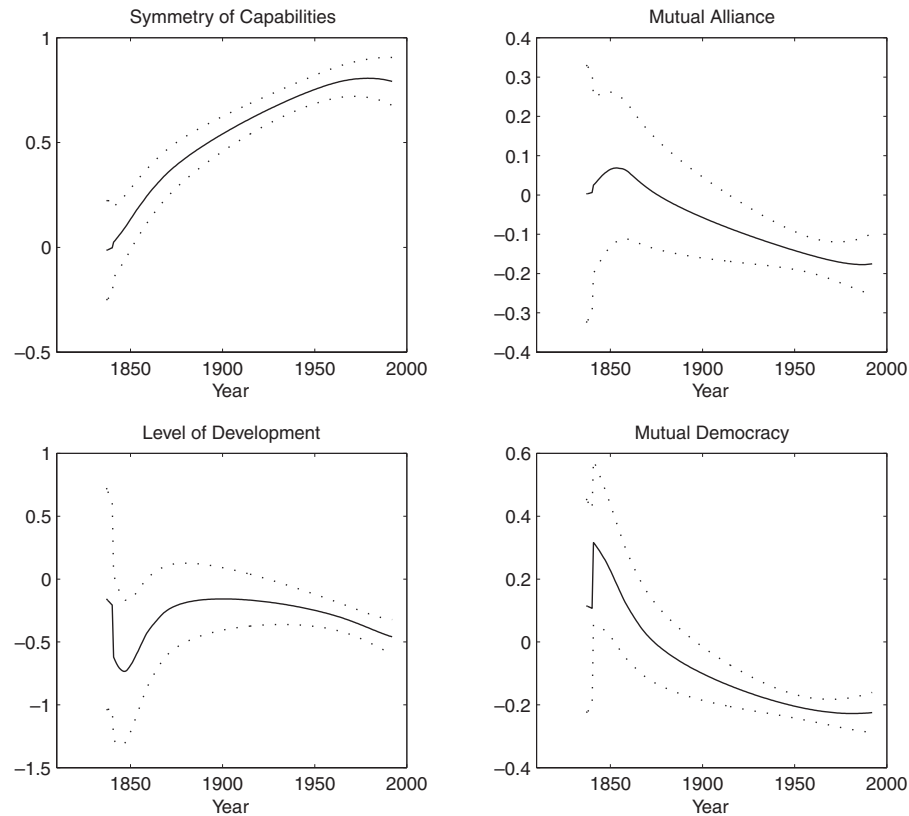
To find out whether these preliminary findings survive a shift to the dynamic analysis, we estimated a time-varying regression model with the same variables as in the static model.<sup>8</sup> As in the bivariate case, the graphical plot of the trends reveals more than the numerical results.

The four panels of Figure 2 summarize the effect of each independent variable. Once again, the strong temporal variance is immediately striking and thus further highlights the relevance of dynamic analysis. This applies for both of the geopolitical variables, the slopes of which appear somewhat puzzling. We start by considering the effect of alliances. With the exception of the 19th century (which may not even be an exception due to the broad error bands for the earlier part of that period), the influence of mutual alignment turns out to be increasingly conflict reducing. The fact that the trend is falling could possibly be accounted for by reference to polarity, to the extent that bipolar alignment systems are more predictable than multipolar ones (e.g., Waltz 1979). As the world's main alliance systems started to crystallize into two blocs around 1900, we would expect the alignment shifts to decline accordingly and, thus, also intra-alliance conflict. It may therefore not be surprising that as the cold war's rigid bipolar alignment patterns emerged, states belonging to the same alliance exhibited an increasing tendency to refrain from initiating mutual disputes. Of course, there were still cases of intra-alliance squabbling, such as the repeated disputes between NATO members Greece and Turkey, but, in the aggregate, it is possible that alliances acquired more normative "stickiness" than the multipolar balance-of-power politics of the 19th century (Risse-Kappen 1996).

The measure of capability symmetry again confirms the positive effect of the corresponding static coefficient, but the temporal variation is considerable. This is surprising because, as explained above, the capability index includes equally weighted components that measure various conceptual dimensions of power and should thus, at least in theory, be reasonably insensitive to historical variations. Yet we find that, from having made little difference in the mid-19th century, the capability measure grows monotonically, reflecting an increasing relevance of capabilities to dispute behavior. Although this ascending trend requires deeper scrutiny than can be offered here, one could infer that the increased cost of warfare has raised the dispute threshold. In other words, as the military violence becomes more costly, only acute cases of symmetry-induced uncertainty are likely to trigger conflicts. Finally, this means that the importance of the capability symmetry increases.

Going beyond geopolitics, we now turn to the liberal part of the argument. The development proxy behaves as would be anticipated by liberal scholars. Throughout the entire period, the effect is negative, and it becomes more so toward the end of the sample. After starting out with wide error bands in the mid-18th century due to missing

8. Following Beck, Katz, and Tucker (1998), it is now common to include a smooth term in duration to correct for duration dependence in international relations models that use dyad-year design. Because the generalized varying coefficient model already picks up time variation, the duration dependence correction is not necessary in this case. (We thank Neal Beck for helpful discussions on this point.)



**Figure 2: The Dynamic Determinants of Militarized Interstate Disputes**

NOTE: Multivariate varying coefficient logit results of militarized interstate disputes from 1837 to 1992, excluding world wars. Dotted lines are the estimated functions plus or minus twice-estimated standard errors. The results indicate that democracy has an *increasingly* negative effect on interstate conflict over time, even after the introduction of realist and liberal control variables.

data problems (see below), the curve follows a slowly sinking trend with narrowing error bands from the turn of the century.

Last but not least, we notice that the democratic trend retains its markedly downward slope, not unlike Figure 1. Starting above the zero line, although with large standard errors, the curve descends quickly into the negative range and remains there for the remainder of the sample period. Because of the gradual narrowing of the error bands, this estimate can be regarded as increasingly robust over time.

Before closing the discussion of Figure 2, a few comments on the shape of the curves in the various subplots are in order. There are very few observations without missing data in the earlier years of our time period. In fact, there are only 12 observations in 1837, 24 in 1840, and 12 in 1841 and 1842. Similarly, there are significant fluctuations in the number of democracies in the data set in these earlier years. The first

democracy appears in 1837 but disappears the following year, only to reappear in 1845. These data problems explain the kinks in the earlier portion of the curves in Figure 2, especially in the development and mutual democracy curves. In contrast, the bivariate mutual democracy curve in Figure 1 has no control variables and far fewer missing data. Therefore, that curve is smoother.

In sum, the dynamic estimation has shown that economic and republican liberalism work in tandem, mutually reinforcing each other. These liberal features survive the exposure to two geopolitical control variables that tap alignment patterns and capability balances.

## CONCLUSION

Although our theoretical discussion falls short of uncovering the microfoundations of the democratic peace, we believe that the empirical findings of this study are suggestive enough to confirm the fruitfulness of such a model-building venture. Contrary to the assumptions of conventional regression analysis, we have found that the influence of key variables tend to vary significantly over time. Indeed, the increasingly pacifying impact of interdemocratic relations vindicates a dynamic interpretation of liberalism.

Although we acknowledge the tentative nature of our findings, we are able to draw a number of important theoretical conclusions. First, realist attempts to explain away the democratic peace as an aberration of the cold war lose credibility, because the decline in conflict propensity among democratic states sets in well before this particular period and does not seem to be reducible to geopolitical effects.

Static interpretations of liberalism fare better in certain respects because, on average, their preferred variables do seem to have the anticipated effect. As long as the empirical scope is limited to comparatively short and stable periods, this static perspective should perform well. Nevertheless, our dynamic findings cast doubt on the cross-temporal generality of such second-image theorizing. In their eagerness to develop a positive theory of liberalism based on static regression analysis and one-shot causal schemes, these liberal theorists seem to have lost sight of liberalism's progressive theme.

We believe that IR theory is likely to benefit from adopting a more explicitly process-oriented perspective instead of expecting causal factors to operate according to putatively time-invariant covering laws. The flexible statistical tools introduced in this study make it possible to escape the limitations of such method-driven research, which forces researchers to sacrifice theoretical imagination for empirical rigor.

We have tried to show that regression modeling with time-varying parameters allows the analyst to adopt an explicitly dynamic perspective that emphasizes the possibility of long-term change. Yet, much work remains to be done before the temporal sequence and spatial interdependence of so far insufficiently articulated causal mechanisms can be pinpointed.<sup>9</sup> In terms of theory, the current study leaves open the question

9. See Gleditsch and Ward (2000) for a pioneering study along these lines.

of the precise relationship between evolution and learning and instrumental rationality and normative evolution.

Nevertheless, despite these empirical and theoretical caveats, it is appropriate to end on a hopeful note. According to our findings, interstate relations among democratic states do appear to be evolving steadily in a pacific direction. This should stimulate researchers to consider the possibility of progress in their theoretical schemes rather than assume it away on a priori grounds. Instead of bemoaning the inexorable laws of anarchy or searching for an invariant link between regime type and conflict patterns, it is incumbent on IR scholars to render the invisible hand of Kantian liberalism a bit more visible, thus contributing to policy making that would prevent its grasp from slipping in the future.

## APPENDIX

We refer interested readers to Cai, Fan, and Li (forthcoming) for extensive technical details on the implementation of the varying coefficient model, of which we present only an overview. The basic goal is to estimate the coefficient functions  $a_j(\bullet)$  in equation (1), which is usually accomplished through a local smoothing technique. Each point  $u_0$  ( $u$ , again, is time in our case) is approximated by a function  $a_j(u)$  locally by a linear function  $a_j(u) \approx a_j + b_j(u - u_0)$  for  $u$  in the neighborhood of  $u_0$ . The conditional density of  $Y$  given the covariates  $(\mathbf{U}, \mathbf{X})$  can be written as

$$f(y|\mathbf{u}, \mathbf{x}) = \exp\{[\theta(\mathbf{u}, \mathbf{x})y - b\theta(\mathbf{u}, \mathbf{x})]/a(\phi) + c(y, \phi)\} \quad (4)$$

for given functions  $a(\bullet)$ ,  $b(\bullet)$ , and  $c(\bullet, \bullet)$ . For a random sample  $\{(U_i, \mathbf{X}_i, Y_i)\}_{i=1}^n$  from this model, the coefficient functions can be estimated using the following local likelihood method:

$$\ell(\mathbf{a}, \mathbf{b}) = \frac{1}{n} \sum_{i=1}^n \ell \left[ g^{-1} \left\{ \sum_{j=1}^p (a_j + b_j(U_i - u_0)) X_{ij} \right\}, Y_i \right] K_h(U_i - u_0), \quad (5)$$

where  $K_h(\bullet) = K(\bullet/h)/h$ ,  $K(\bullet)$  is a kernel function,  $h = h_n > 0$  is a bandwidth,  $\mathbf{a} = (a_1, \dots, a_p)^T$ , and  $\mathbf{b} = (b_1, \dots, b_p)^T$ . Maximizing this function gives estimates of  $\hat{\mathbf{a}}(u_0)$  and  $\hat{\mathbf{b}}(u_0)$ , and the components of  $\hat{\mathbf{a}}(u_0)$ , in turn, provide an estimation of  $a_1(u_0), \dots, a_p(u_0)$ . To obtain coefficient functions  $\hat{a}_j(\bullet)$ , the local likelihood function in equation (5) is estimated for many distinct values of  $u_0$ . In addition to the coefficient functions, this method also allows one to compute pointwise confidence intervals in the conventional way.

One important choice to make in the estimation process is the value for the bandwidth parameter  $h$ , which is a measure of the size of the smoothing window. The choice of bandwidth is a tradeoff between smoothing the coefficient functions  $a_j(\bullet)$  to remove insignificant bumps and not smoothing too much to remove real peaks and valleys in the process (Venables and Ripley 1997). There is now a rapidly developing literature on the selection of bandwidth, but most ideas are based on some form of cross-validation in which the data at each observation are deleted in turn and the remaining observations are used to fit the model. In the results we report later in this study, we estimated the model for a wide range of bandwidth values, and the results are qualitatively robust.

A few words on alternative methods to map coefficient variation might also be useful. Although the vast majority of empirical studies in international relations make no attempt to test



the constancy assumption, there are methods that allow us to search for parameter variation. Two excellent reviews of varying coefficient models can be found in Beck (1983) and Wood (1998). Perhaps the best known method deals with discrete time-varying parameters. If we are searching for a shift in the parameters between two known periods, Chow (1960) has proposed that we could estimate the shift by estimating two equations representing the two subperiods. We could then test to see if the coefficients have changed between the two subperiods. The Chow test provides a way to test the null hypothesis of no difference in parameters by comparing the sum of squared residuals from the two subperiod equations to the overall equation. To the extent political scientists consider parameter variation at all, it is generally limited to computing the Chow test. However, there are two fundamental problems with this approach: the first is that it assumes that we know the two subperiods *a priori*, generally an unrealistic assumption; the second is that the test is sensitive to the exact specification of the subperiods, making the first concern even more important (Beck 1983). Furthermore, an additional assumption of this approach is that the parameters be constant within the subperiods but change only across the subperiods, thus ruling out gradual evolution of the kind proposed in this study. A technique that allows for change in the parameter at a point not fixed in advance, as in the Chow test approach, is change-point (or segmented) regression (Chappell 1989). This technique has the benefit of providing a data-driven approach to picking the change point and continuity in the coefficient function at the change point. However, the flexibility with which parameter variation can be modeled is quite limited.

An alternative approach to capturing variation in parameters is to estimate moving regressions based on contiguous subsets of the data and then plot the parameters for each of these subsets on a single plot. If there is variation in the parameters, it should be revealed in the plot. The main drawbacks to this approach are that there is no statistical test to measure the significance of variation and the plots are sensitive to the number of observations in each subset. Too many observations in each estimation may mask the variation, whereas too few would produce estimates with large errors. Polynomial regression is a method that overcomes some of these problems. If we assume that the parameters vary in a smooth manner, then we can approximate the time variance of any parameter with a polynomial of some degree, with higher degree polynomials providing more flexibility in capturing the dynamics of parameter variation. Hinich and Roll (1981) proposed using Legendre polynomials to avoid numerical difficulties that nonorthogonal polynomials would pose and an *F* test to test the null hypothesis that all the coefficients are 0. This technique is easy to implement but has the drawback that the shape of the coefficient function is very sensitive to the degree of polynomial used. Furthermore, it requires a strong prior assumption about the structure of variation in a parameter and does not allow for modeling the coefficient function in a flexible way.

A more recent method for exploring parameter variation is flexible least squares (FLS), proposed by Kalaba and Tesfatsion (1989). The basic approach of FLS is to estimate the relative costs in terms of residual measurement and dynamic error under the assumption of constant versus varying coefficients. Given a particular set of observations, the costs are mapped along a residual efficiency frontier (REF). A smoothness parameter (similar to the bandwidth parameter in the model we use in this study) allows one to force the varying coefficient function toward or away from the constant coefficient least squares solution along the REF. Wood (1998) provided an overview of FLS with applications to presidential approval and U.S. federal government expenditures. The main drawback to FLS is that it is not appropriate for models with limited dependent variables and nonnormal disturbances.

The generalized varying coefficient model used in this study applies to a broad class of models and provides an extremely flexible framework for estimating varying parameter models. It is especially suited for longitudinal analysis and has the benefit of being part of a well-understood,

generalized, linear models framework. In addition, interpretation of the results is straightforward, and the results are especially accessible in their graphical form.

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# The Study of Interdependence and Conflict

## RECENT ADVANCES, OPEN QUESTIONS, AND DIRECTIONS FOR FUTURE RESEARCH

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A burgeoning literature has emerged on the relationship between economic interdependence and political conflict. This literature is evaluated, and three issues are raised for future research. First, there is a need to improve the theoretical basis of claims about the influence of interdependence on conflict and to specify more clearly the causal mechanisms underlying any such relationship. Second, future research should identify the boundary conditions of the effects of interdependence on conflict. Third, much more attention must be paid to the definition and measurement of interdependence and conflict.

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Over the past few decades, there has been a surge of interest in the relationship between economic interdependence and political conflict. One view that has gained considerable popularity is that growing economic exchange fosters cooperative political relations. Voiced with increasing regularity in both academic and policy circles, this idea has been used to help justify the formation of the European Economic Community, Richard Nixon's opening to China, Willy Brandt's *Ostpolitik*, and Henry Kissinger's conception of détente with the Soviet Union. Nonetheless, critics of this argument have not been stilled. Some observers maintain that, rather than fostering cooperation, heightened economic interdependence generates political discord. Even more widespread is the argument that economic exchange has no strong bearing on the high politics of national security.

This debate is hardly new. For centuries, the nature and strength of the links between interdependence and conflict have been the subject of heated disagreement. Until recently, however, these links remained the subject of remarkably little systematic scrutiny. Lately, the widely recognized need to fill this gap has stimulated a burgeoning empirical literature, the bulk of which concludes that greater economic inter-

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dependence does indeed inhibit interstate hostilities. Still, the question cannot be considered closed, and our purpose here is to suggest directions for the next wave of research on interdependence and conflict.<sup>1</sup>

We argue that three fundamental issues merit additional attention in future work on this topic. First, there is a pressing need to improve the theoretical basis of claims about the effects of interdependence on the use of force. Although considerable progress has been made over the past 20 years in moving beyond broad speculation about whether interdependence influences conflict, too little attention has been focused on identifying the causal mechanisms underlying any such relationship. Second, more effort should be devoted to identifying the boundary conditions of the effects of economic exchange on belligerence. Recent studies suggest that these effects may have changed over time and may differ across countries. There is also some evidence that these effects depend on certain domestic and international factors. We need a better understanding of how such factors condition the relationship between interdependence and hostilities. Third, too little attention has been paid to the definition and measurement of interdependence and conflict. Interdependence is a complex and multifaceted phenomenon; conflict between nations occurs at many levels and in several forms. Scholars have yet to resolve in what form and in what sense interdependence is expected to influence conflict of which type and at what level of intensity.

In the sections that follow, we summarize the core arguments that have been advanced about the relationship between economic exchange and political hostilities and review the recent spate of data-analytic studies designed to test these arguments. We then discuss the major theoretical issues facing scholars working on this topic and consider how the concepts of interdependence and conflict might be clarified and better integrated with causal arguments about the relationship between them. Addressing these issues is crucial. Not only will doing so promote a fuller understanding of how economic relations influence interstate hostilities, it will also help to resolve a broader set of debates over the merits of liberal and realist explanations of international relations, the causes of war, and the political economy of national security.

### INTERDEPENDENCE AND CONFLICT: LIBERALS VERSUS REALISTS

Central to much of the literature on interdependence and conflict is the longstanding claim that open international markets and heightened economic exchange inhibit interstate hostilities. In developing this thesis, liberals have stressed a variety of different causal mechanisms.<sup>2</sup> One argument—cast primarily at the level of the nation-state—is that economic exchange and military conquest are substitute means of acquiring the resources needed to promote political security and economic growth (e.g., Staley 1939). As trade and foreign investment increase, there are fewer incen-

1. For a more extensive analysis of many of the issues raised in this article, see Mansfield and Pollins (forthcoming).

2. For an overview of the various strands of this argument, see de Wilde (1991), Doyle (1997), Keohane (1990), and Stein (1993).

tives to meet these needs through territorial expansion, imperialism, and foreign conquest (Rosecrance 1986). Conversely, heightened barriers to international economic activity stimulate conflicts of interest that can contribute to political-military discord (Viner 1951, 259). Another liberal argument—cast largely at the level of the country-pair, or dyad—is that economic intercourse increases contact and promotes communication between private actors in different countries as well as between governments. Increased contact and communication, in turn, are expected to foster cooperative political relations (Doyle 1997, chap. 8; Hirschman 1977, 61; Stein 1993; Viner 1951, 261).

Still another theme stressed by many liberals is that commercial openness generates efficiency gains that render private traders and consumers dependent on foreign markets. Because political antagonism risks disrupting economic relations between participants and jeopardizing the gains from trade, these actors have reason to press public officials to avoid military conflicts. For their part, public officials—who rely on societal actors for political support and have an interest in bolstering their country's economic performance—have reason to attend to such demands. This argument has been a centerpiece of liberal views on war for centuries. Montesquieu, for example, claimed that

the natural effect of commerce is to lead to peace. Two nations that trade together become mutually dependent: if one has an interest in buying, the other has an interest in selling; and all unions are based on mutual needs. (Quoted in Hirschman 1977, 80)

Whereas Montesquieu's claim centers on bilateral relations, the argument that heightened economic dependence inhibits belligerence has also been cast at the systemic level of analysis. As Barry Buzan (1984, 598) mentioned, a core element of the liberal position is that "a liberal economic order makes a substantial and positive contribution to the maintenance of international security."<sup>3</sup>

However, the liberal view has been criticized by mercantilists and many realists who insist that unfettered economic exchange can undermine the national security of states. Albert O. Hirschman ([1945] 1980), for example, has pointed out that the gains from trade often do not accrue to states proportionately and the distribution of these gains can affect interstate power relations. Shifting power relations, in turn, are widely regarded as a potent source of military conflict (Gilpin 1981; Levy 1989; Mearsheimer 1990). In the same vein, the extent to which trade partners depend on their commercial relationship often varies substantially among the constituent states. If one partner depends on a trading relationship much more heavily than another partner, the costs associated with attenuating or severing the relationship are far lower for the latter than the former. Under these circumstances, trade may do little to inhibit the less dependent state from initiating hostilities.

3. Erich Weede (1995) has advanced an argument related to the liberal claims summarized above that emphasizes the indirect effects of heightened trade on hostilities. As he put it, "trade within as well as between nations promotes prosperity. Prosperity promotes democracy. There is almost no risk of war among democracies" (p. 520).

Another challenge to the liberal thesis stresses that states have political reasons to minimize their dependence on foreign commerce. Military expansion offers one way to achieve this end. Hence, as trade flows and the extent of interdependence increase, so do the incentives for states to take military actions to reduce their economic vulnerability (Gilpin 1981, 140-41; Liberman 1996). Consistent with such arguments, Alexander Hamilton asserted in 1796 that protecting the industrial sector from foreign competition would enhance the United States' "security from external danger" and give rise to "less frequent interruption of their peace with foreign nations" than open trade policies (quoted in Earle 1986, 235). Furthermore, as commerce rises, so does the range of economic issues over which disputes can emerge. Kenneth Waltz (1970, 205, 222), for example, maintained that since

close interdependence means closeness of contact and raises the prospect of at least occasional conflict . . . the [liberal] myth of interdependence . . . asserts a false belief about the conditions that may promote peace.

As such, heightened interdependence may actually stimulate belligerence.

Finally, various observers conclude that international economic relations have no systematic bearing on political conflict (Buzan 1984; Gilpin 1987; Ripsman and Blanchard 1996/97). Many of them hold that hostilities stem largely from variations in the distribution of political-military capabilities and that power relations underlie any apparent effect of economic exchange on military antagonism. These scholars, for example, frequently point to the fact that economic ties between the major powers were significant prior to World War I but far less extensive prior to World War II as evidence that economic links have little systematic impact on armed conflict when core national interests are at stake.

### **STATISTICAL STUDIES OF THE RELATIONSHIP BETWEEN INTERDEPENDENCE AND CONFLICT**

Despite enduring and heated debates about the relationship between interdependence and conflict, empirical analyses of this issue have emerged only recently. The vast bulk of such research has employed statistical methods to analyze large data sets. By contrast, a relatively small number of case studies on this topic have been conducted. We will discuss findings from these case studies at later points in this article. In this section, our purpose is to trace the evolution of large-*n* studies on interdependence and conflict since their inception in 1980.<sup>4</sup> Most such studies support the liberal hypothesis that heightened economic exchange inhibits conflict, although some research challenges these findings. We will examine both camps in turn.

4. For a general overview of empirical studies published through the mid-1990s, see McMillan (1997). More recent studies are contained in Blanchard, Mansfield, and Ripsman (2000) and a special issue of the *Journal of Peace Research*, which was published in 1999 and edited by Katherine Barbieri and Gerald Schneider.



## THE LIBERAL LINEAGE IN LARGE-N STUDIES

Rigorous efforts to examine the ties between economic intercourse and interstate conflict began roughly two decades ago with a pioneering study conducted by Solomon W. Polachek (1980). Far from beginning with a theoretical interest in international disputes, Polachek—a labor economist—simply wondered whether any insight into labor-management strife might be gained by studying political relations between economically interdependent countries.<sup>5</sup> Just as strikes harm the welfare of workers and firms alike, he reasoned, interstate conflict may interrupt mutually beneficial commerce between nations, thus creating a material incentive to avoid the use of force. From this intuition, he developed a formal model showing that the higher the gains from trade between states, the lower the level of conflict between them. Polachek had essentially rediscovered the core liberal claim regarding economic ties and the spread of peace. To test this model, Polachek analyzed the relationship between the volume of bilateral trade and an indicator of the annual “net conflict” between countries constructed from the Conflict and Peace Data Bank (COPDAB) (Azar 1980). He found an inverse relationship between these variables, providing evidence for the liberal position.<sup>6</sup>

In the wake of this seminal article, dozens of studies have explored the links between international trade and hostilities. Most of them have followed Polachek (1980) in focusing on pairs of countries during the era since World War II, although some have been cast at the monadic or the systemic level of analysis, and some have examined longer periods of time (Domke 1988, 119-31; Mansfield 1994; Russett and Oneal 2001). The bulk of these studies have found that rising trade flows inhibit political conflict; however, they have also generated additional hypotheses, drawn links to neighboring research communities, and inspired important methodological innovations with broad implications for the study of international relations.

The first theoretical and empirical expansion of the liberal idea was offered by Pollins (1989a, 1989b). According to the liberal logic, heightened trade inhibits conflict because conflict interferes with commercial relations.<sup>7</sup> Hence, economic agents (consumers, firms, etc.) should favor trade with friendly states and, all other things being equal, avoid trade with rivals and adversaries. In short, Pollins argued, the diplomatic climate between nations will significantly shape patterns of international economic exchange. A parallel argument was offered by Joanne Gowa and Mansfield (1993), who pointed out that trade generates security externalities. Specifically, the gains from trade enhance the political power of each commercial partner, and therefore the distribution of these gains can alter power relations between those partners, their friends, and their rivals. As such, countries will prefer to liberalize trade with allies—since alliances internalize the security externalities stemming from commerce—and restrict trade with adversaries.

5. For an account of how he became involved in the study of trade and conflict, see Polachek (forthcoming).

6. Close to this time, and working independently of Polachek, Arad and Hirsch (1983) offered a formal model of the liberal idea and applied it in a more discursive way to a study of Arab-Israeli relations.

7. However, a study by Barbieri and Levy (1999) challenged this assumption by pointing out various cases in which trade continued between warring countries.



The arguments put forward by Pollins (1989a, 1989b) and Gowa and Mansfield (1993) imply that a simultaneous relationship exists between trade and conflict. Interdependence may foster peace, but political-military relations also shape commerce. The issue of simultaneous causation had been recognized by Polachek (1980, 1992) and Pollins (1989b) and has been explored in various studies (Gasiorowski and Polachek 1982; Kim 1998; Mansfield 1994; Pollins and Reuveny 2000). Data, model specification, and estimation issues surrounding this topic are complex. But much of the literature on the subject suggests that the relationship between trade and conflict is indeed reciprocal. Consequently, studies examining only the influence of trade on conflict or that of conflict on trade—but not both—run the risk of generating results that are undermined by a simultaneity bias. More work on this question is needed.

Liberal theories of international relations do not focus solely on economic interdependence. They also emphasize the pacifying effects of democratic regimes and international organizations (Doyle 1997; Russett and Oneal 2001). Recently, John Oneal and Bruce Russett conducted a series of influential empirical analyses addressing these three legs of what they refer to as the “Kantian Tripod” (Oneal et al. 1996; Oneal and Russett 1997, 1999a, 1999b; Russett and Oneal 2001; Russett, Oneal, and Davis 1998). They have found considerable evidence that each leg strongly affects the likelihood of military disputes: democracy, extensive economic interdependence, and shared membership in supranational institutions all reduce the probability of antagonism.

Bridging research on the relationship between economic exchange and conflict to research on the democratic peace has proven to be quite fruitful. The various works by Oneal and Russett on this issue were seminal and gave rise to a rapidly expanding literature. Particularly important are studies that attempt to specify the conditions under which interdependence inhibits conflict, studies that measure interdependence using factors other than trade flows, and studies that bring recent methodological advances to bear. Each group of studies is discussed later in this article.

#### CHALLENGES TO THE LIBERAL CLAIM

Although much of the existing empirical literature indicates that the flow of trade is inversely related to conflict, some research has qualified this finding, and other studies reject it altogether. It is noteworthy that the earliest questions about Polachek’s (1980) findings were raised by Polachek himself, and two of the strongest challenges to the liberal proposition were mounted by his students—Mark Gasiorowski and Katherine Barbieri. From the outset, Polachek noticed that aggregating data across all dyads produced a negative relationship between trade and conflict but that analyses of U.S. relations with several other countries over time yielded a positive relationship between these variables (Polachek forthcoming). A closer look at U.S. relations with Warsaw Pact nations suggested that the relationship was nonlinear—negatively sloped for high values of trade, but ambiguous in other situations (Gasiorowski and Polachek 1982).

Gasiorowski (1986) took a different and important tack. He noted that economic interdependence is a multifaceted phenomenon. Some facets, such as the gains each state realizes from economic exchange, should inhibit conflict as the liberals predict.

Other facets, however, such as concerns over the distribution of these gains between states, could aggravate conflict as many realists predict. Gasiorowski disentangled the impact of different aspects of interdependence and found that it can have both conflict-inhibiting and conflict-promoting effects. Although his model was almost certainly underspecified (because it omitted a wide variety of variables besides interdependence that are likely to influence interstate conflict), and some subsequent work has found that different aspects of interdependence often have similar effects on conflict (Oneal and Russett 1999a), Gasiorowski's research points to the pressing need for improved measures of interdependence, an issue we discuss further below.

Barbieri (1996a) found that interdependence is positively related to dyadic conflict. She focused on the effects of trade asymmetries and national vulnerabilities created by foreign commerce—aspects of interdependence that realists believe to be conflict-inducing. Barbieri's work has generated considerable controversy, and her results remain open to question. The specification of her trade variables is highly nonlinear (Polachek forthcoming), which makes it difficult to interpret her findings. In addition, Oneal and Russett (1999a, 426) concluded that Barbieri's results are sensitive to slight changes in the specification of her trade indicators. Nonetheless, Barbieri's research raises fundamental questions about the nature and strength of the relationship between interdependence and conflict.

Finally, empirical support for the liberal argument has been challenged on methodological grounds. Specifically, some studies have criticized the statistical techniques used in time-series, cross-section research in which conflict is observed as a binary dependent variable, taking on the value of 1 if hostilities occur and 0 otherwise. In response to these criticisms, new estimation methods have been developed. The initial applications of these new techniques found little evidence that trade influences military disputes (Beck, Katz, and Tucker 1998; Beck and Tucker 1996), although subsequent applications have yielded results that more closely conform to the liberal position (Bennett and Stam 2000; Russett and Oneal 2001).

In all, large-*n*, data-analytic research on the relationship between interdependence and conflict has made crucial advances over the past 20 years. The core liberal claim has found a considerable amount of support. Extensions of the basic liberal idea and connections to compatible "islands of theory" have been established, most notably to the rapidly expanding body of work on the democratic peace. At the same time, challenges to this mainstream work highlight gaps in our understanding and unresolved questions about the links between interdependence and conflict.

### THEORETICAL ISSUES FOR FURTHER EXPLORATION

Most of the burgeoning literature on interdependence and the use of force consists of empirical efforts to determine whether these two phenomena are related. Although this line of inquiry has yielded a set of important findings, inadequate attention has been paid to the causal mechanisms underlying these results. Equally, too little effort has been made to assess whether the interdependence-conflict relationship is bounded

by space and time and whether it depends on domestic or international conditions. We consider these issues in turn.

#### CONCEPTUAL FOUNDATIONS AND CAUSAL MECHANISMS

Even a casual review of the myriad arguments regarding interdependence and hostilities indicates that a wide variety of causal mechanisms have been stressed. Taking this literature as a whole, armed conflict between states has been linked to the interests of consumers, firms, industries, interest groups, nations, supranational institutions, and markets, among other factors. Some arguments are cast at the subnational level of analysis, for example, the claim that firms and consumers have vested interests in commerce that lead them to restrain government officials when conflict is on the horizon, lest hostilities rupture important economic ties. Other arguments are cast at the state level, as when it is argued that economic dependence motivates leaders to satisfy material needs via conquest rather than trade. Still another set of claims focuses on the dyadic level of analysis, for example, positing that the extent and asymmetry of interdependence between states influence the likelihood that they will resort to force. Finally, a number of different causal explanations are pitched at the supranational or systemic level of analysis. Among these explanations are that trade organizations reduce the likelihood of armed conflict among members, that heightened global trade reduces the prospects of war throughout the system, and that the anticipated negative response of capital markets to war gives national leaders pause before they resort to the sword.

In short, there is a welter of plausible hypotheses about the connections between interdependence and conflict. As long as scholars focus primarily on establishing whether these factors are systematically related, there will be various theories to fit the results of almost any empirical study. Greater attention, therefore, needs to be focused on specifying and testing the observable implications of particular causal mechanisms advanced in theories of interdependence and conflict. Doing so is likely to facilitate a better understanding of why and how economic exchange influences the outbreak of armed aggression.

Especially important is the need to articulate more fully the causal mechanisms underlying various theories. As noted earlier, the most widespread liberal argument is that open economic exchange leads private traders and consumers to become dependent on overseas markets. These actors have incentives to withdraw support for public officials who take actions—such as engaging in military conflicts—that are commercially harmful. Realizing this, public officials who need such support have reason to resolve interstate disputes before open hostilities break out.

It would be useful, however, to more fully develop this argument by addressing which groups in society benefit from open international markets, which groups are harmed by commercial openness, and the political influence of these respective segments of society, given existing domestic institutions. One possibility would be to draw on the Stolper-Samuelson theorem. It demonstrates that for a given country, trade barriers benefit the owners of factors of production in which the country is poorly

endowed and impose costs on the owners of factors of production in which the country is abundantly endowed (Stolper and Samuelson 1941). By increasing the risk of trade and the price of imports, military conflict can have exactly the same effect as heightened protection. As such, there is reason to expect that owners of locally abundant factors of production might coalesce to press political leaders to avoid conflict but that the owners of locally scarce factors might behave much differently (Rogowski 1989).

An alternative possibility would be to rely on a specific-factors framework (Mussa 1974), which—in contrast to the Heckscher-Ohlin theorem that underpins the Stolper-Samuelson model—assumes that some factors of production are immobile, at least in the short run. This framework suggests that military conflict is likely to impose particular damage on locally abundant factors that are immobile since they gain from open trade and cannot be easily relocated in the event of hostilities. Furthermore, a specific-factors approach leads to the expectation that lobbying for trade policy will occur along industry rather than factor lines (Magee 1980) and that the factors employed in export-oriented industries will be much more likely to press leaders to resolve political disputes than the factors employed in import-competing sectors.

Regardless of whether trade-policy preferences are drawn along industry or factor lines, however, more attention also needs to be paid to how domestic actors influenced by interdependence affect foreign policy. Recent work on the political economy of trade policy may prove useful in this regard.<sup>8</sup> Some studies argue that government officials set trade policy with an eye toward balancing the preferences of special interests and society at large. Arye L. Hillman (1982, 1989), for example, has developed a model in which state leaders gain support if firms' profits rise and consumers realize an increase in real income. In this model, a tariff increases profits by raising domestic prices but also generates deadweight costs that depress consumers' income. To enhance the likelihood of retaining office, leaders set trade policy by establishing the optimal trade-off between the industry support generated by a tariff and the support of consumers generated by trade liberalization.

Other studies focus on how competition between politicians influences trade policy (Hillman and Ursprung 1988; Magee, Brock, and Young 1989). In many of these analyses, each candidate (or party) makes a pledge about the trade policy that will be enacted if that individual wins office. Each lobbying group then contributes to the campaign of the candidate whose trade policy would do the most to improve its members' utility, thereby bolstering that candidate's electoral prospects. A related strand of literature addresses how interest groups influence the structure of protection. Especially important in this regard is an article by Gene M. Grossman and Elhanan Helpman (1994) in which lobbies indicate the political contributions they will offer in exchange for a given trade policy, and then the government responds by setting policy to maximize its total contributions (across all lobbies) and aggregate societal welfare.

Clearly, none of these models was developed to explain the relationship between interdependence and conflict, and all of them would likely need adjustment before being used for that purpose. Equally, they do not offer any consensus on exactly whose interests will be reflected in foreign policy. One set of analyses suggests that the effect

8. For an overview of this literature, see Rodrik (1995).

of interdependence on conflict depends on how economic exchange influences both society in general and special interests, whereas another set suggests that this effect depends almost wholly on how interdependence bears on a government's core constituents. Nonetheless, building on such studies could help to redress a key weakness of most liberal explanations of international relations, namely, the tendency to rely on pluralist models of domestic politics, which lack a theory of the state specifying how societal actors' interests are aggregated, how such actors translate their interests into foreign policy, and which societal actors are most influential (Krasner 1978).<sup>9</sup>

Equally important is the need for liberal theories (and much of the research on the political economy of trade policy that we just reviewed) to more directly account for state preferences, since it is widely argued that national leaders have interests that influence foreign policy independent of societal actors (Doyle 1997; Krasner 1978; Stein 1993). For example, statist analyses often hold that public officials aim to advance the national interest. In countries where leaders view the gains from economic exchange as promoting social welfare and interstate conflict as likely to scuttle those gains, interdependence is likely to be a more potent impetus to cooperation than in countries where leaders worry about the adverse effects economic intercourse can have on national security. Other analyses assume that leaders attempt to maximize personal power or wealth. Based on such an assumption, heightened interdependence is more likely to inhibit conflict if both extensive interdependence and political cooperation bolster a ruler's authority or if both increase a ruler's ability to extract rents.

The upshot of the preceding discussion is that more attention needs to be focused on exactly how interdependence interacts with domestic institutions, leaders' preferences, and the interests of societal actors to influence interstate violence.<sup>10</sup> There is an equally pressing need to specify how interdependence influences the process through which wars break out (Barbieri and Schneider 1999, 394). It is widely recognized that wars occur in at least two stages: the outbreak of a dispute between states and the escalation of this dispute to the point where force is used (Snyder and Diesing 1977). Existing studies have provided considerable insight into how economic exchange affects the outbreak of conflict. However, they have furnished little insight into how economic interdependence influences the escalation of disputes (Mansfield, Pevehouse, and Bearce 1999/2000; Morrow 1999). One possibility is to build on the insight that armed conflict is a consequence of failed interstate bargaining and link economic ties between states to the bargaining process.<sup>11</sup> In this vein, interdependence could be viewed as a signal sent in the course of bargaining, the costliness of which is related to the extent of economic exchange between states or the difficulty either state would face in foregoing its economic connections. It might then be feasible to specify the point at which a state's noncommercial interests (for military advantage, say, or defense of the homeland) overcome any effect of trade on hostilities.

9. Obviously, these studies offer just a sampling of the frameworks researchers might use to analyze how domestic actors influenced by interdependence affect foreign policy. Our point is simply that more attention needs to be devoted to this issue in the literature on interdependence and conflict.

10. On this issue, see also Barbieri and Schneider (1999).

11. For discussions of this issue, see Gartzke, Li, and Boehmer (2001); and Morrow (1999).

A related possibility is that highly interdependent states rarely engage in full-blown war because the costs of doing so are prohibitive. If, however, these states realize that war is unlikely, each one may be tempted to engage in acts of brinkmanship against the other(s) to meet its foreign policy goals since it can rest assured that these acts will not provoke a military reprisal. This scenario implies that interdependence might foster a great deal of low-intensity conflict, but such conflict is unlikely to escalate, thereby helping to reconcile the claims of realists and neomercantilists, on one hand, and liberals, on the other.<sup>12</sup>

Of course, these points are only suggestive. But addressing issues like those raised here—all of which involve improving the specification of causal processes—would enrich and deepen our understanding of the relationship between interdependence and the use of force.

#### BOUNDARY CONDITIONS AND CONTINGENCY

To date, neither liberals nor their critics have paid much attention to identifying the conditions under which their claims hold. Instead, arguments about the relationship between interdependence and conflict typically have an air of universality, applying to all actors in all times and places. Yet, a growing body of empirical literature indicates that the effects of economic exchange on the outbreak of hostilities depend on various domestic and international factors. Devoting more attention to these contingencies is another important step in promoting a fuller understanding of the interdependence-conflict connection.

Although theoretical arguments about this connection usually are silent on whether their claims are bounded (Barbieri and Schneider 1999), the influence of economic exchange on the use of force seems to have changed over time. As noted earlier, many studies have found that heightened economic exchange has inhibited conflict during the period since World War II, and some observers have arrived at similar conclusions based on analyses of the 19th and 20th centuries (Gasiorowski and Polachek 1982; Mansfield 1994; Oneal et al. 1996; Oneal and Russett 1997, 1999a, 1999b; Polachek 1980; Russett and Oneal 2001; Russett, Oneal, and Davis 1998). In contrast, however, some case study analyses focusing on the 17th and 18th centuries point out how the expansion of major-power trade networks within a discriminatory, mercantilist framework aggravated commercial rivalries and sometimes stimulated armed conflict (Holsti 1991; Levy 1999; Levy and Ali 1998; Milton 1999). Commerce therefore has expanded during the past four centuries within two different policy contexts: initially embedded in a more state-directed and imperialist environment during the mercantilist era and later within a more liberal economic regime. Few studies have addressed whether this shift generated a change in either the nature or the strength of the relationship between interdependence and conflict.

Instead, large-*n* studies have focused almost exclusively on the past half century and largely ignored whether and how the effects of interdependence changed over

12. We are grateful to Erik Gartzke for this point.



time.<sup>13</sup> Taken as a whole, case studies of this relationship have assessed a much longer period. But even the latter analyses tend to center on the 20th century (e.g., Copeland 1996, 1999/2000; Papayoanou 1996; Ripsman and Blanchard 1996/97; Solingen 1998), largely because much of the historical work on the links between interdependence and hostilities addresses World War I and World War II. Important as those wars were, however, it is not clear that they are the best testing ground for theories of these links. One reason is that the primary participants in the world wars were major powers, states that generally had large and relatively well-diversified economies, and, as such, were less dependent on economic exchange than their smaller counterparts. Hence, interdependence may have a less pronounced influence on conflict between major powers than on disputes between weaker states.

Recent research indicates that the effects of interdependence are conditional on more than just the political power of economic partners. The existing literature, for example, has paid little attention to whether international institutions influence the relationship between interdependence and hostilities. A number of recent studies, however, found strong evidence that heightened trade flows inhibit the outbreak of military disputes between members of the same preferential trade arrangements (PTAs)—institutions designed to liberalize commerce among participants (Mansfield and Pevehouse 2000, 2001). In contrast, these same studies found little evidence that trade influences the resort to force among countries that do not belong to such arrangements. Further, Jack S. Levy (1999; see also Levy and Ali 1998) concluded that the interaction between commercial rivalry, power relations, domestic politics, and other factors contributed to friction between England and the Netherlands that bubbled over into war in 1652. In the same vein, Peter Liberman (1999/2000) reported that the effects of interdependence on belligerence during the first half of the 20th century hinged on the offense-defense balance.

Domestic politics also seems to condition the effects of interdependence on conflict. Particularly suggestive is recent work by Christopher Gelpi and Joseph M. Grieco (2001) showing that rising trade ties inhibit military disputes between democracies but tend to promote discord between other states. Their findings reinforce our earlier point about the need for greater conceptual clarity about how domestic political institutions filter the interests of various societal actors and groups. Equally, Etel Solingen (1998) has found that shifting domestic coalitions can stimulate important changes in both the outward economic orientation of countries and their propensity to fight. Paul A. Papayoanou (1996) also emphasized the interaction between interdependence, domestic coalitions, and state institutions. He argued that

balancing behavior that deters aspiring revisionist powers depends on there being extensive economic ties among status quo powers and few or no such ties between them and

13. Some statistical studies of the impact of interdependence on conflict have analyzed the period prior to World War II (Barbieri 1996a, 1996b; Domke 1988; Mansfield 1994; Oneal and Russett 1999b; Russett and Oneal 2001), as have certain analyses of the influence of conflict on interdependence (Barbieri and Levy 1999; Gowa 1994; Gowa and Mansfield 1993; Morrow, Siverson, and Tabares 1998). However, none of these studies reaches back further than the middle of the 19th century—still long after the mercantilist era—due largely to the paucity of reliable economic data for many countries.



aspiring revisionist powers, and status quo powers must also have political institutions that give median economic interests a prominent voice. (P. 45)

Finally, there is some evidence that the effects of interdependence on conflict hinge on domestic economic conditions. Håvard Hegre (2000), for instance, found that heightened interdependence has little effect on hostilities involving less developed states but inhibits belligerence between advanced industrial countries.

Taken together, these studies indicate that whether interdependence promotes or reduces antagonism depends on various domestic and international factors. To date, however, the ways these factors mediate the relationship have not been addressed in much depth. Additional research on this issue is sorely needed and should help identify the boundaries and limits of liberal and other claims.<sup>14</sup> More generally, too little attention has been devoted to specifying and justifying the appropriate temporal domain for studies of interdependence and hostilities as well as the set of countries that should be included in empirical analyses. Case study analyses, for example, have focused primarily on the major powers, although existing theories address a much broader range of countries. Meanwhile, large-*n* researchers have generated samples composed of numerous countries, but important differences exist among many such samples that deserve closer scrutiny.<sup>15</sup> For instance, there is some quantitative evidence that the effects of trade flows on conflict depend on whether all country-pairs or only “politically relevant” dyads (i.e., those that are either geographically contiguous or include at least one major power) compose the sample being analyzed (e.g., Barbieri 1996a, 1996b; but see Mansfield and Pevehouse 2001; Oneal and Russett 1999a).

These issues point to a number of key questions. Should the liberal claim be restricted to market economies because only they develop the private commercial interests with a vested interest in peace? Should it apply primarily to politically relevant dyads? Should the basic argument apply only since the beginning of the 19th century—when the virtues of exploiting comparative advantage in trade relations started gaining increased attention—or should it apply to the earlier mercantile era as well?<sup>16</sup> Research addressing such questions will help to establish the boundaries of claims about interdependence and conflict.

### THE CONCEPTUALIZATION AND MEASUREMENT OF INTERDEPENDENCE AND CONFLICT

Closely intertwined with the theoretical issues raised in the preceding section is a set of important questions concerning how to define and measure both interdepen-

14. On this issue, see also Keohane (1990), Mastanduno (1999/2000), and Stein (1993).

15. Another complicating aspect of any commercial network is that all bilateral relationships exist within an interconnected web. A change in any bilateral relationship will ripple through many other dyads. Pollins and Kirkpatrick (1987) tried to estimate parameters for the trade-conflict relationship in a system of equations, realizing only limited success. Recently, Penubarti and Ward (2000) employed modern methods in spatial autocorrelation to address the same question and found that our understanding of the main relationship may be sensitive to such network effects.

16. On the development of both mercantilism and liberal economic thought, see Irwin (1996).

dence and conflict. Various conceptualizations have been used, but the differences among them and the empirical implications of these differences have generated relatively little discussion. In this section, we therefore address the operationalization of interdependence and conflict.

#### THINKING ABOUT INTERDEPENDENCE

In the field of international relations, “economic interdependence” has two meanings. First, a group of countries is considered interdependent if economic conditions in one are contingent on those found in the others, for example, if inflation in France quickly places upward pressure on German prices. Second, countries are considered interdependent if it would be costly for them to rupture or forego their relationship, as would be the case if relations between the members of the Organization of Petroleum Exporting Countries and the advanced industrial countries (which rely heavily on petroleum imports) were severed. The first of these is generally referred to as sensitivity interdependence; the second is typically referred to as vulnerability interdependence (Baldwin 1980). The key difference between sensitivity and vulnerability interdependence hinges on the costs countries would bear should relations between them be disrupted.

Although these forms of interdependence—and the differences between them—are fairly straightforward, developing adequate indicators of them is not. First, distinct measures are needed for each of them because they often do not move in lockstep. Although there may be extensive economic connections between states (yielding a high level of sensitivity interdependence), they might not find it especially costly to replace these connections by either expanding economic interactions with third parties or making domestic economic adjustments (yielding a low level of vulnerability interdependence). Second, the best measures of sensitivity and vulnerability interdependence involve information about a counterfactual situation, namely, what the costs would be to one country should economic conditions change in or relations be interrupted with another country. Difficulties obtaining reliable estimates of that situation complicate efforts to measure interdependence, but it is nonetheless important for studies of its effect on conflict to demonstrate an awareness of these costs.

#### OBSERVING INTERDEPENDENCE

Economic interdependence has been measured in various ways, with most indicators closely linked to the flow of international trade. In part, this reflects the paucity of data available on forms of economic exchange other than merchandise trade. Although varied, measures of interdependence typically emphasize one of three themes: *openness*, *vulnerability*, or *gain*. Openness indicators are based in one way or another on the ratio of trade to total output. They rely on the idea that the higher the fraction of total output crossing state boundaries, the more costly would be the interruption of such flows. Researchers who emphasize the vulnerability theme have not arrived at the same degree of consensus regarding measurement. However, they frequently rely on indicators of trade asymmetry. Typically, such indicators are constructed using the

portion of trade (imports and/or exports) between a given pair of states, *A* and *B*, represented in the total trade of *A* and in the total trade of *B*. The more these two figures differ, the greater the asymmetry of interdependence between *A* and *B*.

The gain theme is somewhat different. As Polachek (1980) pointed out, the microtheory underpinning the central liberal claim hinges not on trade flows *per se*, but on the gains from trade. At best, these gains can only be measured indirectly since, strictly speaking, they presume the observation of a counterfactual condition (*viz.*, what total product would be if there were no cross-border trade). Economists argue that the gains from trade are correlated with import (or export) price elasticities, and Polachek has used this indicator in various studies (Polachek 1992; Polachek and McDonald 1992; Polachek, Robst, and Chang 1999). Unfortunately, the limited availability of price data severely restricts the range of countries and years over which such elasticities can be used, although Polachek (forthcoming) recently reported that considerable progress has been made in collecting such data.

Of these three main conceptualizations, openness has been most widely employed by far in the literature on interdependence and conflict. Mansfield (1994) used this type of indicator and found that heightened global trade (as a percentage of global output) was inversely related to the frequency of war throughout the international system during the 19th and 20th centuries. Oneal and Russett (1997, 1999a, 1999b; Oneal et al. 1996; Russett and Oneal 2001; Russett, Oneal, and Davis 1998) have employed a related measure in a series of studies cast at the dyadic level of analysis and have reported results consistent with liberal claims. Similarly, at the unit level, William Domke (1988, 131) concluded that countries more connected to the global economy were less likely to go to war. Thus, studies based on the openness dimension of interdependence offer considerable support for the liberal view.<sup>17</sup> Need we look further?

It is frequently argued that the ratio of trade to output—the leading indicator of commercial openness<sup>18</sup>—is a valid measure of both sensitivity and vulnerability interdependence (e.g., Oneal and Russett 1997). This ratio does provide a useful measure of sensitivity interdependence, since it indicates the extent to which trade partners' economies are intertwined. Its validity as an indicator of vulnerability interdependence, however, rests on the claim that as commerce between countries comes to make up a larger portion of each country's total economic output, it becomes increasingly costly for either partner to replace the trade conducted with the other. The basis of this claim can be questioned on three grounds.

First, the size of the flow of trade between states (taken either by itself or as a percentage of national income) may not furnish an accurate indication of the costs to them if their economic relations were disrupted. Yet, as noted earlier, the magnitude of these costs is central to assessing the extent of vulnerability interdependence (Baldwin

17. However, such support is by no means universal. See, for example, Beck, Katz, and Tucker (1998); and Beck and Tucker (1996).

18. It should be noted that various alternative measures of commercial openness have been developed (e.g., Leamer 1988; Sachs and Warner 1995). Furthermore, there have been recent efforts to develop measures of openness based on international finance (Quinn 1997). These indices tend to be monadic and are usually restricted to the period since World War II. Nonetheless, they might be analyzed fruitfully in certain types of future research on interdependence and conflict.

1980; Gasiorowski 1986; Hirschman [1945] 1980; Keohane and Nye 1977). States trading heavily that can easily locate close substitutes for the goods being exchanged clearly are not very dependent on each other. At the same time, states conducting little trade that would have great difficulty locating substitutes for the goods being exchanged may be highly vulnerable. In this light, it is interesting to note that Norrin M. Ripsman and Jean-Marc F. Blanchard (1996/97), who measured vulnerability by tracking trade in strategic goods, presented results at odds with the liberal position. Similarly, the indicator of interdependence offered by Barbieri (1998) combined the volume of trade and a measure of trade "salience" (which is similar to trade concentration and might be related to the difficulty of finding substitute commercial partners). She reported a positive association between interdependence and conflict.

A second problem with measuring interdependence based on the ratio of trade flows between states to the national income of each trade partner is that this value tends to be highly correlated with each partner's economic size (Hegre 2000; Mansfield and Pevehouse 2000). Moreover, it is well known that economically large states tend to be politically powerful and that powerful states are disproportionately likely to become involved in military conflicts. As such, it is important to control for the independent effects of national income in studies of conflict that include the ratio of bilateral trade to national income; otherwise, an inverse relationship between this ratio and hostilities might simply reflect the influence of national income alone. To this end, a pair of recent studies of military disputes analyzed the independent effects of bilateral trade flows and gross domestic product (GDP) as well as their interactive effects via the ratio of trade to GDP (Mansfield and Pevehouse 2000, 2001). Another study estimated a gravity model of international trade—made up of the GDP of each trade partner and the distance between them—to determine the expected amount of commerce between states based on economic conditions and then used the residuals from this model as a measure of interdependence that is independent of national income (Hegre 2000).

As we discussed earlier, the results of these studies differ in important respects from the results of research focusing solely on the ratio of trade flows to national income. Mansfield and Pevehouse (2000) found strong evidence of an inverse relationship between trade flows and conflict involving PTA members but little evidence that commerce influences hostilities between other states. They also found no indication that the ratio of trade to national income affects military disputes (pp. 794-95). Hegre (2000) concluded that interdependence has little bearing on conflict involving less developed states but that it reduces the prospect of antagonism between advanced industrial countries.

Finally, the "cost" conception of vulnerability may be too restrictive, since some claims regarding interdependence and conflict do not center on the economic consequences of disrupting commerce but rather on the security implications of dependency or highly asymmetric trade relations. Some realists, for example, argue that highly asymmetric interdependence may restrain the more dependent partner in a dyad but should not be expected to deter the less dependent partner from resorting to force if their strategic interests collide (Hirschman [1945] 1980). Thus, economic ties between states may restrain only one party from resorting to armed force should a dispute arise while having no effect on (or possibly even inflaming the aggressiveness of) its coun-

terpart. Meanwhile, some Marxist and world systems scholars view asymmetric trade relations as innately exploitive and argue that this situation may heighten the prospect of conflict (Chase-Dunn 1989; Wallerstein 1984). Empirical exploration of these possibilities within the interdependence-conflict research community, however, is rare.

Equally rare are empirical studies employing the gain conceptualization of interdependence, despite the centrality of the efficiency gains from trade to most liberal arguments as well as to some criticisms of these arguments (e.g., Gowa 1994). Although the aforementioned "counterfactual measurement" problem is one reason for the infrequent use of this theme, economists argue that the gains from trade correlate with import (or export) price elasticities and often use this measure as a surrogate. Still, very few scholars have incorporated such a measure in trade-conflict studies (Gasiorowski 1986; Polachek 1992; Polachek and McDonald 1992; Polachek, Robst, and Chang 1999). The nature of the research question rightly impels most scholars to include a large number of countries in their analysis or to examine cases reaching back a century or more; but, as noted earlier, the limited availability of price data makes this sort of wide-ranging inquiry virtually impossible. Nonetheless, it is important that future research wrestle with the implications of the gain dimension of interdependence, given its theoretical importance to debates over the links between interdependence and conflict.

Regardless of whether empirical studies of interdependence stress openness, vulnerability, or gain, they almost always rely on trade data to measure interdependence. In many cases, this research strategy seems to stem from an implicit assumption that other forms of economic exchange are highly correlated with trade flows. The appropriateness of this assumption, however, is open to question, especially in an era when merchandise trade composes a dwindling fraction of all economic exchange. Furthermore, it is not clear that all aspects of economic interdependence (commercial, capital, monetary, etc.) should have the same effect on hostilities (Barbieri and Schneider 1999; Russett and Oneal 2001, 141). A recent study by Erik Gartzke, Quan Li, and Charles Boehmer (2001) broke new ground on this question by comparing the effects of international trade flows, monetary relations, and the cross-border movement of capital. Although their results should be interpreted cautiously, given the paucity of data on capital flows during the period they analyzed, Gartzke, Li, and Boehmer found that extensive monetary and capital ties are at least as likely to inhibit conflict as extensive commercial ties. More studies of this sort should follow.

Similarly, recent work suggests that considering both the international institutions that guide commerce and the flow of trade may enrich conventional measures of economic interdependence and add explanatory power to models of conflict (Mansfield and Pevehouse 2000, 2001; Mansfield, Pevehouse, and Bearce 1999/2000). Particularly important among such institutions are PTAs, arrangements that can foster interdependence through various channels. By liberalizing commerce among members, the establishment of a PTA typically leads to a shift in production within the arrangement to lower cost sources. This is likely to foster members' dependence on these sources absent the availability of equally efficient producers located outside the PTA and low transaction costs of shifting to these external producers. In the same vein, to exploit economic opportunities within a PTA, firms sometimes make investments that support

trade with member countries and have little value outside these specific relationships (Yarbrough and Yarbrough 1992). Doing so heightens the dependence of firms on the continued existence of cooperative economic and political relations within the PTA. Furthermore, some PTAs have been accompanied by macroeconomic and monetary coordination between participants, which is likely to encourage economic integration and interdependence as well (Genberg and De Simone 1993). Moreover, since preferential arrangements limit the ability of participants to restrict access to their markets, members can reasonably anticipate that open commercial relations spurred by a PTA will persist and that the arrangement is likely to generate future economic benefits. For these reasons, PTAs are likely to promote interdependence between participants, an issue that has received far too little attention in studies of political conflict.

Calls for better measures of interdependence are hardly new. Indeed, a considerable amount of ink was spilled over this issue a few decades ago (Baldwin 1980; Gasiorowski 1986; Rosecrance and Stein 1973; Rosecrance et al. 1977; Tetreault 1980). But relatively little has been done to heed such calls, and the need for better measures of interdependence is pressing if we are to resolve debates over the relationship between interdependence and conflict. It is also noteworthy that scholars' choice of theme—openness, vulnerability, or gain—seems to be strongly correlated with their position on the strength and nature of this relationship: supporters of liberal claims tend to employ indicators emphasizing the themes of openness and absolute gain, whereas supporters of realist and neomercantilist arguments tend to highlight the themes of vulnerability and relative gain. We are not implying that the larger debate reduces to this single dichotomy, but more attention needs to be devoted to assessing why certain indicators of interdependence seem to provide greater support for one set of theories than another.

#### THINKING ABOUT CONFLICT

The influence of interdependence hinges not only on the form and facet of economic intercourse being analyzed but also on the type of international conflict being explained. Taken as a whole, research in this area has addressed an extremely broad spectrum of interstate conflict behavior, from hostile statements to full-scale war, while leaving unclear—both theoretically and empirically—whether economic interdependence should affect low-intensity conflict, high-intensity conflict, or both. Similarly, the question of how economic relations influence the escalation of political conflict remains open, as we discussed earlier. The problem is not that studies fail to define the type of conflict being analyzed: indeed, most empirical research is quite clear on that score. Rather, the problem is that the theoretical literature tends to be murky about what type of conflict should be analyzed and, partly as a result, empirical studies tend to define conflict based on the data at hand. The upshot is that existing research focuses on a wide range of different types of conflict, and at least some of the disagreement in the empirical literature can be traced to these differences.

What forms of interstate conflict should this research community address? The most ardent advocates of the liberal position would expect interdependence to inhibit political conflict at all levels of intensity, although much of the oft-cited work by



Immanuel Kant, the Manchester liberals, and others centers on war (Doyle 1997, chaps. 7-8). Realists, meanwhile, might readily concede that trade could suppress less salient interstate conflicts while denying any systematic effect as conflicts become more serious, placing core national interests at stake (e.g., Waltz 1970; Viner 1951). Still other advocates of the liberal proposition might argue just the opposite. States may continue to voice their differences—perhaps even threaten sanctions or the use of force—but domestic trade interests will restrain them from acting on such threats (thus preventing escalation to the highest levels of conflict) lest commerce be disrupted. Once again, the theoretical literature is composed of so many different claims that almost any empirical result can be fit to some extant theory. Improving the foundations of theories linking interdependence to conflict and further specifying the contingencies and boundary conditions of these theories will certainly help matters. But more attention to the different types of interstate conflict and conflict processes is also required to resolve existing debates in this research community. Future work should explicitly consider the likely effects of interdependence on lower-intensity conflict (trade disputes, sanctions, and threats of force), higher-intensity conflict (mobilization, use of armed force, and full-blown wars), and the escalatory and de-escalatory processes that move conflicts from one level to another.

#### OBSERVING CONFLICT

Among empirical studies, methodological orientation plays a large role in determining the facet of conflict that is addressed. The vast bulk of the historically oriented case studies focus on international war—especially major-power war. In contrast, most statistical analyses center on a much broader range of interstate disputes, although they are marked by considerable disagreement about which type of conflict should be addressed. Some of the earliest statistical research on interdependence and hostilities (Polachek 1980; Pollins 1989a, 1989b) relied exclusively on event data sets such as COPDAB and the World Event Interaction Survey (WEIS) (Azar 1980; McClelland and Hoggard 1969). The overwhelming number of such studies conducted during the past decade has focused on militarized interstate disputes (MIDs), which are episodes in which one state threatens, displays, or uses force against another state (Gochman and Maoz 1984). But there has been remarkably little discussion of why this focus is theoretically appropriate or the implications of shifting among these different data sets.<sup>19</sup>

The COPDAB, WEIS, and MID data sets capture markedly different types of foreign-policy behavior. COPDAB and WEIS record events over the broadest spectrum of international interactions—cooperative as well as conflictual—from low-intensity hostility (such as a verbal protest) to the most violent wars. In contrast, the MID data set records only instances involving the threat, display, or use of armed force. Subsequent interactions surrounding this triggering incident are aggregated into

19. For a recent effort to address these issues, see Pevehouse (2001). To be clear, our point is not that scholars should necessarily focus on a single type of conflict but rather that it is important to link the hypothesized effects of interdependence more explicitly to different conflict levels and processes.



a single data point or observation, an individual event that might persist for years. The differences may be substantial in the conceptualization and observation of “conflict” between two actors as either a continuous flow marked at regular time intervals (the COPDAB tradition) or an episode whose time span may be very brief or sometimes prolonged (the MID tradition).

Consider a well-known result from earlier research on interstate conflict: the correlation between “flows” of conflict and cooperation for a given pair of states tends to be high (Dixon 1983). In other words, relations between states are often marked by both cooperation and conflict. This tendency led many researchers using COPDAB or WEIS data to construct a “net conflict” or “net cooperation” indicator that captured the overall diplomatic climate between states (Polachek 1980; Pollins 1989a). But such measures of diplomatic relations are based on a very different way of conceptualizing friendliness and hostility than MIDs, which are by definition episodic, sometimes brief, sometimes prolonged, and at least fairly conflictual.<sup>20</sup> How would COPDAB-based and MID-based pictures of the patterns of interstate conflict compare? To our knowledge, virtually no one has checked for any such correspondence. Do MIDs simply map onto the highest end of the COPDAB conflict scale? Do countries engaging in MIDs (especially at the lower levels, which include episodes like fishing disputes) also exhibit high flows of cooperative behavior to settle such controversies?

Regarding our call for studies of the effect of interdependence on the escalation and de-escalation of conflict, it is not clear that either event-based flow indicators in the COPDAB tradition or episodic aggregations such as MIDs can tell us as much as we would like to know about conflict processes. Existing net conflict-cooperation indicators can capture the general diplomatic climate between countries but may be only loosely related to the escalation and de-escalation of crises. And Correlates of War researchers note that the information recorded for a single MID should not be viewed as the chronicle of a crisis. Nevertheless, a variety of research strategies remain. Case studies may employ process tracing in the analysis of crises to determine whether and how economic interdependence played a part in (de)escalation. Alternatively, large-*n* studies specifying the role that interdependence might play in distinguishing those MIDs that end in war from those resolved peacefully short of war would provide an initial look at this question. Data-analytic researchers might also consider employing collections better designed to record the etiology of crises, such as Russell Leng’s Behavioral Correlates of War data set (Leng and Singer 1988) or the compilation of 20th-century crises gathered by Michael Brecher and Jonathan Wilkenfeld (1997).

The nearly exclusive focus on militarized disputes by quantitative studies of interdependence and conflict during the past decade has certain theoretical and empirical limitations. Nonetheless, this focus has also contributed to the development of important advances in statistical methodologies. Incorporation of MID data into interdependence-conflict studies was roughly concurrent with the sharp rise in the use

20. Penubarti and Ward (2000, 10) argued that these very characteristics could make militarized interstate disputes particularly unsuitable to testing the relationship between trade and conflict. Whether one accepts this point or not, we submit that this research community would be better served to consider the meaning of “interstate conflict” in varied ways rather than relying exclusively on the given concept and measurement of militarized interstate disputes.

of maximum likelihood techniques in the field of international relations. These techniques facilitated the efficient estimation of models featuring a discrete dependent variable, such as the occurrence of a MID. Since then, closer consideration of the statistical properties of MIDs (e.g., that they can be viewed as “events” in a statistical sense, that they are typically arranged as pooled cross-sectional data, that they are relatively unusual events, and that they may both influence and be influenced by commercial ties) has prompted the development of various new maximum likelihood techniques that have broad applicability. Such advances include procedures for analyzing and correcting for temporal dynamics in event-count, time-series data (Beck, Katz, and Tucker 1998; Beck and Tucker 1996; Brandt et al. 2000), for the unbiased estimation of models predicting rare events (King and Zheng 2001), and for analyzing systems of simultaneous equations (Gasiorowski and Polachek 1982; Kim 1998; Pollins and Reuveny 2000; Reuveny and Kang 1998). These developments hold out the promise of allowing much closer correspondence among theoretical arguments, the estimating equations embodying those arguments, and the data used to test them.

In sum, more attention needs to be paid to the aspect and type of political conflict that should be the focus of research on interdependence and hostilities. It is clear that the prevailing diplomatic climate, the occurrence or absence of a militarized dispute, and war are only weakly linked. Consequently, they should not be used interchangeably in empirical studies as all-encompassing indicators of conflict. The tendency to do just that (albeit implicitly) is one reason why an understanding of the relationship between interdependence and conflict remains elusive. Indeed, research probing more deeply the meaning and measurement of both interdependence and conflict would likely make an important contribution to our understanding of the links between the two.

## CONCLUSION

Just over a decade ago, a well-known review of the causes of war lamented the dearth of research on the relationship between economic interdependence and hostilities (Levy 1989, 261). Since then, scholars of international relations have addressed this issue with considerable enthusiasm, stimulating a still modest but rapidly growing literature. These recent studies have made considerable headway in assessing some key aspects of the influence of interdependence on political tensions.

But this body of literature has yet to resolve various core issues. First, a stronger theoretical foundation is needed for many of the competing claims about the relationship between interdependence and conflict. Second, too little stress has been placed on whether this relationship is stable over time—especially over periods before World War II—and across countries. More generally, there is a growing indication that the strength and nature of the effects of interdependence depend on various domestic and international factors. A better understanding of these factors and how they affect the links between economic exchange and political antagonism is badly needed. Third, existing studies often rely on different definitions and measures of both interdependence and conflict. Although that poses no inherent problem, these differences seem to

contribute to variations in the results of empirical studies; and existing theories offer no clear guidance as to which definitions and measures are most appropriate. Moreover, the most widely used measures of interdependence are excessively narrow, focusing on trade flows. There is a glaring need to resolve questions about the merits of relying on particular measures of interdependence and conflict as well as to assess the sensitivity of empirical results to the use of different measures.

The wide diversity of liberal, realist, and other arguments presents an unusually rich source of ideas to engage scholarly debate on the relationship between interdependence and conflict. All too often, however, this diversity has only left scholars talking past each other. The constructive engagement and resolution of these diverse claims will likely require the specification of spatial and temporal boundaries and the conditions and contingencies under which particular forms of interdependence might lead states toward or away from different types of conflict. These are tasks we have barely begun to tackle.

The relationship between interdependence and conflict bears on a host of crucial issues in the field of international relations, including the causes of war and the political economy of national security, regional integration, and international organization, respectively. It also bears on key foreign policy issues. Various Western governments—most recently the Clinton and Bush administrations—have argued that fostering international economic openness will promote both peace and prosperity. Existing studies offer some support for this position. Nonetheless, additional research is sorely needed to determine more precisely how, when, and to what extent economic interdependence affects the tenor of international politics.

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