This is to certify that the

dissertation entitled

Superpower Dispute Initiation:
Status-Quo Evaluations and Strategic Timing

presented by

Christopher K. Butler

has been accepted towards fulfillment
of the requirements for

Ph.D degree in Political Science

Major professor

Date June 14, 2000

SUPERPOWER DISPUTE INITIATION: STATUS-QUO EVALUATIONS AND STRATEGIC TIMING

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Political Science

2000

ABSTRACT

SUPERPOWER DISPUTE INITIATION:
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Looking back at the Cold War, we wonder why the conflict between the United States and the Soviet Union did not escalate even though each made military moves against the other at various times. Unlike other rivalries in history, this one did not produce enough variance of violence to address this problem directly. From an empirical standpoint, we will never really know why a direct military confrontation between the superpowers never took place. Given the *ex ante* potential for escalation (including the possibility for global extermination), one wonders why the superpowers would risk military initiatives at all. This is a question that can be addressed empirically. This dissertation examines the dispute-initiation behavior between the United States and the Soviet Union by focusing on evaluations of the international status quo over time. By explaining the relative peace and its periodic disturbances, we may be able to avoid absolute war.

The first half of the dissertation examines dispute initiation theoretically. I begin with a review of what dispute initiation is and what others have found to be linked with it. I then lay out my own framework for understanding dispute initiation that rests on understanding the international status quo and how this status quo is changed over time. Next, I present two game-theoretic models that present dispute initiation as a strategic-timing problem. The first model examines how the sequence of actions affects the

expected outcome of the game. By endogenizing who goes first in this game, I nullify an artificial initiator advantage. The second model examines how the actual timing of actions—beyond mere sequence—potentially alters the strategic problem. It specifically address the question of the conditions under which the more complicated timing model collapses into a simplified game in which only sequence matters. With respect to understanding dispute initiation, the game models produce several propositions which are then summarized in theoretical hypotheses. Three things are theoretically shown to increase the likelihood of dispute initiation between two actors: (1) a shift in negotiation advantage in favor of one actor over another, (2) a low value of the status quo for either actor, and (3) a low level of patience for either actor.

The next half of the dissertation evaluates these theoretical hypotheses. This evaluation is divided into an empirical component and a historical component. The empirical component begins by showing how the first two theoretical hypotheses are generalizations of power-transition arguments. The empirical test then operates within a modified power-transition framework focusing on the Cold-War rivalry. The results of this test provide supporting evidence for the related theoretical hypotheses. The historical component provides an independent evaluation of the empirical results as well as a non-empirical test for the third theoretical hypothesis. The evaluation itself relies on John Lewis Gaddis's writings on the Cold War. This historical evaluation also supports the theoretical hypotheses and corroborates the empirical results.

In memory of *Charles Kenneth Getchell* (1889-1968).
Inspiring a generation beyond his reach.

ACKNOWLEDGMENTS

Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.
-Robert Frost

Writing a dissertation is very much like taking a long journey. In my case (and many others, I'm sure), the journey involved several false starts and dead ends requiring backtracking. Unlike the traveler in Frost's poem, I *did* travel both roads plus some more. And like a stubborn child, each time I came to an impasse I took the road less traveled by. The funny thing about such roads is that they only *begin* looking grassy and wanting wear. After the first bend in the undergrowth, roads less-traveled-by turn out to be thorny brambles. I hacked my way down a few of these thorny paths, but at each sign of fatigue I received rejuvenation. Sometimes this took the form of sage advice; sometimes it was a needed emotional boost.

Following this theme, it is fitting that my journey did not begin and end with the same mentors. I thank Gretchen Hower and Byounggil Ahn for giving me a good start in my expedition and wish them success in their new endeavors. Although the path I finally chose in completing my dissertation was not the same one I was initially on, I still learned much from each of you.

I also owe a great deal to the members of my dissertation committee. The familiar presence of Bruce Bueno de Mesquita from my undergraduate days helped steady my course. After agreeing to be a remote member of my committee, he remarked that he had never served on a dissertation committee for which the candidate did not successfully complete the thesis. I'm glad to be part of your clean track record.

Jim Granato was similarly supportive and always ready to answer my methodological questions. Your advice and encouragement were greatly appreciated. I'm only sorry that so much of your guidance went into earlier, unused drafts rather than into the final product. I guess you also taught me to trust my footing in empirical problems. Thanks.

The most demanding member of my committee and, in the end, my greatest supporter was Chuck Ostrom. He told me from the beginning what the path would look like—and that I was going to be too stubborn to take his advice toward a quick completion. The final product does resemble your original vision, but I hope my additions give you some consolation that my stubbornness had some benefit. And despite all your statements to the contrary, I have been listening to and following your advice—just as selectively as a son follows the advice of his father. It has been an honor to work with you.

In Ken Williams I found gentle support and a demand for greater clarity. I thank you for both and hope I continue to meet your standards in the future.

And to my committee chair and advisor, Scott Gates. You were mentor, bouncing-board, foundation, and friend—all in one package. Further words cannot really express how much you've done for me. Tusen takk.

Beyond my committee, I owe a special debt of gratitude to Brian Silver and, subsequently, to the Graduate School at Michigan State for the Dissertation Completion Fellowship that spurred me on to a definitive deadline.

I thank Tom Hammond for needed pep talks on the moodier days of dissertation writing. I also thank Ada Finifter for her support before, during, and after my "little" project.

Numerous discussions fed ideas into my dissertation. I owe most in this respect to William L. Reed for redirecting my empirical examination away from clumsy dual logit to the more elegant bivariate probit. Thanks also go to Renee Agress, Chris Bonneau, Randy Calvert, Greg Cline, Bill Hixon, Matt Kleiman, David Lalman, David Lektzian, Walter Mebane, Sara McLaughlin Mitchell, Brandon Prins, Kirk Randazzo, Yuka Sakamoto, Brian Silver, Mark Souva, Christopher Sprecher, Barry Stein, and Wan-Ying Yang. I add the usual disclaimer that I have probably forgotten someone as I'm writing this, but I thank you too.

My parents also lent their emotional support throughout my graduate schooling. My dad, though he wished we were closer to home, always gave me a needed pat on the back—I could feel it, even across the miles. My mom, too, was supportive. But she also got on my case during the last months for not being more diligent in pushing forward toward completion. In that sense, she was harder than the most demanding committee member ever could be. Thanks for the needed shove, mom.

My most affectionate note of acknowledgement must go to my wife, Karin. Not only has she supported me throughout my journey while engaging in her own academic pursuits. She has also given birth to our son, Connor (who has been a joyful rejuvenator himself), and is presently carrying our daughter, Elora. She has also put up with long nights of dissertation writing and the competition for attention that such a project entails.

(The first entry in my dissertation notebook is on our third wedding anniversary.) I owe you a large debt that I hope I can repay—in part—as you write your own dissertation.

And so, this journey has come to a successful end. Like the traveler in Frost's poem, I too tell this with a sigh—but a sigh of relief rather than regret. And though I took several roads less-traveled-by, that really has made all the difference.

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KEY TO SYMBOLS

A_i	Outcome: acquiescence by state *i*
B_i	Utility to actor *i* of actors *i* and *j* moving simultaneously at time *t*
b_i	Outcome: actors *i* and *j* move at the same time
C_i	Outcome: capitulation by state *i*
D (or *d*)	Action: to make a demand
$EU^i(\ )$	Expected utility to actor *i*
F (or *f*)	Action: to use force
F_i	Utility to actor *i* of letting actor *j* have the first move at time *t*
f_i	Outcome: actor *j* moves before actor *i*
L_i	Utility to actor *i* of moving before actor *j* at time *t*
l_i	Outcome: actor *i* moves before actor *j*
N	Outcome: negotiation
P^i	Probability of actor *i* gaining welfare from negotiation or war
q	Outcome: the continuation of the status quo
SQ	Outcome: status quo
$U^i(\ )$	Utility to actor *i*
W	Outcome: war (initiated simultaneously)
W_i	Outcome: war initiated by state *i*
Δ_i	State *i*'s demand
δ_i	Actor *i*'s discount parameter
ρ	Correlation coefficient

CHAPTER 1. INTRODUCTION

There is nothing permanent except change.
-Heraclitus

Change is not made without inconvenience, even from worse to better.
-Richard Hooker

State leaders often desire to change some aspect of their international environment but the timing of such an action is critical to its success, to the continuation of the leadership, and to the welfare of the state. Some states face constraints that impede attempts at change. They lack the resources, influence or other factors necessary to implement the desired change. This is especially true for the so-called "minor powers"—i.e., states that are in a lower position in the international power structure. Major powers face a different problem when considering change. A great power may have the resources and influence required to bring about change but only if no other great power challenges its attempt. This does not mean that great powers do not attempt to change the status quo in the strategic environment of the international system. It does mean, however, that they must await conditions ripe for change. Hence, I ask "when will great powers attempt to change the international status quo?" More specifically, I am interested in determining theoretical conditions that allow us to predict some time—or window of time—in which one or more great powers will act toward change.

There are several ways in which a great power could attempt to change the international status quo. Such change can take place within the any of the arenas of international politics, including law, political economy, and conflict. For instance, a great power may seek some change in an existing security regime or propose the creation of a new regime. Alternatively, a great power may seek to change the sovereignty of some territory (through force or purchase) or to settle a territorial dispute.

Many questions surround the contemporary tranquillity of the international system and the relative peace of the Cold War that followed the greatest conflagration humanity has yet seen. In retrospect, we wonder why the conflict between the United States and the Soviet Union did not escalate even though each made military moves against the other at various times. From our present vantage point, we wonder whether the current peace will bless several generations or will quickly vanish with some new great human tragedy. Hence, this is neither a trivial exercise in modeling historical events nor an investigation of obsolete behavior. It is an attempt to prepare for the future by highlighting precarious times in international relationships before escalation is a possibility. Thus, by explaining relative peace and its periodic disturbances, we may be able to avoid absolute war.

Two issues central to our comprehensive understanding of the Cold-War relationship extend beyond this dissertation and span much of social science. First, the very nature of the status quo and how it changes (or remains the same) is key to understanding political order in general. Second, the question of strategic timing is hardly unique to international politics.

The nature of the status quo is a key component to understanding political order of any kind. All of the questions we ask in political science deal with how or why current political conditions change. Who will win the next election? How will a legislature's composition affect the type of legislation it passes? What are the conditions for a coup? How do democracies spread and what are the effects of that change? With an understanding of how things change, we gain a better appreciation for why things remain the same. This helps us address still other questions.

Strategic timing is also important in grasping the nature of political change. Change is often, if not always, instigated by one or more political actors. Some of these actors are consummate leaders—like Abraham Lincoln or Adolf Hitler—who use their leadership skills to take advantage of a particular environment—for good and ill respectively. Other actors for change are unwitting—like Czar Nicholas II—who react to their environments in a futile hope of arresting change. Not all changes are momentous; nor are all actions intended to produce momentous changes. Indeed, a myriad of changes occur continually that have subtle effects on the fabric of social order.

This fabric—objectifying the status quo—is a network of explicit and informal contracts that specify expected conduct between and among actors. At any point in time, some portion of these contracts are being renegotiated. The means of renegotiation between actors are embedded in a subset of expectations specifying how change is to be conducted. At all levels of social interaction, expectations can be jettisoned by an actor in favor of more unilateral action. Whether through renegotiation or unilateral action, the timing of change plays a critical role in its outcome; thus, the status quo and strategic timing are intimately related.

Timing in the context of social change has two principal components: sequence and environment. The sequence of action has long been suspected to affect social outcomes whether in the form of agenda control or some other first-mover advantage. One aspect of sequence not always grasped is that there can be a drawback in being first. It has been argued, for instance, that incumbents should always lose since their position is known by the challengers well in advance of any election (Downs 1957). Although this logical argument does not withstand empirical validation. it is one of the few considerations of a first-mover *disadvantage*. Another aspect of sequence rarely considered is that if there is a universal first-mover advantage then everyone would want to move first. Simply noting *ex post* that a particular individual was able to maneuver successfully to be the first mover is theoretically unsound at the least. Presumably the actor was maneuvering in a strategic setting that could be examined as another choice problem.

The environment has long been considered a fundamental part of any decision problem. These conditions include the decisions available to each actor, how the decisions produce joint outcomes (including gambles), and the outside factors that influence the actors' preferences. In the context of timing decisions, Axelrod (1979) laid out an intuitive framework for when to reveal critical, private information so as to maximize the decision-maker's probability of winning given the time at which the information was revealed. The environmental conditions considered in that framework include the resource to be exploited, changing stakes over time, costs to maintaining the secrecy of the resource, and the cost of exposure after exploiting the resource. The value of the stakes in a given period (holding all other factors constant) determine whether the decision-maker should use the resource at that time. Thus, both how sequence is determined and the underlying conditions are important to analyzing timing decisions.

PROCESS VERSUS OUTCOMES

Social scientists are often interested in the outcomes of the phenomena they study. But these phenomena have beginnings and middles as well as ends; outcomes are usually the result of a process underlying the social phenomenon. Being aware of this, social scientists model phenomena accordingly. Even so, these models can fall short by capturing the essentials of the middle and end of a process while neglecting the beginning.

It is obvious—and seemingly trivial—that who acts first in a given situation can sometimes affect the result of a social process. Perhaps the most obvious case in point is agenda setting. When there is a voting cycle (and in some cases without one), whoever sets the agenda can determine what alternative is ultimately chosen (cf. Riker 1982; 1986).

In many political processes, the order of actions often has as much impact on the final outcome as do the actions themselves. This is most clearly exemplified by problems of agenda setting. Problems of actor order are not as clearly visible nor as well understood in international conflict as they are in voting theory, but they do exist and are just as important. One technical example can be drawn from *War and Reason* (1992) in which Bueno de Mesquita and Lalman present a situation where war is a complete and perfect information subgame perfect equilibrium even though negotiation and the status quo are strictly preferred to war by each actor. (See the proof of their "Basic War Theorem" and related discussion, pp. 72-75.) An interesting problem arises, however, when we reverse the initiator but use the same preferences. The new subgame perfect equilibrium has the previous war initiator acquiescing! But this is more than a mere technical problem; a similar situation arises within power-transition theory when we consider the initiator puzzle between hegemon and challenger. The perennial question plaguing this theory is why the hegemon does not simply eliminate challengers as soon as they emerge. What is needed for all of these timing problems is a method for endogenizing who begins strategic encounters.

THE STATUS QUO

What exactly is the international status quo? The answer to this question is central to addressing what "change" means and how it is brought about. It is generically defined as "the existing state of affairs" (Webster's New Collegiate Dictionary 1980), but how does this apply to politics and to international relations in particular?

At its most abstract with respect to politics, the status quo is an existing set of policies. What these policies are depends on the area of politics under investigation. For example, if we were interested in tax policy, the status quo would be a summary of the tax rates for all things that are taxed (i.e., tax rates on different levels of income, personal versus corporate taxes, sales taxes, etc.). For domestic politics, existing policies are relatively easy to pin down since they are embodied in legislation or in bureaucratic paperwork. How such policies change is also somewhat easier to explain (on the surface at least) since there are often institutional procedures laying out, for example, how a bill becomes a law.

In international relations, the "existing set of policies" is hardly so simple to summarize. Certain areas of international politics have more clearly specified policies than other areas. For example, the entire idea of *status quo ante bellum* in international law revolves around borders. In international political economy, tariffs, quotas, and content restrictions summarize a good deal of the status-quo policies regulating trade between two states. How these "policies" are usually changed depends greatly on the issue area, although methods usual to one area have been applied to other areas. (The gun-boat diplomacy that opened Japan to international trade in 1854 being but one outstanding case of conflict methods being used to change economic policy.)

The most salient literature concerning the international status quo at the superpower level deals with hegemonic politics. Whether focusing on hegemonic war (Gilpin 1981; 1988), long cycles of global leadership and decline (Modelski 1987; Modelski and Thompson 1989), or power transitions (Organski 1958; Organski and Kugler 1980), all of these authors agree that the rules of international politics are partially crafted by the inherent power hierarchy of the system. Specifically, they all focus on how changes in the international status quo are a result of changes in the distribution of power. The hegemon plays a predominant role in setting the rules given this hierarchical structure. As the most powerful member of the international system, the hegemon uses its power to shape the rules in its favor. Other states generally adhere to these rules for two reasons. They are too weak to challenge the hegemon and find greater benefit in following the rules than in challenging them, or they perceive the rules to be—at least nominally—in their favor.

Morgenthau (1978) also views the status quo as the prevailing distribution of power in the international system. He lays out "three typical international policies" corresponding to what a states wants with respect to the prevailing distribution of power that go beyond just "setting the rules". These are the policy of the status quo, a policy of imperialism, and a policy of prestige (Morgenthau 1978, 53). A state following a policy of the status quo "aims at the maintenance of the distribution of power which exists at a particular moment of history" (Morgenthau 1978, 53). The policy of prestige aims at increasing ones' general reputation in the knowledge that one's power position is more or less immutable. The policy of imperialism aims at expansion and improving one's power position. Conflict of the power-transition type can be viewed as that between a hegemon following a status-quo policy and a challenger following an imperial policy.

But the international system is not entirely hierarchical. Given the coexisting aspect of anarchy that also reflects the nature of the international system, the hegemon is never entirely secure in maintaining its most favored set of rules. Challenges can technically come from all quarters, not just from an identifiable challenger. Even those too weak to force their own set of rules can make the imposition of rules costly for the hegemon. Vietnam presents but one case in point. In addition, the hegemon cannot be assured of its continued status. By virtue and vice of its position, the existing hegemon can be supplanted by a more powerful state. Thus, the international status quo is a function of the existing hegemon and its relations with the rest of the system.

There is also a distinction between an international status quo and a "local" (Bueno de Mesquita 1990) or "regional" status quo (Lemke 1995), and a "domestic" status quo (Hanrieder 1965) and how each affects international relations. In Bueno de Mesquita's particular example, he examined how Prussia gained leadership over the German states and removed Austria from its previous role in that leadership position. Along more general lines, Lemke postulates that there are a series of regional power hierarchies embedded in the overarching international hierarchy. The regional hegemons in these lower-level hierarchies set regional rules as in the larger context, but are constrained in their rule setting due to the interests of the next highest hegemon. Hanrieder focuses on the internal-external distinction of a state's goal formation. He stresses that each state may have a domestic goal that can translate into a different international goal depending on the international conditions. The important lesson is that "the systematic treatment of goals should proceed on more than one level of analysis" (Hanrieder 1965, 131).

The power-transition literature is perhaps most deeply concerned in the discipline with the concept of the status quo. Kugler and Organski (1989, 173) have said that "[d]egrees of satisfaction as well as power are critical determinants of peace and conflict." This idea of "satisfaction" has been operationalized in a variety of ways (cf. Bueno de Mesquita 1975, 1981, 1990; Kim 1991; Werner and Kugler 1996), often in terms of "dissatisfaction." Dissatisfaction has been related to "status inconsistency" within the international hierarchy (Midlarsky 1975). The idea here is that a state has an "achieved status" and an "ascribed status" (Houweling and Siccama 1996, 120; see also Wallace 1972). Achieved status is based on a state's level of power in the international hierarchy. Hence, we can use the distribution of military capabilities to measure achieved status. Ascribed status is based on a state's "prestige within the current hierarchy" (Houweling and Siccama 1996, 120). Prestige is best thought of as a state's level of influence. The difference between achieved status and ascribed status is a state's level of dissatisfaction. How much a state values the status quo, then, is inversely related to its dissatisfaction with the international order.

Bueno de Mesquita (1998) has a more concrete formulation of the international status quo. In his simulation analysis of the Cold War, the status quo is seen as a policy point along a unidimensional issue space. The issue space of importance is whether the United States or the Soviet Union gets its "way" in the Cold War struggle. This is measured in terms of alliance patterns of other nations with respect to the US and the

USSR and is viewed as a zero-sum issue. The actual status quo position along this alliance issue space is determined by a weighted median position (Black 1958) where a state's proportion of systemic capabilities and its salience for the issue (relative to domestic issues) forms the basis of the weighting scheme. Thus, changes in alliances, power, or salience can all lead to changes in the status quo.

STRATEGIC TIMING AND DISPUTE INITIATION

One of the more troublesome problems in the theory of international politics is predicting disruptions in the normal relations of states. Specifically, how does one go about predicting dispute initiation? The basic intuition is that some exogenous condition has changed making dispute initiation valuable or necessary. The problems to prediction are isolating relevant exogenous variables and determining the underlying conflict process. General theories of dispute or conflict initiation range from power transitions (cf. Organski and Kugler 1980; Kugler and Organski 1989) to opportunity and willingness (Most and Starr 1989). Conflict will occur between states when at least one side has both an opportunity to initiate and some fundamental willingness for conflict. Willingness focuses on impetuses toward conflict—such as a desire for gain or some other reason pushing states toward conflict—and on factors constraining states from conflict—such as domestic opposition or the potential costs from escalation. Power-transition theory has a more narrow focus but is also enlightening. This theory concentrates on the preeminent major-power rivalry between hegemon and challenger. Given this structured relationship in which opportunities for conflict abound, the main predictors to conflict are the power transition itself and the dissatisfaction of the challenger (Organski and Kugler 1980; Kugler and Organski 1989). Dissatisfaction (under various names) has been proposed as an important component of conflict within a broader literature as well. The idea of dissatisfaction is intimately related to the international status quo.

Predicting conflict—with its usual connotation of actual violence—is not the only "disruption in the normal relations of states." We have a general conception that conflict as violence is the result of an escalatory process.[1] Given a dispute or crisis as an opportunity for conflict, we can address what makes violence more likely—as has been done by much of the field. But disputes are themselves disruptions of international relations. Thus, we would like to understand the reasons underlying dispute initiation as part of the larger escalatory process. States attempting to change the international status quo are likely a major contributing factor of dispute initiation. Although dispute initiation is not the only method of attempted change, it is a highly visible and salient method. It also has much greater associated risks than other methods.

The international relations literature has a good deal to say regarding conflict initiation in general. Maoz (1982) presents the first systematic analysis of dispute initiation. The analysis is systemic in nature with the unit of analysis being the state-period (with each period being five years) and all independent variables being indicators of a given state's position within the system. Maoz examines three dependent variables within this framework: quantity of initiation, frequency of initiation relative to dispute involvement, and intensity of initiation. Maoz focuses on three measures of "frustration" that are relevant to the present endeavor. These are external interference, an attainment gap, and status inconsistency. External interference is measured as how often a state has

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[1] See Carlson (1995) for an exposition on escalation as a process as well as an excellent literature review of previous studies on escalation.

been targeted for disputes in a given period (117). The attainment gap captures the difference between a state's population growth and its energy consumption growth (118). Finally and most relevant here, status inconsistency captures the difference between a state's military capabilities and its diplomatic status (119).

Maoz finds some contradictory results from his analysis with respect to frustration or dissatisfaction. Dissatisfaction seems to lead to an increased likelihood of dispute initiation *in general*. On closer inspection, however, the initiation behavior of *major powers* does not appear to be affected by dissatisfaction.

> It seems that if there were a relationship to hold for major powers, then the things that make major powers dissatisfied obviously differ from the things that make minor powers dissatisfied. Major powers are apparently not very sensitive to interference in terms of being direct targets to disputes, nor are they sensitive to attainment gaps or to status inconsistency, as are minor powers. (Maoz 1982, 153)

The null results in Maoz's analysis regarding major powers may be a result of the research design. First, the five-year periodization may mask relationships due to the effects of aggregating all variables to fit large discrete intervals. Second, the system-level analysis may be inappropriate to explaining the behavior of major powers. Indeed, power-transition theory posits a more directed (though not strictly dyadic) relationship between hegemon and challenger. Most importantly here, the analysis is non-directional in nature. States are categorized according to very broad dispute initiation behavior; the dependent variables do not differentiate any underlying reasons for why a state would *want* to initiate a dispute against some particular target.

THEORETICAL METHODOLOGY

I take a game-theoretic approach for a variety of reasons. Foremost, I am interested in a highly strategic question. The decision of one state to alter the status quo is highly dependent on the reactions of other states. If no other state will try to counteract the change, then attempting change is a very profitable venture. If the attempt will be rebuffed but without significant loss, it may be worth the effort anyway. If, however, an attempt at change will be met with force, the calculation carries dire consequences that must be weighted very carefully. The downside of these seemingly straightforward statements is that all states make the same decisions all at once. This is the exact realm of game theory.

With game theory, we can model a strategic-decision problem and then apply it to all empirical cases that meet the criteria of the strategic decision problem. Hence, I try to frame the problem in as general a way as possible and still be able to say something meaningful about specific events. Thus, a balance must be struck between generality and understanding. It is far too tempting to start by decomposing a single historical example and modeling its decision structure. Once solved, we may indeed have a great deal of understanding but only regarding this single event. At the other extreme, we could apply a very simple model to many cases. This is the very definition of generalizability, but we potentially lose a large degree of understanding.

For example, we could study the very general question of "conflict" and model it as a Prisoners' Dilemma—indeed, as many people have done. In studying conflict with the Prisoners' Dilemma (and other simple models), others have uncovered the logical foundations regarding several intuitive ideas as well as discovering new, counterintuitive ideas. This body of understanding itself is very general and may not apply to specific cases. We may understand a great deal, but we can predict nothing.

I seek a better balance when addressing the question of strategic timing in international politics. While the relationship between generalizability and understanding represents a problem for game theory, it is also endemic of all social scientific research. Thus, in seeking a model not so general that it dilutes prediction or so specific that it does not increase our understanding, I am simply making explicit a common scientific quandary and using it to help guide us in the present endeavor.

Another guiding principal for my model is the need for tractability. Game theory requires that all included variables (i.e., parameters) to be part of a cost/benefit equation. Hence, if a variable cannot be identified as a cost, a benefit, or some factor mitigating a cost or benefit (like a probability or risk factor), then that variable cannot become a game parameter. I will explore this problem more in following sections.

Given the question of when great powers attempt to alter the international status quo, I am intimately concerned with a timing problem. Leaders must ask themselves whether today is a good day to risk starting a war in the attempt of forcing a favorable outcome. At the same time, leaders must be concerned with their counterparts' decisions. All of these calculations are the purview of game theory. The argument here is that some type of timing game is required rather than a more straightforward (but less accurate) game model.

There are two strategic aspects of the timing problem that make a timing game more appropriate than some simpler model. First, a state contemplating change must consider the response of the other great powers. This conceptualization assumes some kind of subgame resulting from the initial action. Thus, the decision-maker must consider what the other side will do and what consequences this will bring—from complete success to total failure. If this were the only strategic element, we would not need a timing-game framework. We would simply label one side as the challenger to the status quo and model an extensive-form game with the challenger making an initial decision of seeking change or not seeking change. If the challenger did nothing, the game would end. Some of the timing element would still exist since the game's parameters change with time.[2]

There are two basic problems with the above framework. First, any state may wish to change the international status quo. Barring a perfect hegemony, the status quo is not likely to reflect the wishes of any one state regardless of what *de facto* hierarchy exists. This is especially irksome for the states near the top of this hierarchy—namely great powers. Thus, we cannot presume that the world is clearly divided into challengers and defenders.

Second, states that generally favor the international status quo may wish to initiate change themselves. Such change may be in the form of compromise to prevent conflict instead of myopically seeking a policy closer to some ideal position. Thus, even if the world were divided into challengers and defenders, a defender may want to yield early in order to secure most of its position for a longer duration.

The remainder of the dissertation is divided into four chapters. Chapter two examines strategic timing from an analytical standpoint. It contains two game-theoretic

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2 This is exactly what power-transition theory does. See Organski and Kugler (1980).

models that focus on different aspects of strategic-timing decisions. This chapter also presents a number of propositions and theoretical hypotheses that are derived from the game models. Chapter three presents a bridge between theory (in chapter two) and testing (in chapter four). Chapter four examines the specific example of strategic timing between the superpower rivals during the Cold War. In this chapter, I develop testable hypotheses which are specific to the Cold-War relationship but are covered under the general theoretical hypotheses derived in chapter two. Using a binary time-series technique that allows for strategic interaction, the empirical analysis supports the most of the testable hypotheses and does not reject any of the theoretical hypotheses. Chapter five concludes.

CHAPTER 2. THEORY AND MODELS

Dispute initiation results from an interaction of several factors, as discussed in the previous chapter. These factors include: the domestic environments of both states under examination, the general international environment in which the states find themselves, the dyadic context particular to the states under examination, and the states' evaluation of the status quo. The evaluation of the status quo is itself a product of the international, dyadic, and domestic contexts. The dyadic context has been examined by several researchers from a rational-choice perspective. The appeal of rational, dyadic analysis is that it involves the simplest forms of international interaction. From dyadic analysis we hope to glean understanding that can be expanded to broader international problems. The dyadic context is at the heart of the particular problem of strategic timing, as exemplified in the flow diagram below (Figure 2.1). This diagram focus on the dyadic interaction between states *A* and *B* and how that interaction produces initiation. The elements outside the central rounded box were discussed in greater detail in the previous chapter but remain vital determinants of the strategic decision problem.

One of the more celebrated works examining this dyadic relationship is that of Bueno de Mesquita and Lalman (1992). In this work, they set out to examine the general "international interactions" between two states. They devise a sequential game in which the state designated *A* goes first. The outcomes of this game range from the most conflictual (i.e., war) to the most cooperative (i.e., negotiation). The game also allows for null observations that fall between the two extremes (i.e., the status quo). (See Table 2.1 for the notation used in this dissertation.) In this game, the states can make demands

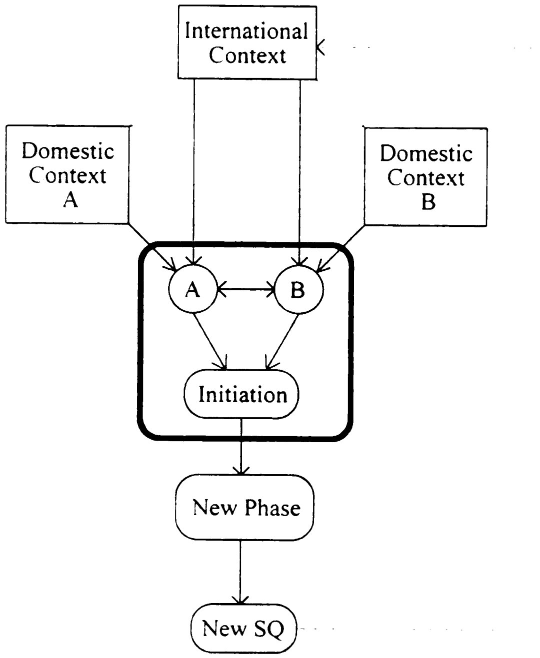

Figure 2.1. Flow Diagram of Strategic Timing

(D or d) upon one another. If both make demands, they then make decisions regarding the use of force (F or f) against one another. Lower case actions represent a second chance for an actor to exercise that option. (See Figure 2.2 for a rendering of Bueno de Mesquita and Lalman's international interaction game.[1]) They thus provide one of the most comprehensive formal models in terms of scope of outcomes in the entire international-relations literature.[2] From this model, they derive formal propositions regarding the circumstances under which each of the outcomes would occur assuming complete and perfect information.[3]

Table 2.1. Notation of Game Outcomes

Outcome	Original Notation	Simplified Notation
Acquiescence by A	Acq_A	A_a
Acquiescence by B	Acq_B	A_b
Status Quo	SQ	SQ
Negotiation	$Nego$	N
Capitulation by A	Cap_A	C_a
Capitulation by B	Cap_B	C_b
War initiated by A	War_A	W_a
War initiated by B	War_B	W_b
War (simultaneous)		W

An amazing result of their formal treatment is that war can be an equilibrium outcome under complete and perfect information. Thus, if their specification is correct, state leaders can go to war with one another with their eyes wide open; they can be

[1] This rendering uses notation consistent with the rest of the dissertation. See Bueno de Mesquita and Lalman (1992, 30) for the original figure.
[2] Other formal models of international interactions with a broad scope include Brams and Kilgour (1988), Brito and Intriligator (1985), Morgan (1994), Powell (1993), and Wagner (1986).
[3] "A game is played under complete information if all the players' payoffs are common knowledge." (Morrow 1994, 349) "A game is said to be of *perfect information* if every information set contains only a single node. No player will then ever be in doubt about what has happened in the game so far." (Binmore 1992, 100). These two conditions mean that the actors know exactly what their situations are without error. As partial evidence of this, several outcomes of the international interaction game are never in equilibrium under these conditions: war started by B and capitulation by either actor.

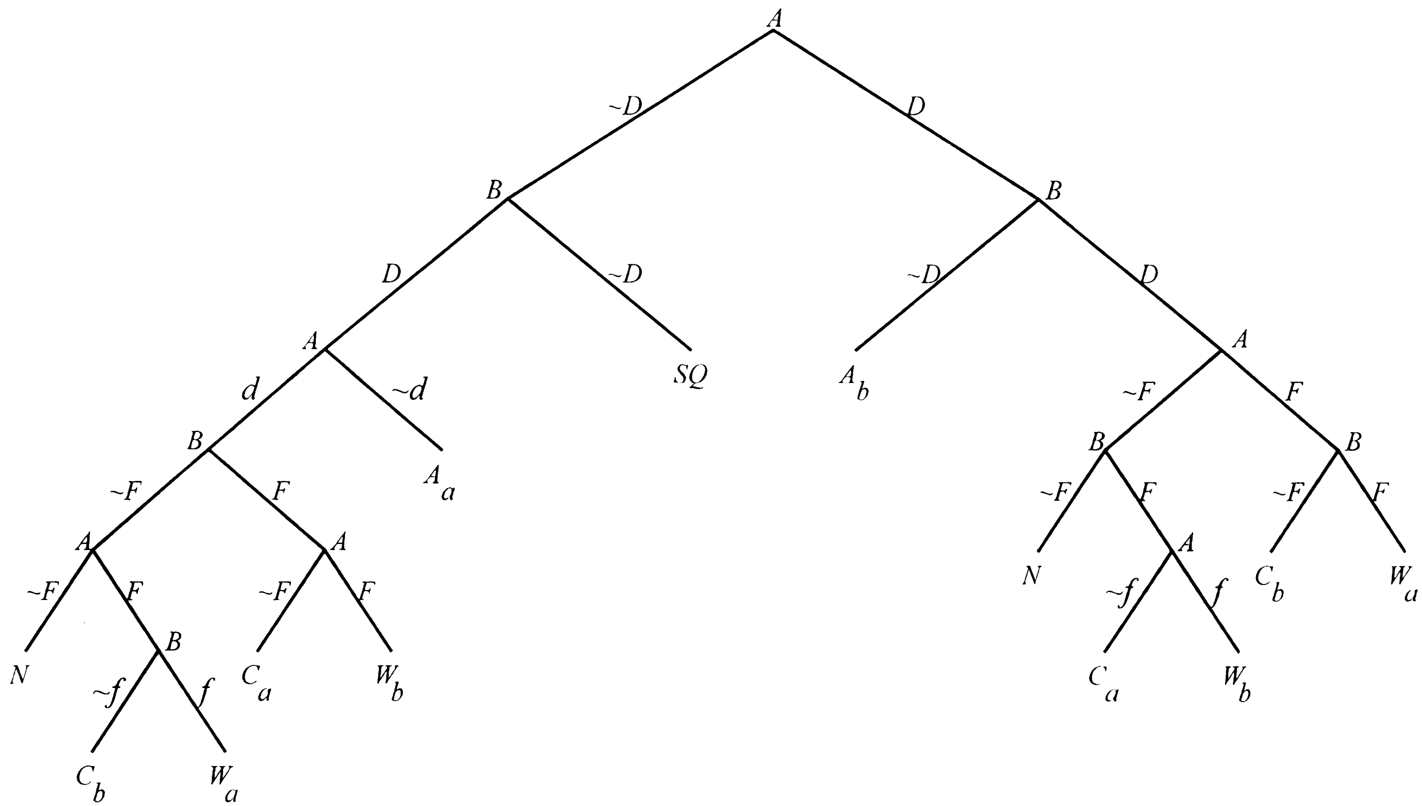

Figure 2.2. The International Interaction Game

perfectly rational, have accurate perceptions, make no mistakes, and yet still go to war. The formal circumstances of this "rational war" are found in domestic Proposition 3.1:

> With perfect information, War_A is a pure strategy equilibrium if and only if we add to the restrictions on the preference orders delineated in chapter 2 (including 2.A7b but not 2.A7a) that for A, $Cap_A > War_B$, $War_A > Acq_A$, and for B, $Cap_A >$ Negotiate, $War_A > Acq_B$. (72)[4]

This proposition says that B prefers A's capitulation over a negotiated outcome and prefers war over its own acquiescence; meanwhile, A prefers capitulating over a war B starts and a war it starts over its own acquiescence. Under these conditions, A makes an initial demand to avoid its own acquiescence. B then makes a counter demand since the expected war is better for it than acquiescing. A initiates the use of force to avoid capitulating followed by B's retaliation. Thus, a hawkish, retaliatory B coupled with a pacific but desperate A produces a violent but rational outcome of war.[5] The desperate position of A sheds light on why a rational war is a reasonable expectation. A would prefer to avoid the use of force, which is deduced from negotiation being preferred to $W_a > A_a > C_a > W_b$. Negotiation, however, is not attainable since B will take advantage of

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[4] The "restrictions on the preference orders delineated in chapter 2" are the result of the following assumptions: (1) the actors are utility maximizers, (2) the utilities of war and negotiation are represented by lotteries of winning one's demand or of acceding to the opponent's demand, (3) the utility of capitulations are certainties, (4) negotiation is strictly preferred to war, (5) getting one's own demand is preferred to the status quo which is in turn preferred to giving in to one's opponent's demand, (6) there is a domestic political cost to using force, a political cost to acquiescing, a physical cost to being the target of violence, and a physical cost for initiating violence, and (7b) demands are the result of domestic political processes that are exogenous from the game. See Bueno de Mesquita and Lalman (1992, 40-1) for a more complete specification of assumptions. The preference restrictions that follow logically from these assumptions are: SQ always preferred to Acq_i and Cap_i; Acq_j always yields the highest utility; Acq_i is always preferred to Cap_i; negotiation is always preferred to Acq_i, Cap_i, War_i, and War_j; Cap_j is always preferred to War_i and War_j; and War_i is always preferred to War_j. See (1992, 47-50).

[5] The terms hawk/dove and pacific/retaliatory (or self-defender) have the same usage here as in Bueno de Mesquita and Lalman (chapter 4). Specifically, a hawk has $Cap_j > N$ while a dove has $N > Cap_j$; a pacific actor has $Cap_i > War_j$ while a retaliatory one has $War_j > Cap_i$. The fact that A is pacific and B is a hawk follows directly from the preferences in the proposition. B's retaliatory nature follows from $W_a > A_b > C_b$.

any "weak" move by A. Thus, this particular A starts a war to avoid giving in—either peacefully or after an initial strike by B.

In the same chapter, they present two propositions on acquiescence—the outcome in which one state gives in to the demand of other without any use of force by either side. The first of these propositions is that an acquiescence by state A is the equilibrium outcome under the same conditions as Proposition 3.1 "except that for A, $Acq_A > War_A$ or Cap_A is the subgame perfect equilibrium in the crisis subgame" (80). Thus, the A in the rational war proposition is not expected to acquiesce *as long as that actor is allowed to move first*. Actor order is implicitly assumed in the propositions. Changing the order given the sequential nature of the game is meant to signify different actors in a different situation. Consider the following role reversal, however.

If we take the actors of the rational war proposition but allow B to go first, the new equilibrium result is quite telling. The crisis subgame initiated by A still results in W_a and the crisis subgame initiated by B still ends in A's capitulation. (See Figure 2.3 for a graphical equilibrium analysis.[6]) B still prefers a war started by A over its own capitulation. Now, however, A must (potentially) choose between W_a and the status quo. The preference restrictions provided by the rational war proposition do not shed light on A's preference over these two outcomes, but this missing information does not change the equilibrium outcome. On the right-hand side of the tree, A chooses not to make a counter demand since $A_a > C_a$. At the top of the tree, B chooses to make a demand since A_a is its

[6] Strictly sequential games (or subgames) are solved using subgame perfection or backwards induction. The solutions are called subgame-perfect equilibria (SPE). See Zermelo (1913) and Selten (1975).

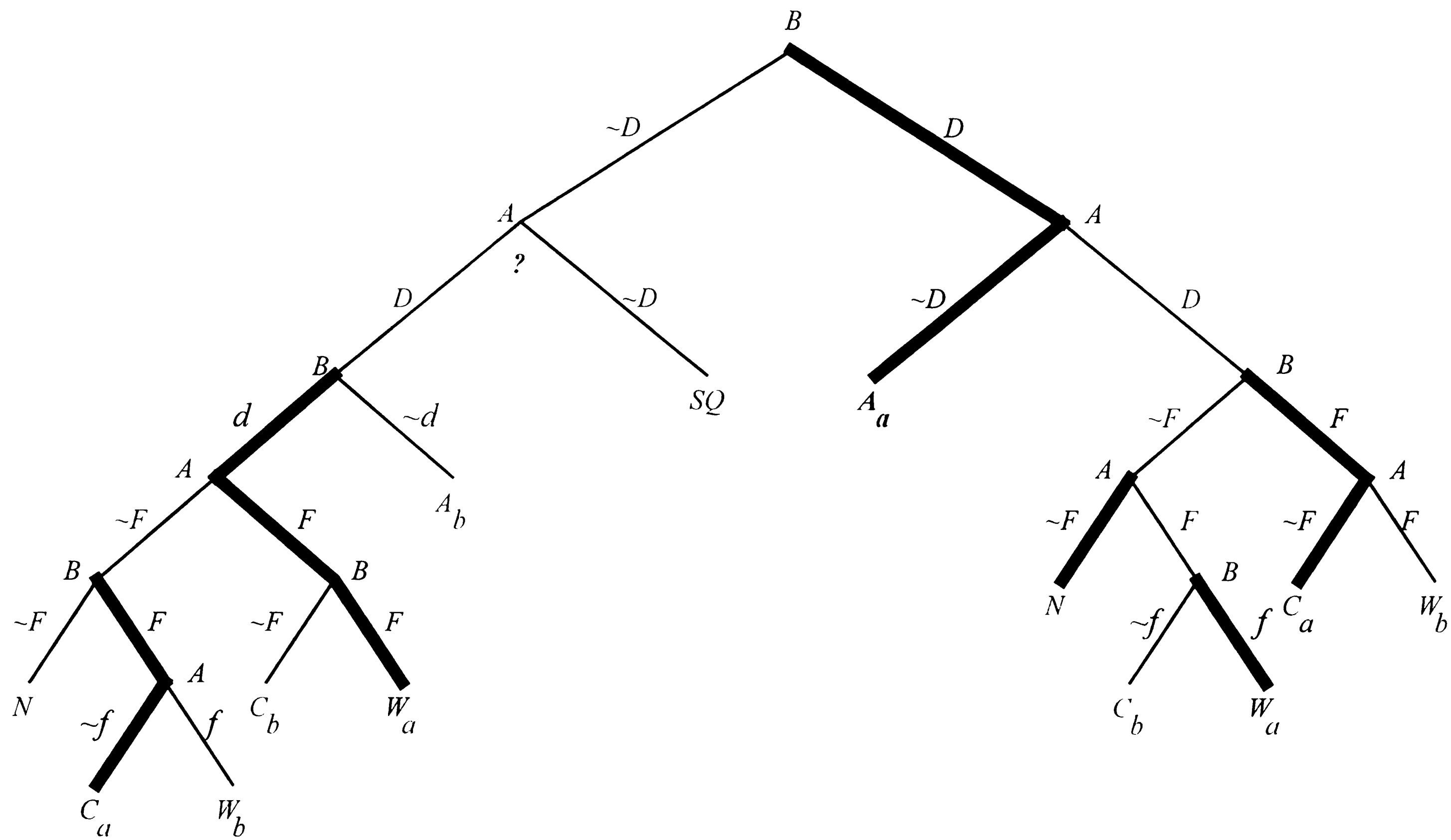


Figure 2.3. Acquiescence by *A* as the Equilibrium Outcome under Proposition 3.1 and Role Reversal

best possible outcome. Thus, if B is allowed to move first under the rational war proposition, the game ends in A's acquiescence.

This result is covered under another proposition in *War and Reason*. The second proposition on acquiescence says that state B can be expected to acquiesce to state A's demands under complete-and-perfect information conditions:

> With full information conditions, assumption 2.A7b (that is, the domestic variant), and strict preferences, Acq_B is a full-information equilibrium outcome of the international interaction game if and only if the equilibrium outcome of the crisis subgame at node 5 is either Cap_B or War_A, and for B, $Acq_B > War_A$. (81)

The question remains as to whether the rational war proposition and the acquiescence by B proposition are different cases involving actors in different situations or something more basic.

A curious problem arises when one realizes the implications of the "rational war" and the acquiescence propositions combined. Specifically, one of the conditional cases of the acquiescence proposition is simply a role reversal of the two actors. The most confounding implication is that the actor who starts a war when it gets to go first acquiesces when the other actor goes first. Thus, if we do not know *a priori* which actor gets to go first, then we cannot make a prediction regarding the equilibrium outcome. One question is whether we can resolve this problem by examining the actors' preferences.

In this particular situation, the state B of the rational war proposition would clearly prefer to initiate the interaction and get state A to acquiesce; this gives state B its highest potential payoff. Since state A prefers starting a war to acquiescing, it would also prefer initiating the interaction in order to get a higher payoff. From this extra-model preference analysis, all that one can say is that each state would want to make the first demand. This is hardly a useful statement.

This logical problem also calls into question the "rational" war result. Even though the state *A* of the rational war proposition prefers starting a war over acquiescing, why would a perfectly rational—and therefore diligent—state *B* ever allow state *A* the initiator advantage? It cannot be that state *B* prefers war to *A*'s acquiescence; the other state's acquiescence is the most preferred outcome in all circumstances. Given the original framework, the only explanation is that state *B* missed a critical opportunity—i.e., it made a mistake. But this assessment undercuts the idea that war can be the result of rational actors making fully informed decisions.

To the authors' credit, the empirical data on which they were indirectly basing their model did not present initiation as a problem. The Militarized Interstate Disputes data set codes disputants as being on the initiating side (called "side A") or as being on the target's side (called "side B") (Gochman and Maoz 1984). An analysis of international outcomes resulting from rational action *given initiator and target* would seem reasonable on the face of it. The logical problem illustrated above suggests that their analysis is in need of re-examination. Since the actors themselves decide whether to make demands, we can model this decision as simultaneous rather than sequential. This has the effect of endogenizing who goes first in the international interaction game. It is also one way of modeling dispute initiation between states.

This single example raises three main questions surrounding the strategic details of dispute initiation. First, how do we go about modeling dispute initiation such that the *artificial* initiator advantage is neutralized? Kilgour and Zagare (1991) provide a method for addressing this question. In their analysis of deterrence, they construct a mixed (i.e., sequential with a simultaneous move) model of mutual deterrence. The simultaneous node is necessary since one-sided models of deterrence—in which one state is deterring the other—suffer from the same artificial initiator advantage as the international interaction game. Although they treat the simultaneous move in their game as uncertainty, I use the same technique to endogenize initiation. Once initiation has been modeled correctly, the next question is how often does initiation advantage matter? The above example points to one case in which it matters—in that switching actor order alters the equilibrium outcome—but other examples can be constructed in which there would be no difference. An explicit model will get at this question more directly.

After addressing these two questions within the specific context of the international interaction game, I look at a more general question of strategic timing. Real-world actors make decisions in real time whereas the conceptual framework of the international interaction game assumes discrete interactions. But under what conditions is it appropriate to think of strategic-timing decisions as discrete events? Put another way, is the *time* of a dispute ever more important than determining the *sequence* of a dispute? If the conditions are too restrictive, a more complicated model would be necessary. If the conditions are fairly general, then a discrete-time framework is a reasonable approximation of the underlying phenomenon.

The remainder of this chapter is divided into three broad sections. The first section deals with the specific problem of endogenizing demand initiation in the international interaction game. It presents a new game with a subtly different structure than Bueno de Mesquita and Lalman's international interaction game but with the same underlying preference assumptions. The analysis of this new game generates a comparison of results between the two games under the same preference conditions. These comparative results allow us to examine, among other things, whether "rational war" is still a possibility once we have removed the initiator advantage from the model. This game implicitly assumes a discrete-time framework in which the actors decide whether to make initial demands in a given period. The second section deals with the general problem of endogenizing who goes first in a continuous-time framework. This model shows conditions under which a discrete-time framework is reasonable. The third section lays out several propositions relating to initiation. These propositions provide a link between the two strategic-timing game models. I then present several theoretical hypotheses that follow from these propositions.

THE DISCRETE-TIME, DEMAND-INITIATION GAME

This section explicitly models demand initiation based on the framework of the international interaction game. I present a new structure for the game that neutralizes the artificial initiator advantage while preserving the main structural features of the original game. I also maintain the original preference assumptions. This is intended to make the revised model as comparable as possible to Bueno de Mesquita and Lalman's model.

Theoretically, initiation means making some sort of demand. When neither side makes a demand, the status quo results. If one actor clearly makes the initial demand, we traverse the game tree from node 3 of the original game (1992, 30) changing actor identity as necessary. See Figure 2.4 for the game examined here.

In the case that both make demands simultaneously, I construct a new subgame that follows the logic of the original and the logic of endogenous initiation. Thus, I allow each actor to choose whether to use force in a simultaneous fashion. If neither choose to

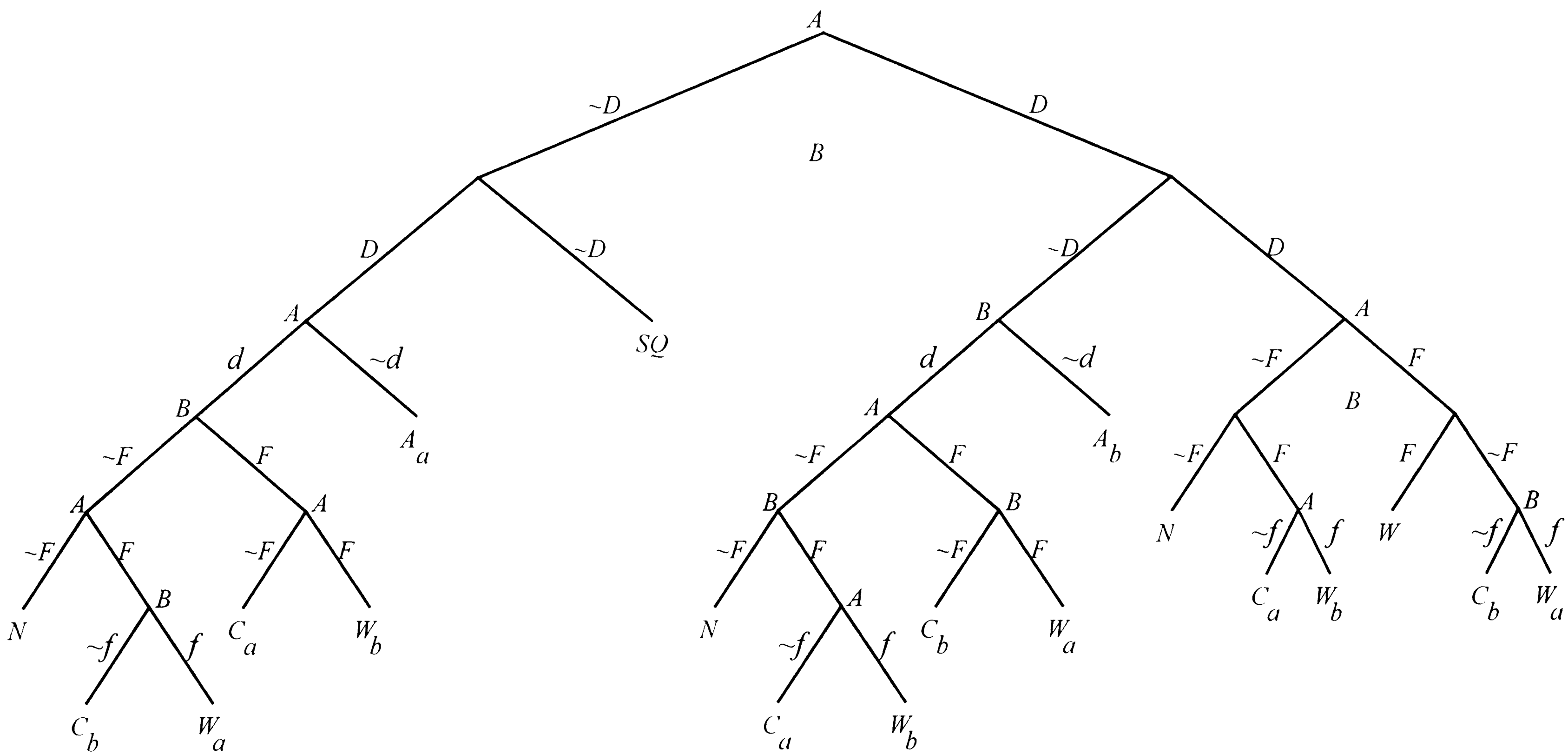


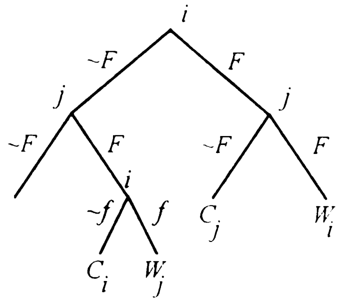
Figure 2.4. The Demand-Initiation Game

use force, negotiation results. If both choose to use force, war results. Note that this war is different from War_A and War_B of the original in that it is initiated simultaneously. I assume that the value of this simultaneous war is an unweighted average of the values of the other war types. If one actor chooses force while the other seeks a peaceful solution, the side that did not use force must be given the chance to retaliate after the fact. These choices of last resort give one side an opportunity to end the cycle of escalation inherent in conflict. The idea of war and negotiation being lotteries (1992, 40) is merely a way summing up an expectation of future escalation.

A Simpler Timing Problem: Conflict Initiation

The subgame occurring after simultaneous demands is a convenient exemplar of strategic timing. Specifically, it is a model of conflict initiation in which actor order has already been neatly endogenized. Its counterpart in Bueno de Mesquita and Lalman's international interaction game is the crisis subgame. (Both are redrawn below as Figure 2.5a—the crisis subgame—and Figure 2.5b—the conflict-initiation subgame.) As part of the larger game, the actor order within the crisis subgame has already been settled endogenously. As a stand-alone model the crisis subgame exhibits the same problem as the international interaction game—the order in which actors move is exogenous and can affect the equilibrium outcome. Thus, analyzing these two subgames will provide insights on initiation in general and aid in analyzing the demand-initiation game.

Models of Conflict



$i, j = \{A, B\}; j \neq i$

Figure 2.5a. Crisis Subgame

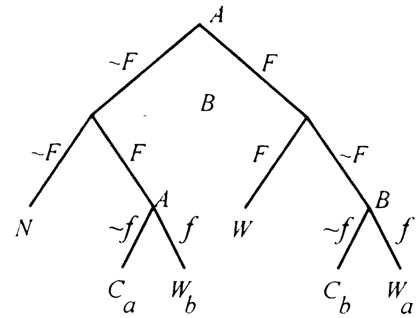


Figure 2.5b. Conflict Initiation Subgame

In this section I solve the *conflict-initiation subgame* by sorting through all relevant preference conditions.[7] This generates a unique set of cases on which comparative equilibrium analysis is based. I then apply the preference conditions of each case to the *crisis subgame* allowing first *A* and then *B* to initiate. This demonstrates how choice of first mover matters within the context of conflict models *and* how an endogenous-initiation model differs from conventional results. After comparing the results of the two subgames, I use the conflict-initiation-equilibria conditions to solve the demand-initiation game.

[7] Although the *structure* of the conflict-initiation subgame is identical to that of Kilgour and Zagare's deterrence game (1991), several distinctions must be noted. First, they make no distinctions among their three "conflict" outcomes with respect to their nomenclature. Second—and incorrectly—the outcomes of their reduced (i.e., 2x2) deterrence games do not change with the preference conditions (311). Thus, even when both states are known to be retaliatory, "Advantage to A" and "Advantage to B" are still conceived as attainable outcomes. (This mistake does not alter their first-order equilibrium results and is implicitly correct in the text: "Of the *two* Nash equilibria in [the Prisoners' Dilemma] game, mutual deterrence is strictly preferred by both players" and is, therefore, the anticipated outcome (310, emphasis added). The matrix accompanying the text has *one* Nash equilibrium but the corrected matrix of status quo and three conflict cells would have two Nash equilibria.) Third, they only consider the retaliatory-versus-pacific preference distinction. Although not a direct comparison, their assumption of "Advantage to self" being preferred to the status quo is similar to both actors always being hawks. This is a strong assumption for general international interactions but not so strong for a deterrence model.

It is obvious in this subgame (in Figure 2.5b) that the question of retaliation is important. By partial backward induction, the actors preferences for self-defense produce three different two-by-two matrices that characterize different types of international problems. If both actors are self-defenders (having $W_j > C_i$), then the situation is characterized by Matrix 2.1.[8] In this game, negotiation and a simultaneous war are both Nash equilibria (NE) since both actors have $N > W_i > W > W_j$. (This is case 1.0. The assignment of case numbers reflects the conditional assumptions that represent the case, including added conditional assumptions that separate cases into differing equilibria.[9])

		B ~*F*	*B* *F*
A	~*F*	N	W_b
A	*F*	W_a	W

Matrix 2.1. Two Self-defenders

If one actor is a self-defender while the other is pacific (having $C_i > W_j$), then a different situation arises. This is presented in Matrix 2.2 with state *B* being the self-defender. In this situation, two preference comparisons need to be determined before a solution can be found. If *B* is a hawk (having $C_a > N$), *A*'s preference over C_a and W must be determined. If *A* has $W > C_a$—which I will label as being a "preemptive self-

[8] Once the game has been simplified into a matrix, Nash-equilibrium analysis is used. See Nash (1951).
[9] Case numbers are of the following form: (conflict-initiation matrix assignment).(conflict-initiation equilibria assumptions).(crisis-subgame equilibria assumptions).(full-model equilibria assumptions). Under this system, cases 2.11 and 2.12 have assumptions 2.1x in common but differ on the last assumption. Similarly, cases 2.12.1 and 2.12.2 have assumptions 2.12.x in common and have the same equilibrium in the conflict-initiation subgame, but they require additional, mutually exclusive assumptions to find the equilibria in the crisis subgame. Xs are used as place-holders.

defender" or PSD[10], then a simultaneous war is the unique Nash equilibrium (case 2.11). If A is not a PSD (having $C_a > W$) while B is a hawk, A's capitulation is the unique NE (case 2.12). If B is a dove (having $N > C_a$), negotiation is a Nash equilibrium (though not necessarily unique). If B is a dove and A is a PSD, both negotiation and a simultaneous war are NE (case 2.21). If B is a dove and A is not a PSD, negotiation is the unique NE (case 2.22).

		B: $\sim F$	B: F
A	$\sim F$	N	C_a
	F	W_a	W

Matrix 2.2. One Pacific Actor and One Self-defender

The last situation that can arise is for both actors to be pacific. This is presented in Matrix 2.3. In this game there are two aspects of indeterminacy. First, the actors could both be doves, both be hawks, or there could be one dove and one hawk. Second, the actors could both be PSDs, neither be PSDs, or there could be one PSD and one non-PSD. When both actors are doves and PSDs, negotiation and war are both NE (case 3.11). When both actors are doves but neither are PSDs, negotiation is the unique NE (case 3.121).[11] When both actors are doves but one is a PSD while the other is not a PSD, negotiation is still the unique NE (case 3.122).

[10] This is a way of saying that the actor is not a "full" self-defender since he would capitulate if he were attacked unawares but would initiate an attack if he thought an attack on himself was imminent ($W > C_i > W_j$).
[11] Assumption 3.x2 is, "no more than one actor is a PSD." This assumption has two parts—neither are PSDs or there is one PSD and one non-PSD. Cases 3.121 and 3.122 each lead to the same NE as do cases 3.321 and 3.322. But cases 3.221 and 3.222 have different equilibria.

		B	
		~F	F
A	~F	N	C_a
	F	C_b	W

Matrix 2.3. Two Pacific Actors

When both actors are hawks and PSDs in Matrix 2.3, war is the unique NE (case 3.21) When both actors are hawks but neither are PSDs, both C_a and C_b are NE (case 3.221). When both actors are hawks while *B* is a PSD but *A* is not a PSD, C_a is the unique NE (case 3.222). This is a symmetrical equilibrium that would lead to *B*'s capitulation if the last assumption were reversed.

If *A* is a dove while *B* is a hawk but both are PSDs, war is the unique NE (case 3.31). Under the same dove/hawk asymmetry, if neither are PSDs, C_a is the unique NE (case 3.321). Similarly, if *A* is not a PSD but *B* is a PSD, C_a remains the unique NE (case 3.322). Finally, if *A* is a dove and a PSD while *B* is a hawk but not a PSD, then no pure-strategy NE exists (case 3.323).[12]

The above analysis, though somewhat tedious, exhausts the possibilities of this subgame. Table 2.2 summarizes the technical conditions under which each outcome is a pure-strategy NE.

We can now turn our attention to crisis subgame (in Figure 2.5a). By applying the preference conditions from the conflict-initiation subgame, I construct a direct, case-

[12] Potential cases 3.123 and 3.223 need not be analyzed separately since the only asymmetry in cases 3.122 and 3.222 is the final assumption (assigning *A* as a non-PSD and *B* as a PSD). This implies that any asymmetric equilibrium (like C_a) is simply reversed (becoming C_b). In cases 3.3x, assumption 3.3 is already asymmetric (assigning *A* as a dove and *B* as a hawk); thus, reversal of the final assumption of case 3.322 is not the same as the reversal of all *A*s and *B*s. Instead, it is a unique case.

by-case comparison between the models. This comparison demonstrates how who goes first matters *and* how the results of endogenous initiation differ from standard results. I discuss the results of this analysis in the next section.

In this comparative analysis, it is necessary to apply a case's conditions to *both* a crisis subgame in which A moves first *and* a crisis subgame in which B moves first. The results of the SPE analysis will only differ when the case conditions are asymmetric. Hence, case 1.0.0 (in which both actors have $W_j > C_i$) has a SPE of N regardless of who moves first.[13] In some symmetric cases, the analysis produces the same equilibrium outcome after adjusting subscripts. For example, case 3.21.0 (in which both actors have $C_j > N > W > C_i > W_j$) results in C_b if A moves first but results in C_a if B moves first. By contrast, case 2.11.0 (in which A has $W > C_a > W_b$ and B has $W_a > C_b$ and $C_a > N$) has a SPE of W_a when A moves first and a SPE of C_a when B moves first.

Some of the cases require additional conditions in order to produce a differentiated solution. For example, case 2.12 (in which A has $C_a > W > W_b$ and B has $W_a > C_b$) could lead to different SPE when A moves first. If A has $W_a > C_a$ (case 2.12.1), then W_a is the unique SPE of the subgame. If A has $C_a > W_a$ (case 2.12.2), then C_a is the unique SPE of the subgame. When B moves first in either case, C_a is the unique equilibrium outcome. Table 2.3 summarizes the case-by-case comparisons for the conflict-initiation subgame (with endogenous initiation) and the crisis subgame (specifying who goes first).

[13] The comparative SPE analysis of the crisis subgame is contained in Appendix A.

Table 2.2. Conflict-Initiation Subgame Equilibria

Case	Conditions for Actor *A*	Conditions for Actor *B*	Pure Strategy NE
Two Self-Defenders			
1.0	$W_b > C_a$	$W_a > C_b$	N, W
One Pacific Actor and One Self-Defender			
2.11*	$W > C_a > W_b$	$W_a > C_b, C_a > N$	W
2.12†	$C_a > W > W_b$	$W_a > C_b, C_a > N$	C_a
2.21*	$W > C_a > W_b$	$W_a > C_b, N > C_a$	N, W
2.22†	$C_a > W > W_b$	$W_a > C_b, N > C_a$	N
Two Pacific Actors			
3.11	$W > C_a > W_b, N > C_b$	$W > C_b > W_a, N > C_a$	N, W
3.121	$C_a > W > W_b, N > C_b$	$C_b > W > W_a, N > C_a$	N
3.122*	$C_a > W > W_b, N > C_b$	$W > C_b > W_a, N > C_a$	N
3.21	$W > C_a > W_b, C_b > N$	$W > C_b > W_a, C_a > N$	W
3.221	$C_a > W > W_b, C_b > N$	$C_b > W > W_a, C_a > N$	C_a, C_b
3.222†	$C_a > W > W_b, C_b > N$	$W > C_b > W_a, C_a > N$	C_a
3.31*	$W > C_a > W_b, N > C_b$	$W > C_b > W_a, C_a > N$	W
3.321†	$C_a > W > W_b, N > C_b$	$C_b > W > W_a, C_a > N$	C_a
3.322†	$C_a > W > W_b, N > C_b$	$W > C_b > W_a, C_a > N$	C_a
3.323	$W > C_a > W_b, N > C_b$	$C_b > W > W_a, C_a > N$	mixed NE only

* These cases are mirror-image cases in which the actors' conditions can be reversed (remembering to change subscripts) and still lead to the same Nash equilibrium.

† These cases are mirror-image cases in which the actors' conditions can be reversed (remembering to change subscripts), but the reversal leads to *B*'s capitulation rather than *A*'s.

‡ The NE of this case is unchanged as long as *at least one* of the actors has $C_j > N$.

Table 2.3. Comparing Model Results of Subgames

Endogenous Initiation	Crisis Subgame: *A* moves first	Crisis Subgame: *B* moves first	Cases
N, *W*	*N*	*N*	1.0.0, 2.21.0, 3.11.0
N	*N*	*N*	2.22.0, 3.121.0, 3.122.0
C_a	W_a C_a C_b	C_a C_a C_a	2.12.1 2.12.2, 3.321.2, 3.322.2 3.222.0, 3.321.1, 3.322.1
W	W_a C_b	C_a C_a	2.11.0 3.21.0, 3.31.1
C_a, C_b	C_b	C_a	3.221.0
No Pure-Strategy NE	C_b	C_a	3.323.1

Discussion of the Comparative Results

Several things are revealed in the preceding analysis. First, who moves first does not *always* matter. Second, endogenous initiation can resolve some of the logical problems of initiator advantage. Third, the method used here for endogenizing initiation does not always specify how initiator advantage is resolved. Finally, modeling initiation as endogenous adds uncertainty to the decision process.

Who goes first does not always matter. When negotiation is predicted in the crisis subgame, it is also an equilibrium of the conflict-initiation subgame. Similarly, when a specified actor is predicted to capitulate in the crisis subgame regardless of who goes first, that actor's capitulation is the equilibrium of the conflict-initiation subgame as well. This result is not surprising. It simply states that when the same outcome is predicted under exogenous initiation irrespective of initiator, then the same outcome should be predicted under endogenous initiation.

Endogenous initiation, however, can resolve some of the logical problems of initiator advantage. When different outcomes are predicted under exogenous initiation—

as in the puzzle between war and acquiescence presented earlier—endogenizing initiation helps resolve the puzzle. In the conflict-initiation subgame, for example, capitulation by one actor is predicted under two puzzling situations. In one situation, the capitulating actor would start a war if given the opportunity; in the other situation, the capitulating actor would force the other actor to capitulate if it could. In both situations the same actor would capitulate if the other actor makes the first move. Hence, it is shown that one actor is clearly disadvantaged if initiation is endogenized. Another example produces war in the conflict-initiation subgame. The same predictions are made under exogenous initiation as in the previous example, but the endogenous-initiation outcome is different. Thus, modeling initiation as endogenous clarifies our logic in two ways. It helps resolve the problem of initiator advantage, and it more finely separates cases than an exogenous-initiation model.

But the method used here for endogenizing initiation does not always specify how initiator advantage is resolved. In two cases from the conflict-initiation subgame the equilibrium analysis does not specify which actor has a decisive advantage when initiation is endogenized. This still represents additional information since the analysis tells us that *neither* actor has an advantage. Indeed, presuming a particular initiator tidily eliminates the "something to chance" that so concerns Schelling (1960) and others. Thus, the endogenous-initiation model represents an improvement over exogenous initiation since it separates cases in which advantage to one actor exists from cases in which advantage does not exist.

Finally, modeling initiation as endogenous adds uncertainty to the decision process. In the cases just mentioned, the endogenous-initiation model stresses that some mixed strategy would be used by the actors. This contrasts with the unequivocal analysis of the exogenous-initiation model. In these cases, however, the added uncertainty was shown to be a better reflection of reality. The endogenous-initiation model also produces unexpected uncertainty that may be an artifact of the chosen model. For example, the conflict-initiation subgame has NE of negotiation *and* war for some cases that unequivocally result in negotiation under exogenous initiation. Although negotiation is Pareto superior, war theoretically remains an equilibrium possibility. A similar but less troubling example exists for the demand-initiation game. Some cases produce NE of status quo and negotiation in the demand-initiation game that only result in status quo under exogenous initiation. Status quo is again Pareto superior, but negotiation remains a possible equilibrium outcome. All in all, however, endogenous initiation helps clarify our thinking regarding political processes and helps separate cases in ways that exogenous initiation is unable to do. In the next section I return to the puzzle that prompted this inquiry.

RATIONAL WAR IN THE ENDOGENOUS-INITIATION GAME

Solving the demand-initiation game follows the same logic as in the preceding analysis. The analysis of the demand-initiation game and its comparison with the original international interaction game are contained in Appendix B. Table B.3 summarizes the comparative results. The demand-initiation equilibria are used in the section on "Propositions Relating to Initiation." In this subsection, I return to the motivating question: Is war rational under complete information when demand initiation is an endogenous part of the strategic decision problem? There are two aspects of this question that are of interest. First, when war is predicted under the original international interaction game, is it still in equilibrium when initiation is endogenized? Second, how do the equilibrium conditions for war differ from model to model?

Recall that Domestic Proposition 3.1 from *War and Reason* lists the conditions for a "rational" war under complete and perfect information. These conditions are that A has $W_a > A_a > C_a > W_b$ while B has $C_a > N > W_a > A_b$. Case 2.11.0.1.4 exhibits these conditions within the international interaction game as long as A gets to move first. Cases 2.11.0.1.5 and 2.12.1.1.0 also exhibit these conditions with the refinements that (1) A gets to move first and (2) A prefers W_a over A_a. When demand initiation is endogenized, only one of these three cases (case 2.11.0.1.4) still has war as the predicted outcome. The other two cases result in A_a despite A preferring W_a over A_a.

In comparing the demand-initiation game to the international interaction game, we see that three additional cases are expected to result in war under endogenous initiation. In each of these cases (2.11.0.2.41, 3.21.0.0.41, and 3.31.1.0.41), the international interaction game predicts the acquiescence of the actor who moves second. This clearly presents an initiator advantage. Under endogenous initiation, however, the actors will fight rather than giving in to the other side.

Since not all wars under international-interaction-game conditions are predicted to be wars in the demand-initiation game and *vice versa*, what are the equilibrium conditions for war when initiation is endogenized? The answer to this question is summarized in Proposition 2.1.

> **Proposition 2.1.** With complete information, W is the unique pure-strategy NE of the demand-initiation game if and only if (1) at least one actor has $C_j > N$ while the other has $C_i > W_j$ and (2) both actors have $W > A_i$.

Using Figure 2.4, let A have $C_b > N$. By the proposition, B must then have $C_b > W_a$. Thus, B will capitulate whenever attacked. If B makes the initial demand, we know from backwards induction that A will force B to capitulate rather than negotiating. We do not know whether A would capitulate or retaliate. Since both actors have $W > A_i$ (by the proposition), $A_i > C_i$ and $C_j > W_i > W > W_j$ (by model assumptions), we know that B has $C_a > W_b > W > A_b > C_b > W_a$. Thus, when pacific B initiates the conflict-initiation subgame, B prefers C_a or W_b to C_b. A would acquiesce for sure if it were pacific; if A were retaliatory, it is also possible for A to have $W_b > A_b$ or $A_b > W_b$. So, there are two possible SPE when B makes the initial demand—A_a or W_b.[14]

When A makes the initial demand, we again do not know whether A would capitulate or retaliate at the final node. We also do not know whether B will choose to negotiate with a pacific A or force a pacific A to capitulate. Thus, A initially choosing not to use force could lead to any of $\{N, C_a, W_b\}$. B, however, will capitulate if attacked. Since A has $C_b > N$ and $W > A_a$ (by the proposition) and $N > W_a > W > W_b$ and $A_a > C_a$ (by model assumptions), we know that A has $C_b > N > W_a > W > A_a > C_a$ and $C_b > W_b$. Therefore, A prefers choosing F (resulting in C_b) over choosing $\sim F$ (resulting in any of $\{N, C_a, W_b\}$). Faced with self-capitulate or self-acquiescence, B chooses to acquiesce. So, A_b is the SPE when A makes the initial demand.

When both actors make demands, we again know that B will capitulate if A initiates force. Since A has $C_b > N$, A would initiate force if A knew that B would not initiate force. We do not know whether A will capitulate or retaliate if B were to initiate force. Regardless, we know that A prefers W over W_a (by model assumption) and W over

[14] This is an example of the symmetry of the game. Although W_b is nowhere a SPE within Table B.3, the cases that have W_a as a SPE can be reversed.

C_a (by proposition and model assumption since $W > A_i > C_i$). Thus, A has a dominant strategy to initiate force in the conflict-initiation subgame. Faced with this knowledge, B can choose not to initiate force (resulting in self-capitulation) or choose to initiate force (resulting in W). B has $W > A_i > C_i$, so B will choose to initiate force also.

We now know that simultaneous demands lead to W, demand initiation by A leads to A_b, and demand initiation by B leads either to A_a or to W_b. In the former case, both actors have $A_j > SQ$ (by model assumption) and $W > A_i$ (by proposition), thus producing W as the unique pure-strategy NE of the demand-initiation game. In the latter case, we know that A has $W > W_b$ and $A_b > SQ$ (by model assumptions). So, A has a dominant strategy to make a demand. B prefers W over A_b, so W is again the unique pure-strategy NE of the demand-initiation game.

When both actors are pacific hawks—i.e., both have $C_i > W_j$ and $N > C_j$, some of the uncertainty of the subgame analysis is removed, but the equilibrium is still W. An inspection of Table B.2 shows numerous cases which did not result in war that have *some*—but never *all*—of the conditions of Proposition 2.1.

THE CONTINUOUS-TIME GAME

In this section I present a "basic" timing game. It is basic in the sense that it presents the lowest level of complexity and yet is still substantively interesting. This basic timing game is relatively easy to solve and yet flexible enough to be used as the basis of applied models. The model presented here is a two-person, non-zero-sum game in continuous time. I show how to solve a basic timing game and present a simple applied model in order to demonstrate its usefulness. This model is also constructed with an eye toward addressing the appropriateness of discrete-time games when the underlying decision problem is really one in continuous time. I use this model to answer the following question from the chapter introduction: Under what conditions is it appropriate to think of strategic timing decisions as discrete events?

SETUP OF THE CONTINUOUS-TIME GAME

The basic timing-game model I employ has the following features. It is a continuous-time game between two players. Each has a single action to take but has to decide *when* to take the action rather than *whether* to take the action. Hence, given players $i = \{1, 2\}$, each must choose a time to act, $t_i \in [0, \infty)$. The value of waiting is a function of the status-quo policy (q_i) and accrues with time. Specifically, the value of waiting to t_i for player i is $\int_0^{t_i} U_i(q)\delta^t dt$ where $\delta \in [0,1)$ is player i's discount parameter.

Other than perpetual and mutual waiting, there are three conceivable outcomes: (1) player 1 moves first, (2) player 2 moves first, or (3) both players move simultaneously. Generalizing to player i, this yields three time-dependent utility functions for each player—namely a leader function (L_i), a follower function (F_i), and a simultaneous function (B_i, for *both*). The notions of leader and follower are used here simply to denote whether the player moved first or let the other player move first. These three functions exist for any two-player, single-action timing game. For the present model, I assume that a move by either player is known by all players. I further assume that such action leads to a deterministic outcome. Thus, unlike a game of duel where the outcome of a shot is probabilistic and may result in the continuation of the game (cf. Glicksberg 1950; Karlin 1959; Kilgour 1973), I assume that any action in the timing game ends the game *for certain*.

All that is needed to solve the game is an expected utility for each conceivable outcome. The type of ending—i.e., whether to a fixed payoff or to a further subgame—is irrelevant for the moment. Denote the conceivable outcomes as l_i if i moves before $j \neq i$, f_i if j moves before i, and b_i if i and j move at the same time. The value of each conceivable outcome is then discounted as to when it occurs. We can think of the conceivable outcomes (l_i, f_i, and b_i) of what would ultimately happen if the related action took place. The associated utilities (L_i, F_i, and B_i) of their respective conceivable outcomes are the *present* expectations of these ultimate outcomes adjusted for when the outcome take place. This can be visualized in the following figure. Consider the case where actor i moves before actor j—i.e., $t_i < t_j$. For the period up to t_i, both actors receive some benefit from maintaining the status quo. When actor i acts, however, this action ends the game. Actor i realizes outcome l_i and actor j realizes outcome f_j. These outcomes are substantively the same but denoted from the perspective of each player—i.e., actor i was the leader and actor j was the follower. In essence, what we have here is a payment stream of q over the period $[0, t_i)$ and then a lump-sum payment at t_i.

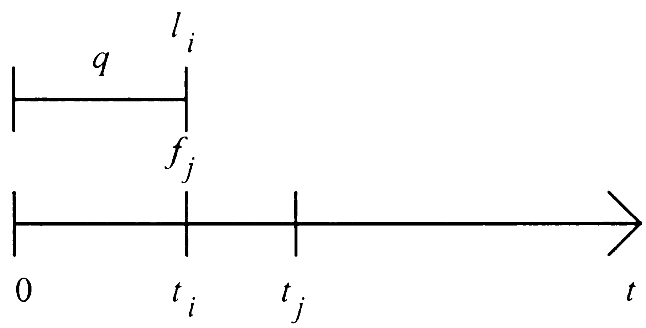


Figure 2.6. Accumulation of Utility over Time

Barring external shocks, it is assumed that (1) each player expects the outcome of a sequence to be the same regardless of when the sequence begins and (2) each player has a constant current value associated with that outcome. This is an admittedly myopic rational framework, but it provides us with the most basic of timing games. From the simplest model we can add complexity later.

Given the above setup, we can calculate the expected value of L_i, F_i, and B_i:

Leader: $L_i = \delta_i^{t_l} U_i(l_i) + \int_0^{t_l} \delta_i^t U_i(q)dt = \delta_i^{t_l} U_i(l_i) - \frac{U_i(q)}{\ln \delta_i}\left(1-\delta_i^{t_l}\right)$, for t_l: $t_i < t_j$

Follower: $F_i = \delta_i^{t_f} U_i(f_i) + \int_0^{t_f} \delta_i^t U_i(q)dt = \delta_i^{t_f} U_i(f_i) - \frac{U_i(q)}{\ln \delta_i}\left(1-\delta_i^{t_f}\right)$, for t_f: $t_i > t_j$

Both: $B_i = \delta_i^{t_b} U_i(b_i) + \int_0^{t_b} \delta_i^t U_i(q)dt = \delta_i^{t_b} U_i(b_i) - \frac{U_i(q)}{\ln \delta_i}\left(1-\delta_i^{t_b}\right)$, for t_b: $t_i = t_j$

The functions calculate the present expected value of each ultimate outcome based on who acts first and when that initial action takes place. Hence, each utility has two components. One component accounts for the value stream associated with the status quo. The other component accounts for the ultimate outcome itself *discounted* by when it occurs. Also, notice that the time variables are from player i's perspective and are defined differently for each function.

These functions have several useful properties. First, in the limit they all equal $\frac{-U_i(q)}{\ln \delta_i}$ (i.e., as $t \to \infty$, $L_i = F_i = B_i$).[15] Second, each function is monotonic. Third, the concavity of each function is an inverse function of its (monotonic) slope. Fourth, the decision process is memory-less as long as the set of parameters remains constant. The first three properties are valuable in determining what the utility functions look like. The last property is useful in making empirical sense of the solutions. Specifically, the actors'

[15] Because δ_i is less than 1, $\ln \delta_i < 0$.

decisions do not change as time progresses *unless* there is a change in parameter values.

The Nash-equilibrium concept is all that is necessary to find solutions for this two-person game. Although the game is set up in continuous time, it should be thought of as a special one-shot game in the sense that both players are assumed to make their timing decisions without knowing the decision of the other player. One could think of a player's strategy as a per-game decision rule that must be submitted to a referee before time zero. A pure strategy in this context is any definitive time at which to act, such as act immediately ($t = 0$) or never act at all ($t = \infty$). A mixed strategy in a continuous-time game is a probability distribution over the time domain (cf. Pitchik 1982; Fudenberg and Tirole 1991, 117-128).

Rather than beginning with mixed strategies (as most others have done), we should first explore whether pure-strategy solutions exist. As with a simple normal-form game, this is done by finding the best-reply functions of each player and then determining where these best-reply functions coincide. By definition, "[a] pair of strategies... forms a Nash equilibrium [if and only if] the strategies are best replies to each other" (Morrow 1994, 80).

SOLVING THE CONTINUOUS-TIME GAME

A *best reply* is the action a player would rationally make *if she knew in advance* what the other player was going to do. In the context of a continuous-time game, this means that if a player knew the specific time at which the other player was going to act, she would evaluate her utility functions with this time point in mind. Three examples must be understood before discussing best-reply functions. First, if she knew that the other player was going to act immediately (i.e., $t_j = 0$), then she can evaluate acting simultaneously with the other player (i.e., $t_i = 0$) or letting the other player take the lead (i.e., $t_i > 0$). Given a deterministic game, having a strategy that says to act after the other player is almost tantamount to waiting forever.[16] This is a valuable simplification when we discuss best-reply functions.

The second example involves the other player waiting forever (i.e., $t_j = \infty$). Then a player must evaluate all possible time points prior to waiting forever as well as evaluating the perpetual-waiting option. In this evaluation, only two utility functions are important. If she acts first (regardless of when), then she seeks to maximize her leader function. If she waits forever along with the other player, she receives the utility for waiting forever (which is the same in all three utility functions). Since the utility functions in the basic timing game are monotonic, maximizing the leader function is a matter of knowing whether it is increasing or decreasing with time. If it is decreasing, she will act immediately. If it is increasing, then she will wait forever.

In third example, the other player has decided to act at some specific time point other than acting immediately or waiting forever. In this case, a player must evaluate three possibilities. It is prudent to use the utility of acting simultaneously with the other player as a baseline. From this baseline, she must also consider acting before as well as acting after that time point. Once again, the utility of acting after is fixed by the time at which the other player acts. In evaluating the utility of acting before the other player, she should determine the best time point at which to act. If her leader function is decreasing, her utility of acting first is maximized by acting immediately. If it is increasing, her

[16] We will see a special situation later in which a player must threaten to act "soon after" some critical point in order to induce an equilibrium in which the other player acts exactly at that critical point.

utility of acting first is maximized by acting just before the other player. This is an *epsilon* response in which she may want to act at $t_j - \varepsilon$, where ε is greater than but very close to zero. As far as her decision in this example, she simply compares the three relevant utilities, chooses the highest, and acts accordingly.

We may now turn to the larger idea. A *best-reply function* is a summary of best replies for all possible decisions of the other player. Given a continuous-time game, we can think about this function as a one-to-one relationship that specifies what a rational player should do given every possible choice of time point by the other player. Appendix C systematically evaluates the best-reply functions for each of the twenty-four utility patterns. I present a summary of results here. There are only eight best-reply functions in the basic timing game. These are summarized in Table 2.4.

Best-reply functions (BRFs) 3 and 6 above are dominant strategies in that no matter what the other player does, player *i* has a clear course of action. In BRF 3, player *i* will wait forever while in BRF 6 player *i* will act immediately.

BRF 1 represents a matching strategy that can be associated with a coordination problem. This coordination problem is not unlike the simple two-by-two variant shown below in Matrix 2.4, where the alternatives are act or wait. For BRF 1, a player would like to act at exactly the same moment as the other player. Acting out of synchrony, either as leader or as follower, results in a reduction of utility. For BRF 1, this is true for all time points.

		Actor 2	
		act	wait
Actor 1	act	2, 2	0, 0
	wait	0, 0	2, 2

Matrix 2.4. A Simple Coordination Game

Table 2.4. Summary of Best-reply Functions

Best-reply function 1	$t_i^*\big\|_{t_j} = t_j$	
Best-reply function 2	$t_i^*\big\|_{t_j \le t_{critB}} = t_j$ $t_i^*\big\|_{t_j \ge t_{critB}} = 0$	$t_{critB}: L_i(0) = B_i(t_{critB})$
Best-reply function 3	$t_i^*\big\|_{t_j} = \infty$	
Best-reply function 4	$t_i^*\big\|_{t_j \le t_{critF}} = \infty$ $t_i^*\big\|_{t_j \ge t_{critF}} = 0$	$t_{critF}: L_i(0) = F_i(t_{critF})$
Best-reply function 5	$t_i^*\big\|_{t_j = 0} = 0$ $t_i^*\big\|_{t_j \in (0,\infty)} = t_j - \varepsilon$ $t_i^*\big\|_{t_j = \infty} = \infty$	
Best-reply function 6	$t_i^*\big\|_{t_j} = 0$	
Best-reply function 7	$t_i^*\big\|_{t_j = 0} = \infty$ $t_i^*\big\|_{t_j \in (0,\infty)} = t_j - \varepsilon$ $t_i^*\big\|_{t_j = \infty} = \infty$	
Best-reply function 8	$t_i^*\big\|_{t_j = 0} = \infty$ $t_i^*\big\|_{t_j > 0} = 0$	

In BRF 4, the player does mind being the follower *so long as* the other player acts before some critical time point. If the player suspects that the other player will not act or will act after the critical time, she would rather act immediately rather than take the risk of waiting. This critical point is defined as the point where player *i*'s utility for being the follower equals her utility for acting immediately.

BRF 2 has characteristics of both BRF 1 and BRF 4. On the one hand, there is a domain in which the player would prefer to match the other player's decision. On the other hand, if the player believes that the other player will not act or act after some critical time, she would rather act immediately. In this case, the critical point is defined as the point where player *i*'s utility for acting in synchrony equals her utility for acting immediately.

BRFs 5 and 7 are unique in that they have epsilon components. In both cases, the player's leader function is increasing *and* the player would like to act before the other player if he acts at some definitive time distinct from acting immediately or waiting forever. As a result, she would need to act *just prior* to the point when the other player will act. When the other player waits forever, each of these functions dictate that the player should also wait forever. These BRFs differ at the initial end point. When the other player acts immediately, a player would also want to act immediately if her BRF were as in case 5 since her simultaneous utility function is greater than her follower function. This is the best that she can obtain given the other player's action. In BRF 7, she would want to wait since her follower function is greater than her simultaneous function.

Finally, in BRF 8 a player would much prefer to be the leader since her leader utility function is decreasing with time and greater than the other two utility functions. However, if the other player acts immediately, the choice of being a leader is removed. Furthermore, the player would then prefer to wait since being a follower is better than acting in synchrony.

EQUILIBRIA OF THE CONTINUOUS-TIME GAME

Now that we know all possible best-reply functions, we can examine the Nash equilibria of the game. Recall that a Nash equilibrium is a pair of strategies such that player *i*'s strategy is a best reply to player *j*'s strategy *and* player *j*'s strategy is a best reply to player *i*'s strategy. As a result, neither player would want to deviate from his or her designated strategy. The best-reply functions defined above represent the fundamental features of a player's utility functions. This intrinsically means that a best-reply function characterizes a player's type. In some cases, there may be several utility patterns characterized by the same best-reply function.

By matching one player's best-reply function with the other player's best-reply function, we merely have to determine where the two functions correspond. Specifically, any time points for which $t = \infty$ are equilibrium points. For example, if both players are characterized by BRF 1, then each wants to act in synchrony with the other. Hence, any strategy pair in which the two players act simultaneously is a pure-strategy equilibrium of the game. At the other extreme, the players' best-reply functions may not correspond at any point. For example, if player 1 is characterized by BRF 1 while player 2 is characterized by BRF 8, there is no pure-strategy equilibrium. Player 1 wants to act in synchrony with player 2 while player 2 wants to act immediately *only if* player 1 does not also act immediately. As a result, there is no mutual best reply and, hence, no pure-strategy equilibrium. Table 2.5 summarizes the pure-strategy equilibria from all possible pairings of best-reply functions.

The somewhat surprising—though pleasant—result is that most pairings of best-reply functions have a *unique* pure-strategy Nash equilibrium. This is true in two-thirds (24 of 36) of the non-redundant pairings.[17] This means that most of the time there is a straightforward prediction and/or prescription regarding strategic timing.

For 6 more of the 36 cases, there are only two pure-strategy Nash equilibria. This makes substantive interpretation more difficult. In each of these cases, the players are faced with a coordination problem. Depending on the specific pattern of utilities, one of the two equilibria may be Pareto optimal. For example, when both players have BRF 5, they want to coordinate on both acting immediately or both waiting forever. In this case, waiting forever is mutually superior. Additionally, mixed strategies for these cases are simply probabilities of using one equilibrium strategy (such as acting immediately) over the other (such as waiting forever or choosing some epsilon-trigger strategy). This represents a technical improvement over existing solutions of continuous-time games which *begin* by assuming mixed strategies based on probability distributions.

In three of the non-redundant pairings the coordination problem is more pervasive. Recall that when a BRF-1 type meets another BRF-1 type, any strategy pair in which the two players act simultaneously is a pure-strategy equilibrium of the game. This means that there is an infinite number of pure-strategy equilibria. Sometimes this

[17] Since the table is symmetric, we need only consider the cells on the diagonal and the cells to one side of the diagonal. All other cells are redundant in that they are already represented in their mirror cell. There are 24 unique pure-strategy Nash equilibria among the 36 non-redundant pairings.

Table 2.5. Pure-strategy Nash Equilibria given Best-reply Functions

i \ j	BRF 1	BRF 2	BRF 3	BRF 4	BRF 5	BRF 6	BRF 7	BRF 8
BRF 1	(t_i, t_j) $\forall\ t_i = t_j$	(t_i, t_j) $\forall\ t_i = t_j$: $t_j \le t_{critB}$	(∞, ∞)		$(0, 0)$ and (∞, ∞)	$(0, 0)$	(∞, ∞)	
BRF 2	(t_i, t_j) $\forall\ t_i = t_j$: $t_j \le t_{critB}$	(t_i, t_j) $\forall\ t_i = t_j$: $t_i = \min\{t_{cBi}, t_{cBj}\}$	$(0, \infty)$	$(0, \infty)$	$(0, 0)$	$(0, 0)$	$(0, \infty)$	$(0, \infty)$
BRF 3	(∞, ∞)	$(\infty, 0)$	(∞, ∞)	$(\infty, 0)$	(∞, ∞)	$(\infty, 0)$	(∞, ∞)	$(\infty, 0)$
BRF 4		$(\infty, 0)$	$(0, \infty)$	$(0, \infty)$ and $(\infty, 0)$	$(\varepsilon, 0)$	$(\infty, 0)$	$(0, \infty)$ and $(\varepsilon, 0)$	$(0, \infty)$ and $(\infty, 0)$
BRF 5	$(0, 0)$ and (∞, ∞)	$(0, 0)$	(∞, ∞)	$(0, \varepsilon)$	$(0, 0)$ and (∞, ∞)	$(0, 0)$	(∞, ∞)	
BRF 6	$(0, 0)$	$(0, 0)$	$(0, \infty)$	$(0, \infty)$	$(0, 0)$	$(0, 0)$	$(0, \infty)$	$(0, \infty)$
BRF 7	(∞, ∞)	$(\infty, 0)$	(∞, ∞)	$(\infty, 0)$ and $(0, \varepsilon)$	(∞, ∞)	$(\infty, 0)$	(∞, ∞)	$(0, \infty)$
BRF 8		$(\infty, 0)$	$(0, \infty)$	$(\infty, 0)$ and $(0, \infty)$		$(\infty, 0)$	$(\infty, 0)$	$(0, \infty)$ and $(\infty, 0)$

coordination problem can be dealt with if there is a Pareto-optimal equilibrium (such as when the slopes of the simultaneous utility functions of both players have the same concavity). However, when there is not a Pareto-optimal equilibrium the players face a considerable problem in which one player maximizes utility if both act immediately while the other maximizes utility if both wait forever. In this case, a mixed strategy in the form of a probability distribution over time is necessary to determine predicted times of acting. For the other two pairings with this coordination problem, one or both of the players would rather act immediately than wait beyond some critical point to act in synchrony. When both players are of this type, both acting immediately is optimal.

Finally, there are three non-redundant pairings in which there are no pure-strategy Nash equilibria. For all of these pairings, mixed strategies are required but are restricted to probabilities on acting immediately or waiting forever. Consider first the pairing of BRFs 1 and 4. BRF 4 is willing to be a follower if the other player is a leader but prefers to be a leader if the other player will not act before a critical time point. BRF 1 seeks synchrony which is contrary to BRF 4. Thus, there is no pure-strategy equilibrium. Given this situation, BRF 1 will randomize between acting immediately and waiting forever rather than choosing some intermediate time point. This follows from the fact that utility will be maximized at one of the end points. As a result, both players randomize between acting immediately and waiting forever. The situation is the same (though more clear-cut) for the pairing of BRFs 1 and 8.

Now consider the pairing of BRFs 5 and 8. BRF 8 is willing to be a follower only if the other player acts immediately. Otherwise, it would like to be the leader and act immediately. BRF 5 would like to coordinate on acting immediately or waiting forever

but has an epsilon response for any time in between the two. This response has the effect of inducing other player types to be leaders. Against BRF 8, however, the epsilon response is meaningless since this type would like to be the leader. The reason there is no pure-strategy equilibrium is that if BRF 5 acts immediately, BRF 8 would prefer to wait (figuratively) forever. If BRF 5 waits forever or acts at some intermediate time, BRF 8 will act immediately. When this happens, BRF 5 would like to change its decision to acting immediately which brings us full circle. However, the time points of acting immediately and waiting forever are ultimately what the players are fighting over. Hence, each can randomize over these two—and only two—strategies to form their mixed strategies.

SIMPLIFICATION

The above analysis implies that the strategic-timing question often collapses into a simple two-by-two matrix in which each player acts immediately or waits forever (or at least until the parameters of the game change creating a new strategic-timing problem). To demonstrate this, consider that each player can act immediately, wait forever, or act at some discrete time between the two extremes. If each act at some discrete time other than $t = 0$, they could act simultaneously or one could act first. This is summarized in game matrix 2.5. Three discrete times are considered for each player such that all combinations can be examined. The outcomes resulting from the strategy pairings of (t_{i1}, t_{j1}) and (t_{i3}, t_{j3}) are undetermined since we do not know whether the time choices are equal or not.

	$t_j = 0$	$t_j = t_{j1}$	$t_j = t_{j2}$	$t_j = t_{j3}$	$t_j = \infty$
$t_i = 0$	b_i, b_j	l_i, f_j	l_i, f_j	l_i, f_j	l_i, f_j
$t_i = t_{i1}$	f_i, l_j	?	$L_i(t_{i1}), F_j(t_{i1})$	$L_i(t_{i1}), F_j(t_{i1})$	$L_i(t_{i1}), F_j(t_{i1})$
$t_i = t_{i2}$	f_i, l_j	$F_i(t_{j1}), L_j(t_{j1})$	$B_i(t_{i2}), B_j(t_{j2})$	$L_i(t_{i2}), F_j(t_{i2})$	$L_i(t_{i2}), F_j(t_{i2})$
$t_i = t_{i3}$	f_i, l_j	$F_i(t_{j1}), L_j(t_{j1})$	$F_i(t_{j2}), L_j(t_{j2})$	?	$L_i(t_{i3}), F_j(t_{i3})$
$t_i = \infty$	f_i, l_j	$F_i(t_{j1}), L_j(t_{j1})$	$F_i(t_{j2}), L_j(t_{j2})$	$F_i(t_{j3}), L_j(t_{j3})$	$\frac{-q_i}{\ln \delta_i}, \frac{-q_j}{\ln \delta_j}$

$0 < t_{i1} < t_{i2} < t_{i3} < \infty$ for i and j, and $t_{i2} = t_{j2}$

Matrix 2.5. Normal-form Version of the Basic Timing Game

The logic behind simplification is that the game's equilibria are corner solutions or mix on corner solutions. There are only a handful of exceptions to this statement. If these exceptions can be eliminated theoretically or screened out empirically, then the analysis of strategic timing can be treated very much as a static game *but is based on a continuous-time framework.* Specifically, one can use the following two-by-two matrix (Matrix 2.6 below) when examining substantive applications of strategic timing. This means that, after determining how the timing nature of a problem leads to the three ultimate outcomes, one can use the familiar Nash-equilibrium concept to solve the initiation problem. The use of this simplification is predicated on defending the assumptions of the continuous-time model as being applicable to the substantive question.

		Actor 2	
		act	*wait*
Actor 1	*act*	b_1, b_2	l_1, f_2
	wait	f_1, l_2	$\frac{-q_1}{\ln \delta_1}, \frac{-q_2}{\ln \delta_2}$

Matrix 2.6. Simplified Version of the Basic Timing Game

DISCUSSION OF THE CONTINUOUS-TIME GAME

The continuous-time game presented here is one particular game among many possible games. This particular game shows that—under the model assumptions—a discrete-time game can be an appropriate simplification of an otherwise complicated structure; other timing games may not simplify so nicely. However, the method for finding pure-strategy equilibria can be applied to any continuous-time game. This method entails describing all potential best-reply functions and analyzing the equilibrium behavior of pairings of these best-reply functions as representatives of types of actors. The method employed here is in stark contrast to the method used everywhere else in the literature on continuous-time games which assumes that a technique based on mixed-strategy solutions is most appropriate. My analysis suggests that the focus on this technique may be misguided to the extent that a simpler method can find solutions more efficiently.

Even under the present model's assumptions, two cases do not simplify to the "now or forever" solution—namely the pairings of BRFs 1 and 2 and of BRF 2 with itself. In the former pairing, there is a coordination problem over the time points between 0 and t_{critB}. The time point $t_i = t_j = 0$ is best for the player having BRF 2 but worst for the player having BRF 1. Similarly, the time point $t_i = t_j = t_{critB}$ is best for the player having BRF 1 but worst for the player having BRF 2. The most likely strategic solution is a mixed strategy over *all* the time points between 0 and t_{critB}.

A similar coordination problem exists in the latter pairing between BRF 2 and itself. Specifically, the actors are coordinating over time points between 0 and some distinct time point in the future. As in the previous case, the actors can adopt a mixed strategy between 0 and the minimum t_{critB}. In this case, however, the time point $t_i = t_j = 0$ is best for the both players. The reason this does not fit in with the simplification in Matrix 2.6 is that neither actor would choose to wait forever.

If we can screen out the above pairings and accept the model assumptions, then the two-by-two simplification of the continuous-time game is very similar to the beginning of the demand-initiation game. Specifically, the first moves in the demand-initiation game are theoretically made at the same moment in time. This can be conceived of as a two-by-two game in which each actor either makes a demand—i.e., it acts—or does not make a demand—i.e., it waits (see Matrix B.1). Thus, the parameters of the continuous-time game in Matrix 2.6 represent the expected utilities of the different initiation patterns as calculated by backwards induction from the resulting subgames. The one notable discrepancy between the matrices is that the status quo in the discrete-time game is not modified by a discount parameter. This discrepancy will be discussed in the next section and in chapter 3.

PROPOSITIONS RELATING TO INITIATION

Three propositions neatly tie the two games together and help explain *dispute* initiation in the real world. The first (Proposition 2.2) establishes the conditions of the continuous-time game that make a discrete-time framework a reasonable simplification of an otherwise complicated problem. The second (Proposition 2.3) gives the conditions for maintaining the status quo in the continuous-time game as long as Proposition 2.2 holds. Proposition 2.3 has direct connections with the demand-initiation game since it assumes that a discrete-time game is an appropriate simplification of the underlying continuous-time problem. The third proposition (Proposition 2.4) mimics Proposition 2.3 by providing the conditions under which the status quo is in equilibrium in the demand-initiation game. These propositions provide the basis for several theoretical hypotheses regarding real-world dispute initiation.

Proposition 2.2 is a strictly conditional proposition summarizing the relevant properties of the particular continuous-time game presented above. It does *not* suggest that the four conditions of the proposition are the *only* conditions under which a discrete-time game is an appropriate simplification of some underlying continuous-time strategic-decision problem. The first three conditions are, however, fairly general in their applicability to the question of appropriate simplifications of continuous-time games.

> **Proposition 2.2.** In a continuous-time strategic-decision problem, if (1) two players face a timing choice of taking some singular action over an infinite time horizon, (2) the value of waiting accrues with the length of waiting, (3) the value of the status quo is itself constant over time, (4) there is a deterministic, fixed outcome after an action is taken, *and* (5) strategy pairings with coordination problems over specific intervals can be screened out, then a discrete-time game is an appropriate simplification of the same continuous-time strategic-decision problem.

The continuous-time game presented here is based on the line of reasoning that addresses the following question: From my standpoint today, what do I expect in the future? Expectations depend on which future scenario takes place. In this game, future scenarios are functions of the decisions of the actors. Similarly, my decision *today* is predicated on information I have *today*. If that information changes tomorrow, I must re-evaluate my decision based on that information. This "current information" assumption greatly simplifies the decision problem for analyst and decision-maker alike.

Condition 1 of Proposition 2.2 specifies the particular class of continuous-time games to which the proposition applies. Games with multiple actions or a finite time horizon, for example, may not exhibit the same properties. At the same time, condition 1 does *not* specify what the action is. The only requirement is that the action is an attempt to change the status quo. Conditions 2 through 4 deal with expectations. Condition 4 implies that if an action is taken in the continuous-time game, it sets off a chain of events with known properties.[18] The end result of this chain reaction is assumed to be time invariant in accordance with the information assumption above; expectations regarding trends in the game parameters are not taken into account.

Conditions 2 and 3 deal explicitly with what happens before an action occurs. Condition 2 simply states that the actors treat mutual waiting like a benefit stream over time. Condition 3 fixes the marginal benefit of mutual waiting in accordance with the current-information assumption. This does *not* mean that the status quo is necessarily beneficial; it could have zero or negative value. Given the current-information assumption, conditions 1 through 4 are fairly general in their applicability. Condition 1 does not limit what the status-quo-disrupting action can be; conditions 2 through 4 make standard rational-choice assumptions. Condition 5 then excludes a few continuous-time-game cases from the set of cases that can be reduced to a discrete-time game.

Proposition 2.3 assumes that *some* simplification of the continuous-time problem can be appropriately represented by Matrix 2.6. This proposition specifies the conditions under which this particular discrete-time game results in the maintenance of the status quo.

> **Proposition 2.3.** When Matrix 2.6 is an appropriate simplification of the underlying continuous-time strategic-decision problem, (*wait*, *wait*) is the unique NE of the game if and only if (1) both actors have $-q_i/(\ln \delta_i) > l_i$ *and* (2) it is *not* the case that both have $b_i > f_i$.

[18] This condition also specifies a class of continuous-time games to which the proposition applies.

Condition 1 of Proposition 2.3 is sufficient for (*wait*, *wait*) to be a NE; condition 2 is necessary for uniqueness of that NE. The major tie between models is that (*wait*, *wait*) results in the maintenance of the status quo. This is analogous to the status-quo outcome in the demand-initiation game. A similar generic proposition could be constructed for Matrix B.1. Condition 1 in Proposition 2.3 would translate to, "Both actors prefer *SQ* to the SPE of the subgame in which one actor makes the first demand." Condition 2 would translate to, "It is *not* the case that both actors prefer making simultaneous demands to letting the other actor make the first demand." From the equilibrium analysis of the demand-initiation game (in Appendix B), we know that there are more specific circumstances required to support the maintenance of the status quo; Proposition 2.4 summarizes these circumstances.

> **Proposition 2.4.** With complete information, SQ is a pure-strategy NE of the demand-initiation game if and only if (1) negotiation is a NE of the conflict-initiation subgame *and* (2) both actors have $SQ > N$.

The logic behind condition 1 of Proposition 2.4 is that whenever negotiation is a NE of the conflict-initiation subgame, negotiation is the unique SPE of the crisis subgame regardless of who goes first. (See Table B.1.) The status quo is only achievable in the demand-initiation game as an equilibrium when negotiation is predicted in the crisis subgames. (See Table B.3 and accompanying analysis.) With the possibility of negotiation, the status quo is a stable equilibrium only if both actors prefer it over negotiation.

Given the centrality of negotiation in Proposition 2.4, it is equally important to know the conditions under which negotiation is a NE of the conflict-initiation subgame. These conditions are summarized in Proposition 2.5. This proposition highlights the primacy of two inequalities that determine whether an actor is retaliatory (or pacific) and whether an actor is a dove (or a hawk).

Proposition 2.5. With complete information, N is a NE of the conflict-initiation subgame if and only if one or more of the following is true: (1) both actors have $W_j > C_i$, (2) both actors have $N > C_j$, (3) if one actor has $C_j > N$, the other must have $W_j > C_i$, *or* (4) if one actor has $C_i > W_j$, the other must have $N > C_j$.

The two central inequalities in Proposition 2.5 are $N > C_j$ and $W_j > C_i$. Recall that war is conceptualized as having the same expected policy outcome minus costs associated with using force. Specifically, $U^i(W_j) = U^i(N) - \varphi_i P^i - \gamma_i(1 - P^i)$. As $U^i(N)$ increases, the likelihood of either (or both) inequalities being true increases for actor i. But there is a general mathematical relationship between $U^i(N)$ and $U^j(N)$ such that as $U^i(N)$ increases, $U^j(N)$ decreases.[19] Thus, a change in the value of negotiation that makes actor i more likely to meet the conditions of Proposition 2.5 simultaneously makes actor j less likely to meet the conditions of the proposition.

This apparent circularity can be resolved by examining *shifts* in the relative advantage one side has in negotiations rather than the value of negotiation. If negotiation was the NE of the conflict-initiation subgame in period $t - 1$, for example, then any shift that gave an advantage to one side in period t could disrupt the previous equilibrium. Generalizing this consequence to any shift in advantage generates the first theoretical hypothesis.

Hypothesis 2.1. Any change that shifts the expected advantage of negotiation from one actor to the other increases the likelihood of conflict initiation and demand initiation between the actors.

Consider the following example. If at time $t - 1$ two actors are both self-defenders having $SQ > N > W_j > C_i$, then Matrix 2.7 summarizes the demand-initiation game and

SQ is the NE. A shift in negotiation advantage in favor of actor B can produce a N' such that B now has $N' > SQ > N > W_a' > W_a > C_b$. This same shift in advantage that increases B's expected utility of negotiation and war necessarily *reduces* A's expected utilities for those outcomes. A would have one of two revised preference orderings: $SQ > N' > W_b' > C_a$ or $SQ > N' > C_a > W_b'$. In the first instance, A remains a self-defender and Matrix 2.7 is still an accurate summary of the demand-initiation game (replacing N and W with N' and W' respectively). Since B now prefers N' over SQ, B will make a demand while A does not.

		B ~*D*	*B* *D*
A	~*D*	*SQ*	*N*
	D	*N*	*N*, *W*

Matrix 2.7. Status Quo NE with Two Self-Defenders

In the second instance, B's favorable shift in negotiation advantage alters A's type; A is now pacific. A number of other preference evaluations would have to be designated to determine how this change in type would affect the actors' behaviors; however, one case stands out as a proof of existence. This is represented in Matrix 2.8 in which A's change of type also alters the equilibrium behavior throughout the game tree. The actors no longer have a possibility for negotiation. Under the particular conditions of case 2.11.0.2.42, A will make a demand but B will not. The shift in negotiation advantage that was *prima facie* in B's favor ends up creating a condition in which B acquiesces to A's demand. Thus, a shift in negotiation advantage in favor of one actor over another makes demand (and conflict) initiation more likely *but not in a directionally predictable fashion.*

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[19] See Appendix D for a proof of this statement.

		B	
		~D	*D*
A	*~D*	*SQ*	A_a
	D	A_b	*W'*

Matrix 2.8. A Shift in Advantage to *B* with Acquiescence by *B* as the NE

Hypothesis 2.1 helps us evaluate condition 1 of Proposition 2.4 in which negotiation must be a NE of the conflict-initiation subgame in order for the status quo to be a NE of the demand-initiation game. Thus, the greater likelihood of conflict initiation produces a greater likelihood of demand initiation. Condition 2 of Proposition 2.4 also specifies that both actors must prefer the status quo over negotiation for the status quo to be in equilibrium. This allows us to make the following *directional* hypotheses since the actor who have a low evaluation of the status quo is more likely to be the demand initiator.

> **Hypothesis 2.2.** The value of the status quo for an actor is *inversely* related to that actor's likelihood of demand initiation, *ceteris paribus*.

Harkening back to Matrix 2.6—i.e., the discrete-time simplification of the continuous-time game—we can also address how an actor's level of patience affects that actor's behavior. The discount parameter reflects an actor's evaluation of the future in general. Condition 1 of Proposition 2.3 states that both actors must have $\frac{-q_i}{\ln \delta_i} > l_i$ in order for the status quo to be in equilibrium. As δ_i gets smaller—reflecting greater impatience—(and $-\ln\delta_i$ gets larger), this inequality is more likely to be violated.

> **Hypothesis 2.3.** An actor's evaluation of the future as reflected by its discount parameter (i.e., δ_i) is *inversely* related to that actor's likelihood of demand initiation, *ceteris paribus*.

CONCLUSION

This chapter began with a technical puzzle. In an existing model of international interactions, the conditions for war and the conditions for acquiescence of a would-be war initiator could not be separated. This puzzle raised a number of questions. How could we model initial interactions without assuming an initiator advantage? How did the artificial initiator advantage affect the earlier model analysis? In particular, under what conditions should we expect to see dispute initiation? Do other model assumptions—specifically discrete- versus continuous-time frameworks—adversely affect the analysis? All of these questions have now been answered.

Eliminating the artificial initiator advantage was easy enough. By simply assuming the first move of the game was simultaneous and that what happened after this first move was sequential, the actors themselves are able to determine who goes first. Solving such a game may be more tedious then a simpler, purely sequential game, but the solution technique is possible with existing technology.

We then saw that the artificial initiator advantage affected the earlier analysis in some cases but not in others. Of forty-eight unique cases, only eighteen resulted in the same equilibrium outcomes in the demand-initiation game and in the international interaction game *regardless of who went first*. An additional sixteen cases resulted in the same equilibria *if* we could correctly specify who went first in the international interaction game. Thus, the demand-initiation game represents an improvement in predictive power over the international interaction game by separating cases without making *ad hoc* assumptions regarding sequence. In some cases the demand-initiation game revealed that no improvement was possible; thus, a prediction of demand initiation can be made but the final outcome is not known for certain. Compared to the international interaction game, these cases had an equally vague prediction. The improvement in predictive power did, however, come at a cost. In three of the cases the demand-initiation game created greater indeterminacy than the international interaction game. Given the added predictive power in most of the cases, this is a minor cost.

The major benefit of the demand-initiation game over the international interaction game is that it allows us to predict conditions for dispute initiation. The implicit starting point of the international interaction game is the pre-existence of a dispute. Given a dispute in progress, the international interaction game helped determine the likely result of the dispute. The demand-initiation game adds to our understanding by taking us one step back in the decision process between states. The theoretical hypotheses clarify the conditions of these predictions.

The continuous-time game addresses one potential threat to the demand-initiation game. Since I was able to show that one modeling assumption of the international interaction game altered its model analysis, how could I be certain that my own modeling assumption—i.e., discrete time—did not have a similar problem. Such an argument leads to an infinite regression of fault and improvement, but addressing one potential threat among many seemed prudent. One threat in particular seemed more serious than others: Was dispute initiation merely a sequencing problem in a discrete time period, or was it a more complicated timing problem? Under some reasonable assumptions regarding strategic decisions over time, I was able to show that the continuous-time problem often collapses to a per-period problem. This adds theoretical plausibility of the discrete-time results.

But theoretical plausibility is not the sole criterion of whether a model adds to our understanding of a real-world phenomenon. Models—or, more accurately, their implications—also need to be evaluated in light of real-world evidence. The remainder of the dissertation is oriented toward that task. Chapter 3 addresses the difficulties in directly testing formal models. I then provide a bridge between an ideal, direct test and an acceptable, indirect test. Part of this bridge shows that the theoretical hypotheses of my formal models are generalizations of more specific power-transition (Organski 1958) arguments. Chapter 4 presents the indirect test within the specific framework of power-transition rivalry between the United States and the Soviet Union. The empirical examination lends support to Hypotheses 2.1 and 2.2.

CHAPTER 3. LINKAGES

A hot-air balloonist looking down at the earth without a visual aid can see a vast amount of area but not many details. An observer on the ground can see many details but only over a limited area. The balloonist is helpful to the observer to the extent that the observer is traveling from one area to another or in some way needs to know what is beyond his immediate field of view. The ground observer is helpful to the balloonist to the extent that the balloonist needs to know details on the ground (such as whether conditions are good for landing at a particular location). Even if each needs the particular services of the other, they are helpful to each other only in as much as they can communicate effectively.

Theories and models have the balloonist's point of view. They ignore most details and are not firmly anchored in the real world. They also have a large scope. Theories are abstract in their concepts but are assumed to be general in their applicability. The real world itself is like the ground. It is full of details that *may* be relevant for some occurrence. Any given event has many facts that make the event unique but not all of the facts are relevant to explaining how the event came about. The communication between the ground observer and the balloonist is like an empirical model that helps make sense of the relevance of formal models to the real world and informs the theorist of what factors are important from the mass of details that make up the real world. Thus, an empirical model is less abstract than the theory and more parsimonious than the real world.

We can visualize the relationship between the formal model, the empirical model, and the real world as planes of abstraction that mirror one another. (See Figure 3.1.) The real world contains infinite detail and infinite phenomena. The formal model contains very limited detail and generally represents an explanation of a single phenomenon. The empirical model contains elements of both the formal model and the real world. It, too, generally focuses on a single phenomenon but usually incorporates more detail than the formal model while keeping detail limited in scope. At the outset of an inquiry, we seek to have connections among all three levels of abstraction that help us gain understanding of the phenomenon under investigation. As Sindal (1985, 56) has asserted, "Only [formal] models embedded in theoretical arguments, and carefully tailored to the relevant empirical correspondences… in an issue area will provide interesting and (potentially) falsifiable claims." I presented my case for such a formal model in the previous chapter. The next task is to make more solid connections from the empirical model upward and downward.

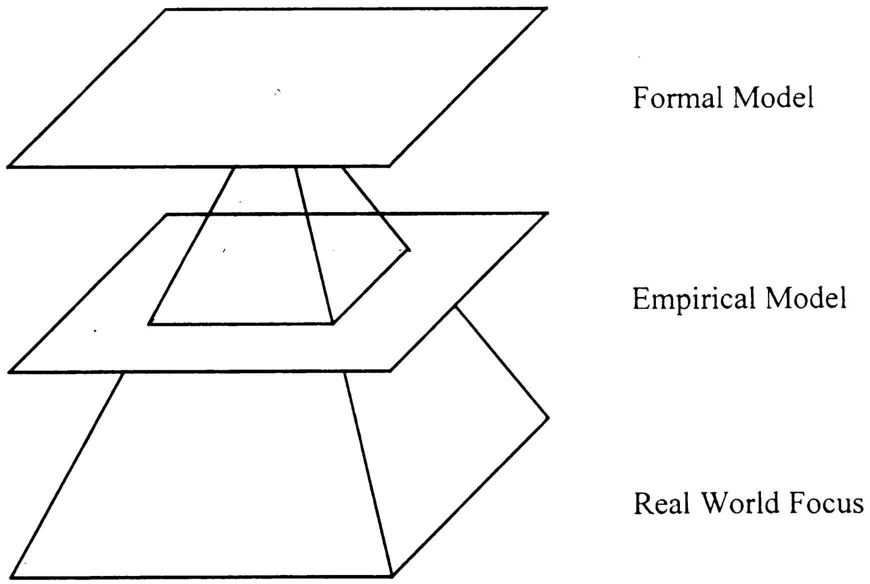

Figure 3.1. Planes of Abstraction

The remainder of this chapter is divided into two sections. In the first section, I review the general value of modeling phenomena and point out some of the short-comings of the current state of modeling in social science. I also discuss how we may deal with these short-comings by bridging the gap between the formal model and its real-world focus. In the second section, I outline my own strategy for linking the theory in chapter two with the testing in chapter four.

THE VALUE OF MODELING

The value of any formal model is in the extent to which it helps us understand some portion of the real world. This understanding can take various forms. First, understanding could come from explaining (e.g., Bates, de Figueiredo, and Weingast 1998) or predicting (e.g., Bueno de Mesquita, Newman, and Rabushka 1985) specific events. This is akin to modeling the orbital paths of the planets as is done in physics. Social science models are not nearly as accurate as Newtonian ones, but the form of understanding can be the same. Second, understanding could also come from explaining general behavioral patterns. This is usually in the form of empirically validating theoretical propositions (See Gates and Humes 1997, 14-16). Explaining general behavior is *ceteris paribus* in nature. Third, a modeling enterprise could also assist in identifying relevant (and irrelevant) variables in an existing empirical literature. Finally, formal models help us bring clarity to complex problems.

Even if a formal model can make accurate predictions of specific events, it is still only a model—i.e., a simplifications of reality. The best predictive model incorporates only the factors that are especially relevant *in a particular domain*. A model that plots the orbit of a planet about its star is not expected to predict whether either body will explode. Conversely, a model of the life cycle of stars is not expected to predict the orbit of a planet. The relevant factors are different in each case and the models reflect this.[1] Thus, the value of a model is directly related to how relevant its assumptions are with respect to what the model is trying to explain.

As formal models and empirical models in social science become integrated, they will become indistinguishable from one another. Given the experience of physics, it would seem that the most valuable formal model takes relevant factors as inputs and produces an accurate prediction for a specific situation. I would call such an integrated model "mature". One of the hallmarks of a mature model is that it not only identifies what are relevant factors, but it also identifies how those factors relate to each other. As such, it gives us a guidebook for measuring the real-world factors that are then inputs back into the model. The mature model tells us what is relevant and what to look for the real world. Thus, the mature model has firm connections with the real world. Models in social science have a long way to go before maturing. The next section provides a bridge between theory and empiricism short of having a mature model.

OVERCOMING IMMATURITY

The present problem is one of making connections between the formal models of the previous chapter and the real world *when such connections are not obvious.* The three theoretical hypotheses guide us with respect to relevant concepts in need of measurement. These hypotheses specifically point to (1) shifts in negotiation advantage, (2) the value of the status quo, and (3) discount parameters. The measurement of (1) and

[1] Interestingly, expectations of international relations theories are such that they were criticized for not predicting the implosion of the Soviet Union.

(2) will be taken up in chapter four. As often happens, not all model parameters are readily measurable. This is the case for the discount parameters of national leaders.[2]

Besides measurement, the other problem of bridging from abstract model to real-world evaluation is in the empirical model itself. Referring back to Figure 3.1, the task is to find an empirical model that simultaneously (1) mirrors relevant aspects of the game model and (2) contains meaningful aspects of the real world. The relevant aspects of the games to be captured by the empirical model are per period strategic decision-making regarding demand initiation and escalation only after demands have been made. It is only a small step to operationalize a theoretical demand as an actual dispute.[3]

The meaningful aspects of the Cold-War rivalry that should be contained in the empirical model include several features. First, there was very infrequent *direct* escalation; thus, any empirical examination must focus on conflict initiation rather than escalation. Second, the Cold-War conflict was global in nature. It was very much a conflict over the rules of the system vis-à-vis open markets and democracy versus command economies and autocracy. This amounted to attempting to win over other states into one camp or the other. Third, particular attention should be paid to the meaning of the international status quo with respect to the superpower rivalry in light of this global competition for influence. Finally, there are data limitations on which time period can be used as the unit of analysis. In particular, some data are only available on a yearly basis; so, the year is the time unit of analysis. Each of these areas—i.e., aspects of the game and aspects of the world—will be discussed further in the next section.

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2 Discount parameters can be measured in a laboratory setting.

3 It is also a step that Bueno de Mesquita and Lalman have already taken.

LINKING THEORY AND TESTING

One nice feature of strategic timing is that attempts at changing the international status quo have high visibility. Attempts at change are marked by the beginning of international crises and most militarized international disputes. One drawback is that we cannot observe missed opportunities: situations in which attempted change would be predicted by a fully specified model or in which attempted change was part of a mixed-strategy solution. Another drawback is that some parameters are difficult to measure. Thus, we seek to exploit the advantages of observability while minimizing data deficiencies.

This is done by examining situations in which one great power (restricted here to the United States and the Soviet Union after the Second World War) engaged in threats or employed its military such that an international crisis or dispute ensued. The date of crisis or dispute initiation and termination form the basis of the dependent variable. Admittedly, this assumes that all crises or disputes are attempts to change the international status quo: without knowing the private motivations of state leaders, this is the best proxy we have. The empirical puzzle we have surrounding these initiation dates is why one state chose that date to initiate a dispute while the other states did not. Hence, we can compare the domestic circumstances in each of the states as a gage of why one state chose to initiate a dispute. We can also incorporate environmental factors and dyadic cost/benefit analysis as part of the empirical analysis insofar as data is observable.

ASPECTS OF THE GAME

There is one principal aspect of the game that should be included in an empirical assessment of the theoretical hypotheses. The main selection criterion for any empirical model is accurately reflecting the structure of the dependent variable. Following this selection criterion, any empirical assessment should take the decisions of *both* superpowers into account. Given a decision of "initiate a dispute" or not for each superpower in any time period, there are two widely used empirical models that could be considered on different grounds: logit and multinomial logit. On the one hand, separate logit (or probit) regressions for each decision stream would model individual choices. On the other hand, multinomial logit would construct a joint dependent variable based on each state's decision; this would model *outcomes* over time. Unfortunately, neither of these common empirical models accurately reflects the strategic nature of the paired decisions. In what follows, I will critique the logit and multinomial models and then present a less commonly used model that is appropriate to the current investigation.

Logistic regression models the basic decision an actor makes over a series of periods. Like all discrete-choice models, logit assumes random utility maximization (King 1989). This underlying conceptualization tying theory and method posits that there are observable and unobservable components to an individual's utility with respect to the researcher. Empirical methodology can account for this by modeling the observable components as independent variables and by explicitly modeling the unobservable components in the stochastic error term. Thus, given the researcher's operationalization of the critical utility parameters into independent variables, we get as close as possible to modeling an individual's choice empirically without knowing that individual's precise utility function. The main drawback to logistic regression in the context of superpower rivalry is that it assumes a decision-theoretic framework in which a single individual maximizes his or her utility *irrespective* of the potential decisions of others. This eliminates the strategic nature of the decision problem. On the face of it, multinomial logit overcomes this obstacle but only by creating another one.

Alvarez and Nagler (1998) present a thorough discussion of empirical model choice for spatial models of elections. They demonstrate that multinomial logit estimation of a multicandidate choice problem is more efficient *but no more consistent* than successive estimations of binary logit estimation of the same problem (Alvarez and Nagler 1998, 60-66). Unfortunately, the problem they are modeling empirically is theoretically different from the strategic one of dispute initiation. Whether they are looking at individual- or choice-specific variables, the final choice is still *one* candidate (or party) from among the available contenders. The problem is decision theoretic in nature, not strategic. Applying a multinomial estimation technique to estimate which *joint outcome* is most likely from the *individual choices* that each state makes per period transforms the problem. Estimating outcomes of joint decisions no longer assumes that there is random utility maximization whereby an *individual* is predicted to choose the alternative with the highest observed utility. If we assume that the random-utility-maximization conceptualization still holds, this would now represent some kind of joint utility that nature or some other third party is maximizing for the actors. This is hardly what a strategic-choice model would predict.

Another problem with the multinomial model for strategic contexts is that it would include variables in a single equation that may not be relevant to one actor or relevant to each actor in different ways. In Alvarez and Nagler's example demonstrating that successive binary logits are just as consistent as a single multinomial logit, the variables included in each estimation were always the same set of variables (1998, 63).

This makes perfect sense given their problem of estimating the choice of a single voter using two different methods. It does not make sense when analyzing the decisions of separate actors who may hold different things relevant.

Fortunately, there is a readily available, although infrequently used, technique that allows estimation of individual decisions in a potentially strategic setting. A seemingly unrelated (or bivariate) probit estimates two binary-choice equations simultaneously and includes a correlation coefficient between the errors of the two equations (Meng and Schmidt 1983). In this estimation technique, the decisions made by one individual can affect the decisions made by the other. Unlike basic logit or probit, each individual is trying to choose the decision that maximizes his or her (random) utility *given the likely decision of the other decision-maker*. This is much closer to the idea of a Nash equilibrium that is the underpinning of the theoretical results. Chapter four contains further discussion of this technique.[4]

ASPECTS OF THE WORLD

Given the question of when great powers attempt to alter the international status quo, I am intimately concerned with an initiation problem. Leaders must ask themselves whether today is a good day to risk starting a war in the attempt of forcing a favorable outcome. At the same time, leaders must be concerned with their counterparts' decisions for they too are asking whether today is a good day to risk starting a war.

From a rational-choice perspective, we want to understand the decision calculus of a state's leadership within a given time period. Attempting this calculation for a non-

4 Signornio (1999) and Smith (1999) present their own methodological techniques for modeling strategic interaction empirically.

specific target—like the groundbreaking work of Maoz (1982)—removes a good deal of purposeful choice from the decision-makers and reduces initiation to a purely stochastic question. We would like to know more than what *generally* increases the likelihood of dispute initiation by a given state. It would be far more valuable to know what makes a given state more likely to initiate a dispute *against a specific target*. There will be a systemic component in this decision calculus, but there will also be dyadic and monadic (i.e., domestic) components. These relationship-specific components may have characteristics that generalize from relationship to relationship, but empirical testing of dispute-initiation behavior will require operationalizations that are unique to the relationship being examined.

If we were studying a major-minor relationship, it might make sense solely to examine the decision calculus of the major power against the minor power and not the reverse. When examining a major-power dyad, there is an obvious potential for either state to initiate against the other. This means that there is potential for a more strategic analysis involving reciprocity, perceptions, and other factors.

Because of the risk of escalation, a state leader contemplating change must consider the response of the other great powers. The decision-maker must consider what the other side will do and what consequences this will bring—from complete success to total failure. Two other things are also important in understanding dispute initiation. First, any state may wish to change the international status quo. Barring a perfect hegemony, the status quo is not likely to reflect the wishes of any one state regardless of what *de facto* hierarchy exists. This is especially irksome for the states near the top of this hierarchy—namely great powers. Thus, we cannot presume that the world is clearly divided into challengers and defenders. Second, states that generally favor the international status quo may wish to initiate change themselves or initiate disputes to prevent change. On the one hand, such change may be in the form of compromise to prevent conflict instead of myopically seeking a policy closer to some ideal position. Thus, even if the world were divided into challengers and defenders, a defender may want to yield early in order to secure most of its position for a longer duration. On the other hand, a defender of the status quo may initiate a dispute preemptively to reinforce its current favorable position. Thus, defenders of the status quo have two options of "change": compromise, that does not involve dispute initiation, and dispute initiation to alter the trajectory of the status quo and slow its deterioration relative to the defender's interests. This may mean that defenders initiate disputes less often than challengers. It is clear, however, that both challengers and defenders have incentives to initiate disputes. Restricting analysis to the dispute-initiation behavior of challengers would lead to a skewed view of the world.

In the context of the superpower rivalry, each views the other as a potential target and perceived themselves as potential targets within this relationship. Although there were periods of détente between the rivals, the possibility of direct confrontation was always present. We know from hindsight that escalation to violence was extremely rare and short in duration. In addition, much of Cold-War politics was played out through third parties, including most of the bloodshed. Even so, there were several episodes in which the normally cold relations between the United States and the Soviet Union breached a threshold beyond which peace and war were both possibilities. The most famous of these episodes include the Berlin Blockade (initiated by the Soviet Union) and the Cuban Missile Crisis (initiated by the United States). Our knowledge that none of these disputes led to war does not detract from the seriousness with which the leaders confronted one another or from the potential that either side could have pushed the other beyond the brink. Our hindsight of this relationship necessarily limits quantitative study of the Cold-War conflict to the early stages of the escalatory process. Given the formal models of the previous chapter and their focus on *initiation* rather than escalation, this limitation is not problematic.

Power-transition theory has particular relevance to the Cold-War relationship. Although there was obviously no power-transition war, a few related questions remain. First, was there a power transition between the United States and the Soviet Union? Depending on the measure of power, the answer is not clear. It is apparent that both sides believed that a transition was possible—if not likely—and that the Soviets were pushing their economy to produce such a transition.[5] In addition, there was a certain tunnel vision concerning the health of the Soviet state beyond its military might. As Gaddis puts it, "both sides had tacitly agreed to calculate their strengths in the particular category of power… in which the Soviet Union could still match the United States." (Gaddis 1997, 292)

Given this aspect of the rivalry, what was the role of dissatisfaction in sparking and/or preventing dispute initiation? According to Organski and Kugler (as expressed succinctly in Kugler and Organski (1989)), both a power transition and dissatisfaction

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5 For example, Defense Secretary Schlesinger raised alarm flags in December 1974 that the United States could become a "second-class power" with respect to the Soviet Union if the present budget trend coupled with inflation continued (Finney 1974).

(especially that of the challenger) are required for a power-transition war to occur. If war is the highest point of the escalatory process, then some dispute should precede the escalation to war. It is equally likely that a dispute initiated because of an expected power transition plus dissatisfaction would *not* lead to war simply because war was expected to be so costly that giving in on a small issue (relatively) was seen as acceptable. Being pushed too far on numerous "small" issues would likely elicit a tougher response. One side may initiate a single dispute for a small, short-term advantage but would not continue pushing out of fear of eventual escalation. Thus, the ideas embodied in Organski and Kugler are relevant to the Cold-War case despite the absence of a power-transition war.

The above power-transition argument closely follows the logic of the theoretical hypotheses derived in chapter two. Hypothesis 2.1 emphasizes the importance of shifts in the "expected advantage of negotiation." One real-world factor that could shift this expected advantage is a change in power or capabilities. Thus, the power-transition argument is contained within the broader implications of the demand-initiation game. Hypothesis 2.2 emphasizes that the value of the status quo is inversely related to dispute initiation. As discussed in chapter one, status-quo evaluations are merely one guise of dissatisfaction. Thus, the power-transition theory focus on dissatisfaction is also contained in the implications of the demand-initiation game. Although power-transition theory has tended to focus on war as its primary phenomenon, war is only one outcome of an escalatory process. The theoretical hypotheses suggest that similar calculations are being made earlier in that process than most power-transition theorists have heretofore considered.

CHAPTER 4. TESTING THROUGH POWER-TRANSITION THEORY

On December 31, 1991, the Soviet Union formally ceased to exist, thus ending the greatest rivalry in the history of world politics. Unlike Athens, Carthage, or Germany, the demise of the Soviet Union was not a consequence of war. Indeed, the Soviet Union collapsed despite eleventh-hour attempts by the United States to keep its old rival intact. Yet war was not an unexpected possibility between the two superpowers. Tensions waxed and waned, but war was always a consideration in Cold War politics. Given that no war occurred, is there anything in the pattern of conflict that did occur that helps to explain the absence of war? I argue that the timing of disputes between the rivals did not allow escalation to occur, thus lowering the probability of war. I further argue that the timing of disputes did not occur by happenstance but was the result of strategic interactions between the actors.

There were several plausible reasons for the superpowers to take that final step to war. Of these reasons, ideology—i.e., differing ideological outlooks on how the international system should be run economically and politically—is the most basic but not the only one. A Soviet attempt to force its allies to remain within its camp could have provided a similar push to war. Another reason could have been a last-ditch effort by the Soviet Union to assert its position in the world.

The absence of war presents something of a puzzle for power-transition theory. In 1974, the Soviet Union surpassed the United States in capabilities as measured by the Correlates of War Project (Singer and Small 1982). (See Figure 4.1.) This meets one criterion for a power-transition war between a hegemon and a challenger (Organski 1958;

Organski and Kugler 1980). The other criterion is the dissatisfaction of one of the rivals—usually the challenger (Organski 1958; Kugler and Organski 1989). While it can be argued that the Soviet Union was not satisfied with the international system of 1974, no power-transition war occurred, not before 1974, and not after. [1]

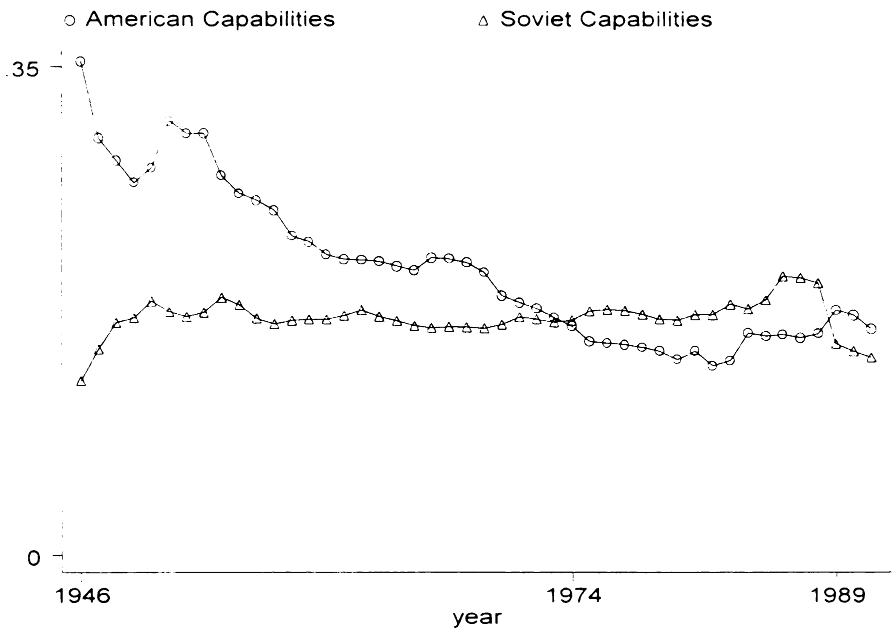

Figure 4.1. American and Soviet Capabilities, 1946 to 1991

Another case that experienced a power transition that did not end in war occurred when the United States surpassed the United Kingdom in 1897. The usual explanation given for this—and a sound one—is that the United States was *not* dissatisfied with the international system during this time period (see, e.g., Lemke and Kugler 1996, 21). At the same time, the United States did not threaten the United Kingdom since their interests in the international system were so similar. As Organski put it (1958, 323), "the major

[1] Lemke and Werner (1996) measured commitment to challenge the status quo and plotted this measure for Russia/the Soviet Union for each decade from 1820 to 1970. This measure for the Soviet Union was consistently positive—i.e., indicating strong commitment—for the Cold War era (pp. 249-50).

reason why England has allowed the United States to take her place without a struggle is because the United States has accepted the Anglo-French international order. [The United States has] not upset the working rules." But this was not the case between the Soviet Union and the United States. Clearly, the Soviet Union had its own "working rules," but did not press for their adoption in a way that produced a major war. Hence, the puzzle remains.

Power-transition theory is intimately concerned with great-power relationships, so it should apply to the Cold War rivalry. The relationship between the United States and the Soviet Union is clearly a candidate dyad fitting power-transition definitions of hegemon and challenger, respectively. One wonders in retrospect whether any aspect of power-transition theory can be applied to explain the absence of war between the Cold War rivals. Specifically, can the logic of power-transition theory be used to explain lower levels of conflict?

Lemke and Reed (1996) find that jointly satisfied relevant dyads rarely engage in Militarized Interstate Disputes with one another. Additionally, Geller (1992; 1996) argues that power-transition theory can be used to explain conflict initiation among major-power "contenders." Geller finds that the dyadic power condition (i.e., unequal, equal, or overtaking) helps explain conflict initiation—the inferior power is more likely to initiate conflict during unequal periods while the superior power is more likely to initiate conflict during the equal and overtaking periods. This presents a starting point for understanding American-Soviet relations during the Cold War.

I argue that power-transition concepts of satisfaction and rates of capability change can be used to explain directed dispute-initiation behavior. In particular, the satisfaction of one's rival translates into one's own dissatisfaction. This dyadic dissatisfaction makes dispute initiation more likely, *ceteris paribus*, for hegemon and challenger alike. Additionally, a rapid strengthening of the challenger, *ceteris paribus*, increases the likelihood of dispute initiation in either direction. These effects hold even while controlling for various domestic conditions in each state. From further implications of core power-transition arguments, I also test whether the general satisfaction of a state or changes in the hegemon's capabilities affect dispute-initiation behavior. Neither of these additional arguments find support in the data.

The remainder of the chapter is divided into five sections. In the next section, I argue how the logic of power-transition theory can be used to explain dispute initiation between the Cold War rivals. I then lay out the empirical model and hypotheses. Next, I describe the measurement of the independent variables. In the penultimate section, I present the results and discuss their relation to the hypotheses. The final section concludes.

ARGUMENT

Power-transition theory has traditionally been applied to the likelihood of war between a dominant power and a challenger. The two criteria for a power-transition war are the power transition itself and the dissatisfaction of one of the rivals—usually the challenger. These two conditions lead Organski (1958, 325) to the conclusion that "wars occur when a great power in a secondary position challenges the top nation and its allies for control."

Organski alluded to lesser forms of conflict in attempting to identify potential challengers. Thus he wrote (1958, 328), "[w]hen nations are dissatisfied and at the same time powerful enough to possess the means of doing something about their dissatisfaction, trouble can be expected." This very general statement has been refined by Kugler and Organski (1989, 175) in which they write, "[a]s a dissatisfied great nation approaches parity by growing in power more rapidly than the dominant nation, instability increases and so does the probability of conflict." Within the context of superpower relations, the *expectation* of a power transition in the near future may have an effect on the likelihood of dispute initiation short of war. The expectation of a power transition is based on the growth rates of rivals:

> The power-transition model postulates that the speed with which modernization occurs in big countries is also quite important in disturbing the equilibrium that existed theretofore. For if development is slow, the problems arising from one nation's catching up with the dominant one may have a greater chance of being resolved. On the other hand, if growth takes place rapidly, both parties will be unprepared for the resulting shift. (Organski and Kugler 1980, 21)

This argument emphasizes rates of change in addition to power transitions themselves. Although power-transition *wars* have been observed only after power transitions (Organski and Kugler 1980, 59) and the probability of "big" wars has been found to be highest when the initiator perceives its capabilities to be greater than half (Bueno de Mesquita and Lalman 1992, 205), these findings take as given an already initiated dispute.

But wars do not simply occur in a vacuum. Rather, war is one end result of an escalatory process.[2] Escalation in this process begins with some crisis or dispute. The decision to begin a crisis rather than negotiating in good faith has been tied to the expectation of gain through coercion (Schelling 1966). It is through this link of

[2] See Carlson (1995) for an exposition on escalation as a process as well as an excellent literature review of previous studies on escalation.

escalation that the logic of power transition can help explain lower levels of conflict.

Following Geller (1992), I assume that the power-transition variables are associated with both dispute initiation and war. This is consistent with Schelling's argument regarding gain through coercion. The challenger would expect to gain more in a dispute if its recent growth rate were high. In the short-term, the challenger is more powerful than it has been in the past. In the long-term, if the high growth rate can be maintained, the challenger could be expected to overtake and supplant the hegemon. Thus, the acquiescence of the hegemon might be expected by the challenger. At the same time, relative satisfaction would temper the challenger's dispute-initiation behavior. Dispute initiation always carries with it the risk of war. A relatively satisfied challenger with a high growth rate might be inclined to wait for tacit acquiescence rather than risk war in hopes of a forced acquiescence; therefore, such a challenger may *not* initiate a dispute. I add to this two other elements. First, I focus on year-to-year interactions within the one, superpower dyad. This allows me to examine subtle changes and their effects on dispute initiation. Second, I incorporate domestic-level data that have proved useful in other studies. These variables help explain the dispute initiation behavior that starts or prevents the escalatory process. Third, I use an empirical model that allows me to examine the degree to which the decisions of each actor are contingent on the decisions of the other actor.

MODEL AND HYPOTHESES

Examining dispute initiation behavior requires incidents of initiation as well as non-initiation. Thus, the basic framework for the empirical model is a binary time-series (cf. Keenan 1982). But the argument above also stresses that dispute initiation is a decision made by one state and directed at another. This strongly suggests that there are two decision streams over time *and* that the decisions may very well be contingent upon one another. For example, when the Soviet leadership is considering whether to initiate a dispute against the United States, they are simultaneously influenced by their implicit utility as well as the likelihood that the United States will initiate a dispute against the Soviet Union. This potential contingency in the decision-making within each state can be modeled to estimate *jointly* the effects of the independent variables on *both* dependent variables.

DEPENDENT VARIABLES

Given the focus on dispute initiation rather than ultimate outcomes, each dependent variable is a binary variable representing the beginning of a dispute during a given year with the *directional* dyad-year as the basic unit of analysis.[3] These data are derived from the Militarized Interstate Dispute data set (Gochman and Maoz 1984; Jones, Bremer, and Singer 1996). Coding this dependent variable requires (1) extracting all disputes in which both the United States and the Soviet Union were actors on opposite sides of the dispute—i.e., one was on side A (which codes for the *side* that initiated the dispute) while the other was on side B, (2) finding all of the disputes in this subset for which both the United States and the Soviet Union were originators—i.e., each was part of the dispute from the very beginning of the dispute and did not join later, (3) separating the subset found in point two into disputes in which the United States was on side A and disputes in which the Soviet Union was on side A, and (4) constructing two dichotomous

[3] The annual periodization is a result of several independent variables only being available for the annual level; a quarterly series of dispute initiation could also be constructed.

time series for each subset in which the year is coded as a one if a dispute began or continued in that year and a zero otherwise.

This coding procedure captures the essential aspects of dispute initiation. The first point above indicates that the two states of the dyad in question were involved in a dispute. This is clearly an indication that someone is trying to disturb the international status quo.[4] It also provides a reference group from which initiation can be determined. Specifically, once we have identified the cases in which two countries were involved in a dispute, we then want to determine who initiated the dispute. Points two and three are the mechanisms by which dispute initiation is determined. Point two makes a critical distinction between initiating a dispute and joining an on-going dispute. Only the initiation of disputes is considered in this examination. Point three makes the assumption that *for states involved in a dispute from its inception* the state coded as being on side A acted consciously to take directed action against the state coded as being on side B. The distinction between originators and joiners becomes critically important for this assumption. In particular, even if two states could *join* a dispute on the same day but after the dispute has begun, it is no longer possible to apply the side A/side B assumption to these states. The state joining the dispute on side B could be "initiating" a dyadic dispute with the state joining the dispute on side A. Furthermore, once a dispute is under way it is much more difficult to say unequivocally that a state is initiating a dyadic dispute against any state in particular on the other side. More likely than not, a state joins a dispute to help a friendly state in a time of need. This emphasizes that joining a dispute

[4] Although the Militarized Interstate Disputes data set contains many cases that some researchers deem to be of less significant (such as fishing disputes), the disputes between the superpowers generally involved much higher stakes.

is more akin to escalatory behavior than to initiation behavior.

This operationalization is consistent with existing usage in the literature. A Militarized Interstate Dispute begins with a threat—explicitly spoken or implicitly part of a military mobilization—and then has the potential of escalating to violence or war. Maoz (1982) used Serious Interstate Disputes in his ground breaking work of dispute initiation. Leeds and Davis (1997) use the same operationalization as I do.

There were fifteen dispute episodes initiated by the United States against the Soviet Union. Eleven of these episodes were initiated solely by the United States. None of the disputes extended from one year to another. The average duration of these disputes was 52 days. Two disputes were initiated in 1967 and again in 1980. Thus, thirteen years are coded as American dispute initiation against the Soviet Union.

There were twenty dispute episodes initiated by the Soviet Union against the United States. Eighteen of these episodes were initiated solely by the Soviet Union. The average duration of these disputes was 58 days. Four of the disputes extended from one year to another (but never into yet another year). Four years witnessed multiple disputes: 1958, 1963, 1964, and 1979. Seventeen years are coded as Soviet dispute initiation against the United States. Table 4.1. lists the years of dispute initiation.

MODEL

The dependent variables as operationalized are dichotomous but the underlying assumption is that there is an unobservable, continuous variable associated with the probability of dispute initiation. This assumption is captured in the following empirical model in which y_{jt} are the observed dependent variables and y^*_{jt} are the unobservable continuous dependent variables.

Table 4.1. Years Coded as Dispute Initiation

USA *vs.* USSR	USSR *vs.* USA
1960	1948
1961	1949
1962	1958
1964	1959
1965	1961
1967	1963
1970	1964
1972	1966
1977	1967
1980	1968
1981	1970
1985	1978
1986	1979
	1982
	1983
	1984
	1986

$$y^*_{1t} = \mathbf{X}_{1t}\boldsymbol{\beta}_1 + \varepsilon_{1t} \quad \text{where } y_{jt} = \begin{cases} 1 & \text{if } \; y^*_{jt} > 0 \\ 0 & \text{if } \; y^*_{jt} \le 0 \end{cases} \quad j = 1,2$$
$$y^*_{2t} = \mathbf{X}_{2t}\boldsymbol{\beta}_2 + \varepsilon_{2t}$$

Given the arguments from the previous section, X_{jt} has the following general form:

X_{jt} = {Satisfaction, Rates of capability change, Domestic politics}.

The errors, ε_{1t} and ε_{2t}, are assumed to be identically distributed according to a standard bivariate normal distribution with correlation ρ. The subscripts t indicate the time period of the observation. Estimation of separate equations is possible but carries with it two risks. At a minimum, the coefficients of two separate models will be inefficient. At worst, the coefficients will tell the wrong substantive story. Additionally, estimating separate models when there is potential for interdependence of choice assumes that the underlying framework is decision theoretic rather than strategic. Specifically, an *individual* binary-choice model would assume that the actor is making decisions without taking into account the likely response of the rival. By contrast, a *joint* binary-choice model takes this additional information into account. The empirical model above manages all three of these problems.

CORRELATED ERRORS, CONTINGENT DECISIONS

The model above has a correlation coefficient (ρ) between the errors of the two equations. The implicit assumption when running separate analyses is that $\rho = 0$. A joint binary-choice model allows us to test this assumption rather than assuming it. Thus, ρ can be considered an additional variable. Excluding ρ (by conducting separate analyses) has the same potential problems as omitted-variable bias (cf. Yatchew and Griliches 1985).

In the present study, ρ can be used to assess the degree of contingent decision-making that is present between the superpowers. If ρ is positive, then the Cold War rivals would have been tacitly making decisions in the same direction (e.g.. not to initiate disputes against one another in any given time period). If ρ is negative, the superpowers would have been acting in generally opposite directions (e.g., being less likely to initiate a dispute when the other side has a higher expectation of initiating a dispute). If ρ is indistinguishable from zero, then no clear contingency can be inferred. A final important point regarding ρ is that it is *not* the correlation between the dependent variables but is the correlation between the *errors* of two equations in a simultaneous model. Thus, we could observe a pairwise correlation of zero between the dependent variables and still have a ρ that is *not* zero. This would suggest that contingency of decision-making may be obscured when directly examining the data but can be recovered through appropriate modeling techniques. The possibly of correlated errors and contingent decisions presents the first hypothesis:

Hypothesis 4.1. If there is contingency of decision-making, then $\rho \neq 0$.

INDEPENDENT VARIABLES AND RELATED HYPOTHESES

SATISFACTION

Satisfaction should reduce the likelihood of dispute initiation. I make a distinction between two kinds of satisfaction: *international* and *dyadic*. International satisfaction is a state's satisfaction with the international system independent of its assessment of the dyadic relationship. Dyadic satisfaction, in contrast, is an assessment of relative satisfaction within the dyad. In usage, the international satisfaction of one's rival translates into one's own dyadic *dis*satisfaction. Thus. one's international satisfaction should *reduce* the likelihood of one's own dispute initiation while the international satisfaction of one's rival should *increase* the likelihood of one's own dispute initiation against that rival.

A state's satisfaction with the status quo is presumed to be linked to its international influence. The greater a state's influence, the less likely the expectation that it will need to initiate a dispute to get what it wants. By the same token, the international influence of a state's *rival* is inversely related to the state's satisfaction with the status quo. This suggests that state *i*'s influence will get at state *i*'s general satisfaction and state *j*'s influence will get at state *i*'s dissatisfaction with state *j*.[5] Thus, state *i*'s influence reflects its overall satisfaction with the international environment, not within the dyad. State *j*'s influence, by contrast, reflects state *i*'s dissatisfaction within the dyad *to the extent that state i and state j are rivals for international influence.* Thus, state *j*'s influence is a dyadic measure of dissatisfaction while state *i*'s influence is a general international measure. A high level of influence for state *j* implies a high level of dissatisfaction for state *i*; this high dissatisfaction is then assumed to make state *i* more likely to initiate a dispute against state *j* as a result of this dyadic dissatisfaction. The hypothesis associated with dyadic dissatisfaction is:

> **Hypothesis 4.2.** The international influence of rival state *j* is positively related to state *i*'s likelihood of initiating a dispute against state *j*.

[5] Note that running ($influence_i - influence_j$) presumes more information than running them separately. Specifically, it presumes that the relative value of one's own influence and the influence of one's rival is the same. Although the coefficient on the difference variable is expected to be negative, checking whether the difference of coefficients on the separate influence variables is negative examines the same expectation while preserving the relative importance of each variable.

Dissatisfaction with the international system in general is an important element of power- transition theory (Kugler and Organski 1989). Hypothesis 4.2 emphasizes dissatisfaction within a particular dyad. We also need to consider the general dissatisfaction with the international environment. As argued above, a state's own general international influence reflects its degree of satisfaction with the international system. Thus, low levels of influence are expected to be associated with more dispute initiation.

> **Hypothesis 4.3.** The international influence of state *i* is inversely related to state *i*'s likelihood of initiating a dispute against any other state, *ceteris paribus*.

The idea that one's international influence reduces one's *overall* dispute-initiation propensity may hold at the monadic level—c.f. Maoz (1982)—without yielding similar results at the dyadic level. In this sense, dyadic dissatisfaction holds more relevant information than general international satisfaction.

Rates of Capability Change

Rates of capability change reflect the speed-of-modernization argument made in Organski and Kugler (1980, 21). This argument can be applied without an actual power transition. When the challenger experiences rapid growth—or a large increase in capabilities—both sides are thrown off balance. This then increases the likelihood of dispute initiation. For sake of completeness, I also examine whether increases in the hegemon's capabilities has the intuitively converse effect of decreasing the likelihood of dispute initiation.

The power-transition framework places greater emphasis on the growth rate of the challenger than on the decline of the hegemon. In particular, Organski and Kugler stated, "if growth takes place rapidly, *both* parties will be unprepared for the resulting shift."

(1980, 21 emphasis added.) Given this argument, a sharp rise in Soviet capabilities is expected to produce more dispute initiation by *both* states. This argument can be generalized. Increases in challenger capabilities make the challenger more likely to press its short-term advantage while the same condition makes the hegemon more likely to attempt to keep the challenger at bay. Decreases in challenger capabilities make the challenger less of a threat to the hegemon and removes any short-term advantage the challenger may have had. This result is expected to be monotonic with respect to dispute-initiation propensity. Large increases in challenger capabilities make both states much more likely to initiate disputes compared to small increases.

> **Hypothesis 4.4.** Changes in the challenger's capabilities are *positively* related to dispute initiation within a dyad.

Power-transition theory has relatively little to say regarding how the decline of the hegemon affects the likelihood of conflict. However, the argument above has a logical implication not examined in the literature. A decrease in hegemon capabilities gives the challenger a short-term advantage similar to the advantage it gets from an increase in its own capabilities. A decrease in hegemon capabilities could also make the hegemon desperate to hold onto its position. In the Cold War context, as the United States declined or the Soviet Union grew stronger (each relative to the rest of the world), a power transition became more likely and—by implication—so did dispute initiation. Thus,

> **Hypothesis 4.5.** Changes in the hegemon's capabilities are *inversely* related to dispute initiation within a dyad.

Domestic Politics

The domestic environment component of X_{jt} reflects control variables that either have been useful in past studies or present conceivable proxies for different domestic circumstances. The democratic nature of the United States provides a number of potential domestic explanatory factors. Two prominent political factors are the election cycle and national party politics. For the non-democratic Soviet Union, there are relatively few domestic variables that can be used consistently throughout the entire period under examination. Leadership periods, however, are proxies for different domestic environments.

Following Ostrom and Job (1986), I examine whether presidential election years are more or less likely to elicit dispute initiation by the United States. In addition, to the extent that the American election cycle affects the behavior of other states, I would expect other states to be less likely to engage in dispute initiation against the United States during a presidential election year. The rationale behind this expectation is that negative action taken against the United States during an election year is more likely to engender an electorate hostile toward the action taker. The hostile electorate would then be more likely to select candidates that hold national-security interests antithetical to the initiating state. This expectation might be stronger for presidential election years since there is more at stake in terms of a foreign-policy shift.

Party politics is another possible explanatory factor in dispute behavior involving the United States. The party of the president has been shown to be an indicator of general American foreign-policy stances (Holsti 1996). It is also possible that the party of the president serves as a signal of likely American responses to the actions of other states. Specifically, Republicans are generally conceived as hawks while Democrats are generally conceived as doves (see also Fordham 1998). This has been considered to mean that the United States is more likely to get involved in disputes under Republican presidents but is more likely to witness escalation of disputes under Democratic presidents (cf. Palmer and Regan 1999).

Another party-based explanatory factor is the composition of Congress in relation to the party of the president. The underlying idea is that if the president faces a Congress in which one or both chambers are controlled by the opposite party, it is more difficult for the president to get the (tacit) approval necessary for military action. This is part of the "structural explanation" for the democratic peace that is the focus of Palmer and Regan's recent parliamentary work. This explanation "would lead one to expect that more complex coalitions should engage in less (or less serious) conflict than simpler governments" (Palmer and Regan 1999, 3). In the context of the United States, the "complex coalition" is a divided government. By the institutional reasoning above, it is expected that this variable is negatively related to dispute initiation by the United States against any other state.

Theoretically, Soviet leadership periods are conceived of here as proxies for different domestic environments. They could also reflect different leadership styles similar to the hawk-dove distinction of Republicans and Democrats. Additionally, they could represent different eras within Cold War history. Given these competing interpretations, it is difficult to point to clear predictions that are not historically informed. As the best available and most consistent indicators, however, it would be unwise not to examine the effects of Soviet leadership on dispute-initiation behavior within the dyad.

MEASUREMENT ISSUES

SATISFACTION

The satisfaction variables are measured indirectly by the general international influence of a state in a given year. Rather than assume that the United States (as hegemon) was always completely satisfied, I set out to measure the satisfaction of both the challenger and the hegemon. This assumption of relative satisfaction of the hegemon is partially supported by Lemke and Reed (1998, 513) where they argue that:

> Power transition theory does not assume, argue, or suggest that the power a nation obtains or enjoys predetermines its evaluation of the status quo. According to power transition theory, there is no consistent relationship between power and status quo evaluations.

The idea of influence is quite consistent with the concept of satisfaction within the context of the Cold War rivalry. The very nature of the rivalry itself was a contest to see who could gain more influence over the bulk of states in the international system. Thus, the influence of the rival is a direct measure of dissatisfaction within the Cold War contest.

The influence of state i in year t is measured as the number of foreign embassies headed by full ambassadors (A_{it}) controlling for the number of countries in the world (N_t)—i.e., $(A_{it})/(N_t - 1)$.[6] The intuition behind this measure is three-fold. First, there exists a budget constraint for any given country on the number of foreign embassies it can maintain. Second, states will seek to have embassies in countries whose importance

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[6] The data for A_{it} for the United States was collected from the *Diplomatic List*, a periodic publication of the United States Department of State. The data for A_{it} for the Soviet Union was collected from two sources. Data for the period 1946 to 1966 is from Edward L Crowley's (1970) *The Soviet Diplomatic Corps, 1917-1967*; data for the period 1967 to 1993 is from the *Europa World Factbook*. The data for N_t is from the Interstate System Membership data set from the Correlates of War Project at the University of Michigan (cf. Singer and Small 1966).

is greater to them relative to other countries. Third, ambassadors—as opposed to embassies—reflect a greater degree of perceived importance and vary more often.

As long as the budget constraint does not permit a country to have an embassy in every capital in the world, as is generally the case for most countries, states must make decisions regarding where to have embassies. One can presume that these decisions are based on the relative importance of a relationship either by way of trade, foreign aid, or international politics generally. Thus, countries that are ranked as more important by more states will have more embassies than less important, less influential states. Several other researchers have keyed in on this aspect of international influence. The most prominent of these studies is Wallace (1972) in which he used Singer and Small's (1966) data on the number of diplomatic missions accredited to a state's capital.

Using the number of embassies—rather than ambassadors—as a base measure presents a few problems. Embassies are not opened or closed very often. This implies that a measure based on the number of embassies will not be sensitive to more subtle changes in international influence evaluations. An ambassador can be recalled for a number of reasons, the most significant of which is a signal of displeasure to the host government. Thus, a country's capital may witness many ambassadors returning home *without any decline in the number of embassies.* Thus, a measure based on ambassadors rather than embassies has greater sensitivity.[7]

[7] Embassies still represent a budget constraint since an embassy is usually established with diplomatic relations. Thus, the number of embassies a country has in its capital is the limit for the maximum number of ambassadors.

Rates Of Capability Change

A hypothesis testing whether *rates of change* affects dispute-initiation behavior should reflect that expectation rather than parity. This can be done using Singer, Bremer, and Stuckey's (1972) Capability Composite Index to examine a state's proportion of global *capabilities*. This is an index measure from the Correlates of War Project that is an unweighted average of six system proportions: military expenditures, military personnel, energy consumption, iron and steel production, urban population, and total population.[8] Changes in capabilities from year to year for each state are used to assess the rates-of-change argument.[9]

Domestic Variables

The American domestic variables focus on the election cycle and national party politics. I coded a dummy variable for *presidential election* years that takes the value one in a presidential election year and zero otherwise. I coded another dummy variable for *Republican president* that takes the value one when for years in which there is a Republican president and zero for Democratic presidents. Finally, I coded a dummy variable for *divided government* that takes on the value one if both chambers of Congress are not controlled by the party of the president.

A methodological problem arises when trying to use *Republican president* and *divided government* in the same model. The pairwise correlation between these two variables is very high (0.8333). Including both in one model produces a near-colinearity

[8] The updated Correlates of War data were used for this study. de Soysa, Oneal, and Park (1997) compared power-transition results between Correlates of War and GDP measures of power and found them to be generally consistent.

[9] Lemke and Werner (1996) examined military build up relative to the dominant state using the Correlates of War military expenditure component only. That measure is similar to the rates-of-change measure employed here in that it focuses on changes in capabilities.

problem (cf. Greene 1993). Theoretically, it makes sense to think about the president influencing Soviet behavior toward the United States while divided (or unified) government influences American behavior toward the Soviet Union. This simply implies that the Soviets concentrated on American leadership (and their likely responses) while the Americans were concerned with potential domestic problems. Gaddis (1987, 16) emphasizes the Soviet part of this argument:

> There was here a tendency, repeated more than once in the subsequent history of Soviet-American relations, for Moscow to attribute too much power to the president of the United States, and to neglect the domestic constraints under which he operates.

Thus, I use *Republican president* (but not *divided government*) when analyzing Soviet dispute initiation and use *divided government* (but not *Republican president*) when analyzing American dispute initiation. This takes care of a methodological malady by using a theoretical thesis and a historical hint.[10]

For the Soviet Union, I simply use dummy variables for individual leadership periods, coding the head of the Communist party as the leader. For each leader, I coded whether he was the head of the Communist party for a given year. As a matter of measurement, I required the leader to be in power for one-half year or more; otherwise, that leader-year was coded as a zero.[11] No particular *ex ante* expectation is made for any of these leadership variables. Not considering them, however, could produce incorrect inferences if personal leadership is driving international relations.

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[10] The results are, however, robust to altering the model specification with respect to these two variables.

[11] This coding rule produced one year for the Soviet Union—1953—for which no leader was coded as being in power. Stalin was the leader until his death in March, but Khrushchev did not assume the role of party chairman until October. All other years are coded as having one and only one leader.

One final methodological problem must be noted before moving on to the estimation section. The leadership variables *Stalin*, *Andropov*, and *Chernenko* produce perfect predictions with American dispute initiation. Including these variables makes the estimation highly inefficient. As an additional result, including all three other Soviet leadership variables in the estimation of American dispute initiation produces similar problems. As a partial remedy for this, I only included *Khrushchev* and *Brezhnev* in that part of the analysis. On the Soviet side of the analysis, I only included *Gorbachev* for similar reasons.[12]

RESULTS

Bivariate probit is the appropriate technique to estimate the empirical model.[13] The results of the bivariate estimation are reported in Table 4.2.[14] The model predicts 80% of American and 78% of Soviet dispute initiation correctly. This corresponds to reductions in error of 29.2% and 40.5%, respectively.[15] The likelihood ratio index (LRI) for the model is 0.3670.[16] The results support two of the four power-transition hypotheses. The results also support the hypothesis that there was contingency of

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[12] The results of satisfaction, capability change, and the American domestic variables are robust to the different specifications of Soviet leadership variables in the model to the extend that the inclusion does not produce inefficiencies. For example, if *Gorbachev* is estimated on the American side of the analysis while *Khrushchev* and *Brezhnev* are estimated on the Soviet side of the analysis, the results regarding the main hypotheses do not change but the Soviet leadership variables become insignificant.

[13] See Meng and Schmidt (1983) and Greene (1990, 660-663) for a technical discussion of bivariate probit and its properties. See Huffman and Lange (1989) for an intuitive case in which the estimates provided by bivariate probit were substantively different from treating all decisions as individual rather than interdependent.

[14] Estimation and Figures 1 and 2 were produced using Stata 6.0 ®. The remainder of the figures were produced using Excel ®.

[15] The reduction-in-error (ROE) measure used here is the same as that used in Brenner, Hagle, and Spaeth (1990). ROE% = (% Correct - % in modal category)/(% in modal category).

[16] $LRI = 1 - \ln L/\ln L_0$, where $\ln L_0$ is log likelihood of the null model. $\ln L_0 = -58.4524$ for this model. See Greene (1993, 651).

decision-making.

There is strong support that the international influence of a state's rival increases the likelihood of that state initiating a dispute against its rival. Soviet influence had a positive and significant effect on American dispute initiation and American influence had a positive and significant effect on Soviet dispute initiation. Thus, Hypothesis 4.2 finds support in the data. There is also strong support for the growth-rate hypothesis. Increases in Soviet capabilities (as the challenger) had a positive and significant effect on *both* American and Soviet dispute propensities. Thus, Hypothesis 4.4 also finds support in the data. These results strongly support the argument that the core power-transition concepts of satisfaction and rates-of-capability change can be used to explain conflict behavior short of war. The finding that dyadic dissatisfaction is a positive indicator of dispute initiation is consistent with power-transition theory. The strong mirror relationship in which one's rival's international influence pushes a state closer to dispute initiation validates the assertion that this variable is measuring dyadic dissatisfaction. The observed mirror relationship also suggests that the relative satisfaction of the hegemon may be more important than previously believed.

Hypothesis 4.3 and Hypothesis 4.5 must be rejected. The international influence of the United States did not significantly affect American dispute initiation against the Soviet Union. Similarly, the international influence of the Soviet Union did not significantly affect Soviet dispute initiation against the United States. Finally, changes in American capabilities had no significant effect on either American or Soviet dispute propensities. Recall that these hypotheses are extensions of power-transition arguments rather than derived from core concepts. Thus, the insignificant results on American

Table 4.2. Seemingly Unrelated Bivariate Probit Results

	USA *vs* USSR		USSR *vs* USA	
	Coefficient (Robust SE)	p	Coefficient (Robust SE)	p
American Influence	7.4856 (8.9705)	0.404	19.7399 (6.8251)	0.004
Soviet Influence	20.4280 (6.7206)	0.002	2.4047 (2.2377)	0.283
Change in American Capabilities	8.9016 (36.4726)	0.807	-5.4669 (21.2041)	0.797
Change in Soviet Capabilities	182.0035 (55.8895)	0.001	134.7297 (50.7815)	0.008
Presidential Election Year	0.9804 (0.6276)	0.118	0.4585 (0.5909)	0.438
Divided Government	-0.8903 (0.5068)	0.079		
Republican President			-1.6834 (0.5126)	0.001
Khrushchev	3.9233 (1.1413)	0.001		
Brezhnev	1.2906 (0.7214)	0.074		
Gorbachev			-1.3914 (0.6586)	0.035
Constant	-19.7170 (9.6280)	0.041	-16.1200 (5.5731)	0.004
ρ	-.7169 (0.1933)			

N = 46	LRI = 0.3670
LL = -37.0016	ROE% of American Initiation = 29.2%
Wald $\chi^2(15) = 38.53$	ROE% of Soviet Initiation = 40.5%
$P > \chi^2 = 0.0008$	

influence for American dispute initiation and on Soviet influence for Soviet dispute initiation are not unexpected. Similarly, changes in the dominant state's capabilities are not argued to elicit special behavior with the power-transition framework. Although Hypothesis 4.5 is an implication following the logic of Hypothesis 4.4, there is an expectation among all parties that the dominant power will eventually decline. This is clearly present—in capability terms—in the Cold War context. Since this expectation is common knowledge, the general decline of American capabilities should not be expected to cause unexpected behavior. Rather, it is the unexpected bursts of Soviet capabilities that put both sides off balance and produce more conflictual behavior.

The correlation coefficient clearly indicates a negative relationship between the errors in the two equations supporting Hypothesis 4.1. A Wald test on the hypothesis $\rho = 0$ also rejects the notion that the choices are being made independently ($\chi^2(1) = 5.137$, $P > \chi^2 = 0.0234$). This is despite the fact that the pairwise correlation between the two dependent variables is only 0.0196. As suggested earlier, we do not directly observe the contingent behavior of the superpowers. But the results seem to indicate that when one superpower was *likely* to initiate a dispute (whether or not it did), the other superpower was simultaneously *less* likely to do so.

This finding by itself can be interpreted in a number of ways. It could indicate an awareness, for example, that restraint was perceived as necessary within the relationship. This feeling of restraint is consistent with Gaddis's (1987, 1997) historical arguments regarding the nuclear aspect of the rivalry. It is also consistent with Vasquez's (1996) argument that non-territorial rivalries—like that between the United States and the Soviet Union—require third-party contagion in order to escalate to war. The negative correlation could also indicate that initiator advantage was often one sided. If circumstances favored one side in a given year *and* the other side realized this, then the advantaged side would be more likely to initiate while the other would be less likely to do so. Regardless of the underlying mechanism, the decisions of the actors were negatively contingent upon one another.

The American domestic control variables also exhibited the predicted effects with one exception. Presidential election year had a positive but moderate effect on American dispute initiation. This finding is consistent with the results in Ostrom and Job (1986, 555). The same variable had no significant effect on Soviet dispute initiation. Divided government exhibited the expected negative effect on American dispute initiation. Likewise, Republican presidents reduced the propensity of the Soviet Union initiating disputes against the United States.

The Soviet domestic control variables also effected dispute-initiation propensities. The leadership periods of Khrushchev and Brezhnev increased the likelihood of American dispute initiation. The other leadership periods either had no significant effect on American dispute-initiation behavior or produced inefficiencies in estimation. Similarly, only the leadership period of Gorbachev revealed a significant and negative effect on Soviet dispute initiation toward the United States.

PUZZLE REVISITED

These findings relating power transition to dispute initiation also help explain why the superpowers did not engage in a power-transition war in the mid 1970s. Despite the Soviet Union surpassing the United States in capabilities in 1974 and a *general* sense of dissatisfaction between the rivals, the multivariate analysis accurately predicts no

Soviet dispute initiation for the years 1973 to 1976 and no American dispute initiation for the years 1971, and 1973 to 1976. (See Figure 4.2.)[17] Without dispute initiation, escalation to war was not possible during these critical years.

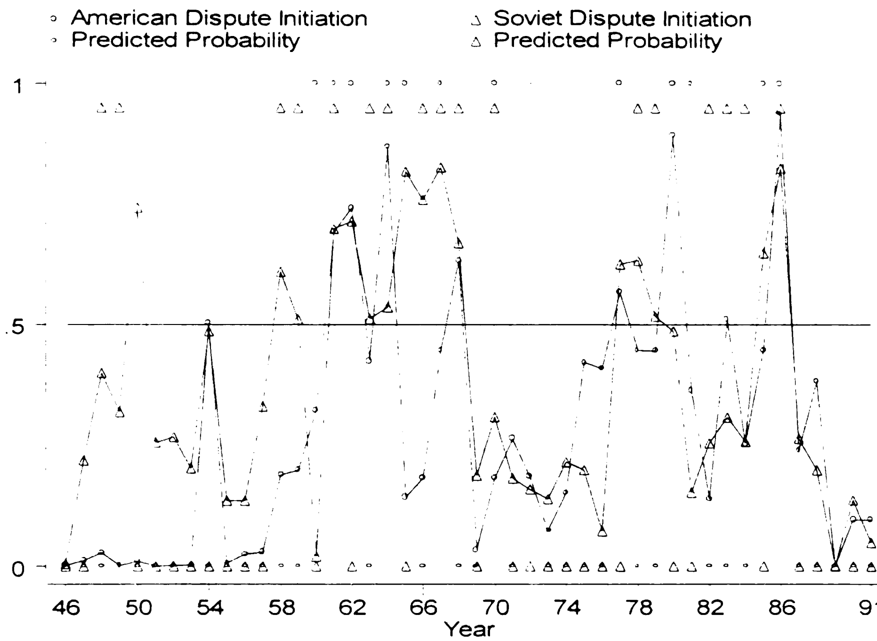

Figure 4.2. Overlay of Dispute Initiation and Predicted Probabilities

The model predicts no dispute initiation for the years 1969 through 1976. The mean predicted probabilities of dispute initiation for this period are 0.215 for the United States and 0.184 for the Soviet Union. This contrasts with mean predicted probabilities of 0.297 and 0.409 respectively, for the remainder of the Cold War.[18] Adding a dummy variable for this period does not change the substantive results and is not significant in either equation (having p-values of 0.791 and 0.368 respectively). Thus, the model

[17] Figure 4.2 plots the marginal predicted probabilities of American and Soviet dispute initiation given the model parameters and the values of the independent variables for a given year. Actual American and Soviet dispute initiation are also plotted for reference. Soviet dispute initiation is off-set so that the years of actual dispute initiation can be clearly distinguished.
[18] The actual mean probabilities of dispute initiation for the forty-six years under examination were 0.2826 and 0.3696 for American and Soviet dispute initiation, respectively.

appears to tell the same story for this subset of years and for the Cold-War rivalry in general.

That story suggests that the Soviet Union had a lower average likelihood of initiating a dispute for the eight-year period than for the Cold War in general. This is demonstrated in the following figures displaying the marginal effects of American influence (Figure 4.3) and of changes in Soviet capabilities (Figure 4.4) on Soviet dispute-initiation behavior.[19] In both cases, we see that the probability of Soviet dispute initiation for the eight-year period is not substantially different from the overall probability of Soviet dispute initiation. But the range of the two independent variables for the eight-year period produced moderate probabilities of dispute initiation compared to other periods. This had the effect of lowering the average probability of Soviet dispute initiation for the period in question.

The story in the American equation is more nuanced. The marginal effects of Soviet influence (Figure 4.5) and of changes in Soviet capabilities (Figure 4.6) for the eight-year period both point to *higher* probabilities of American dispute initiation relative to the Cold-War period. The offsetting effect is the existence of a divided government for the whole of the eight-year period. The probability of American dispute initiation when there was a divided government (and holding the other conditions of the eight-year period constant) was 0.187. The corresponding probability of American dispute initiation under a unified government was 0.501. According to the empirical results, the existence of a divided government was a restraint on American dispute-initiation behavior during a

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[19] The marginal effects were calculated by holding all other continuous independent variables at their means and the dichotomous variables at their modes, for their respective time periods. The "adjust" command in Stata was used to calculate all marginal effects.

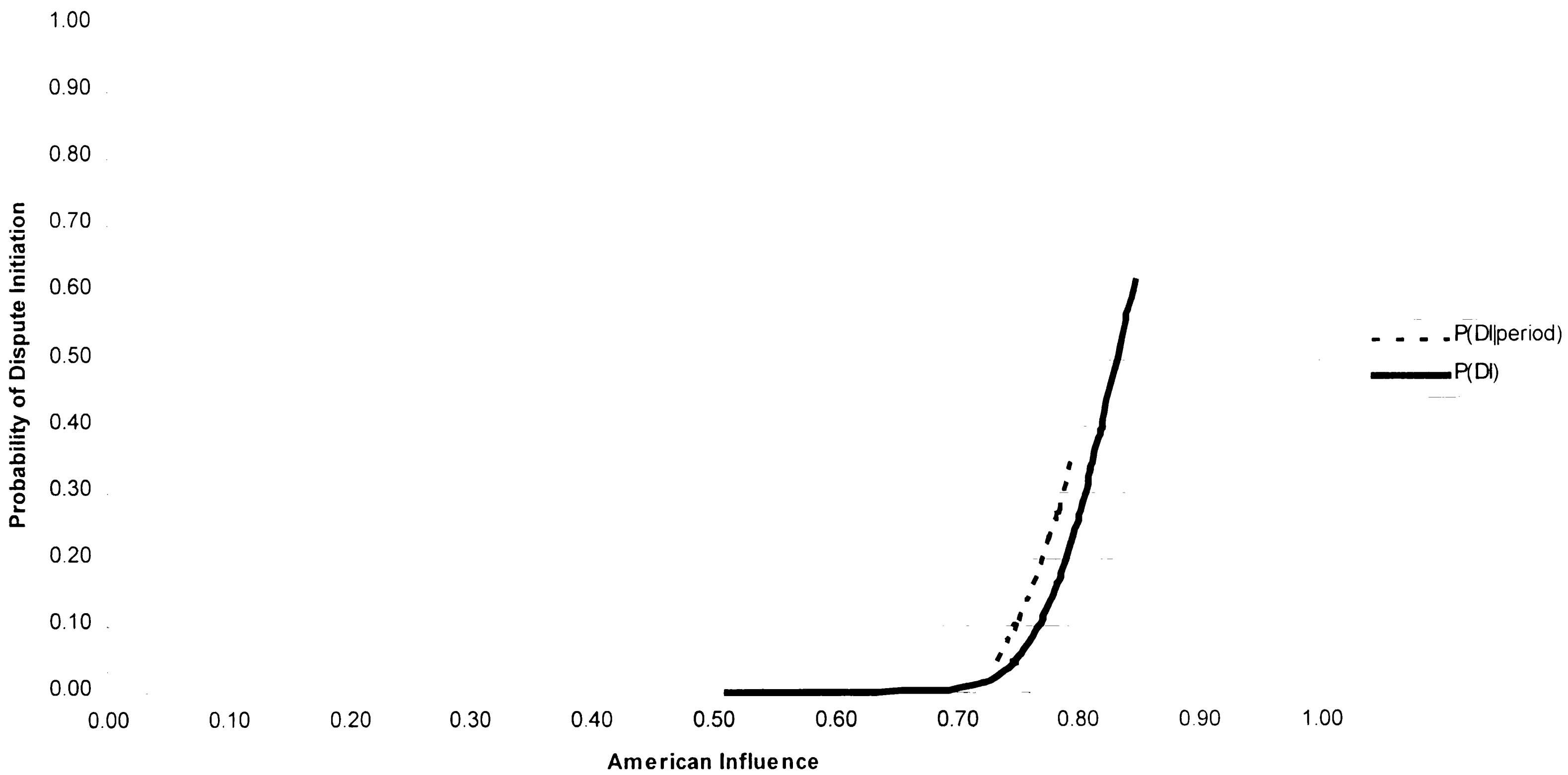

Figure 4.3. Marginal Effects of American Influence on Soviet Dispute Initiation

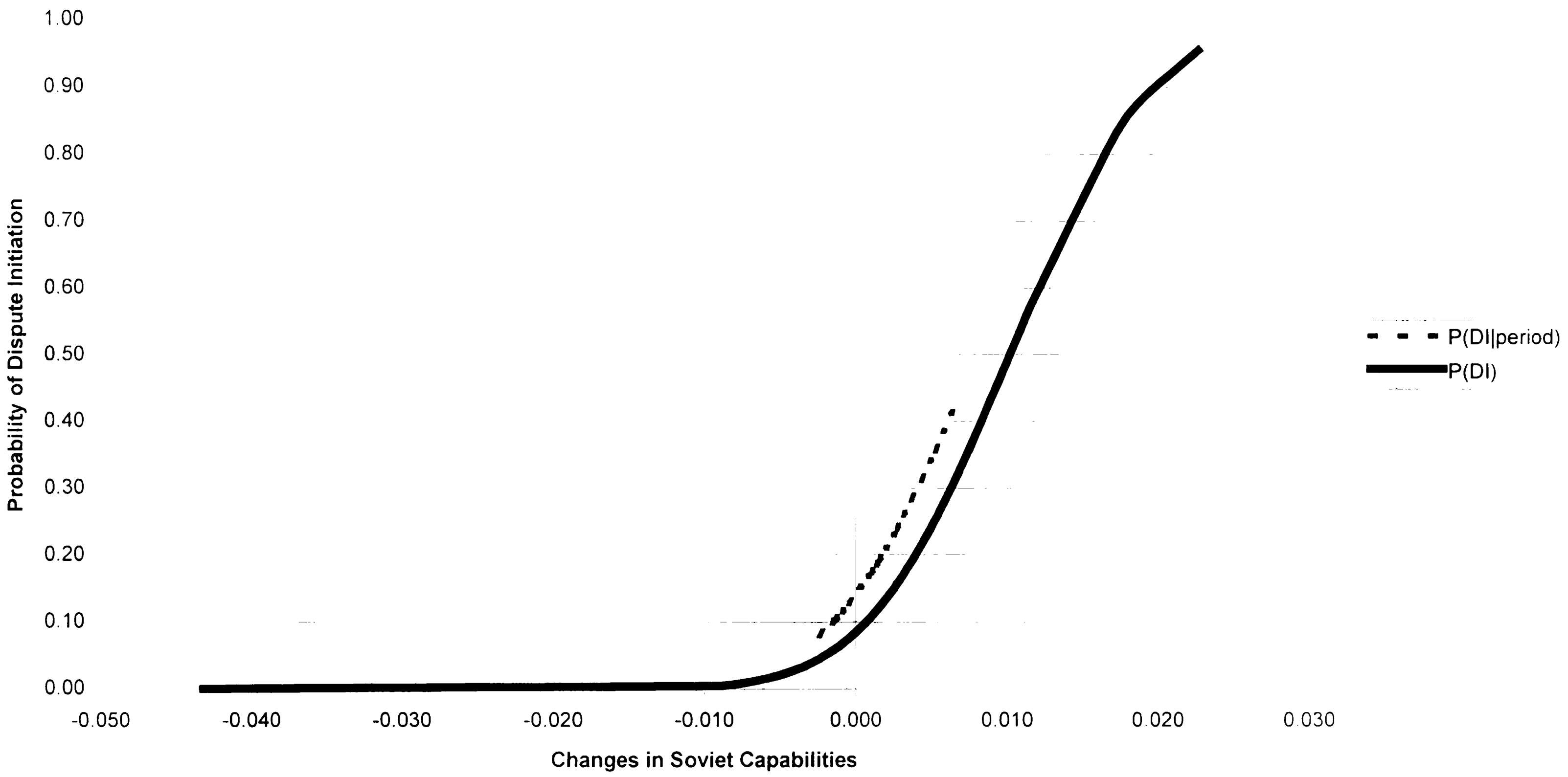

Figure 4.4. Marginal Effects of Changes in Soviet Capabilities on Soviet Dispute Initiation

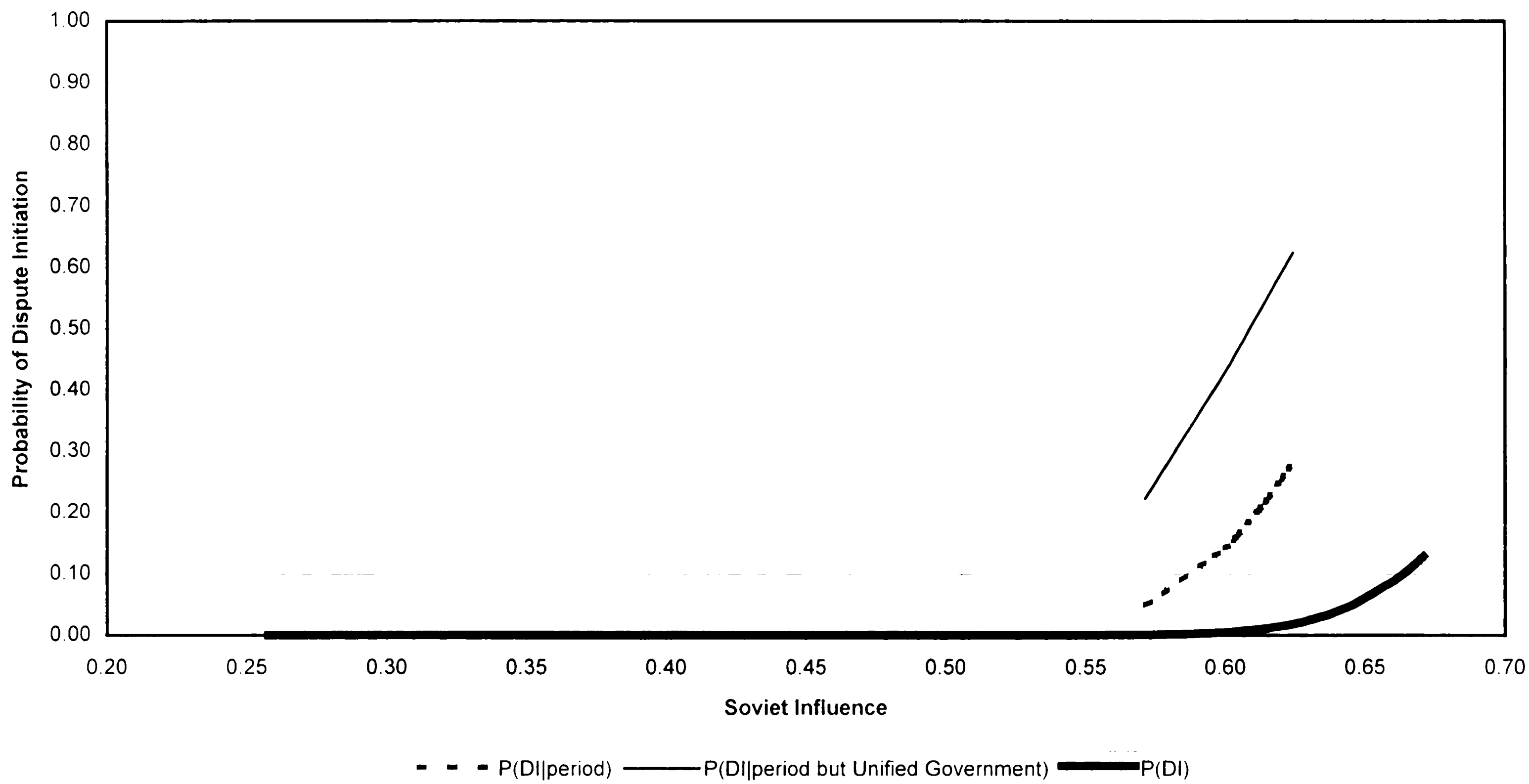

Figure 4.5. Marginal Effects of Soviet Influence on American Dispute Initiation

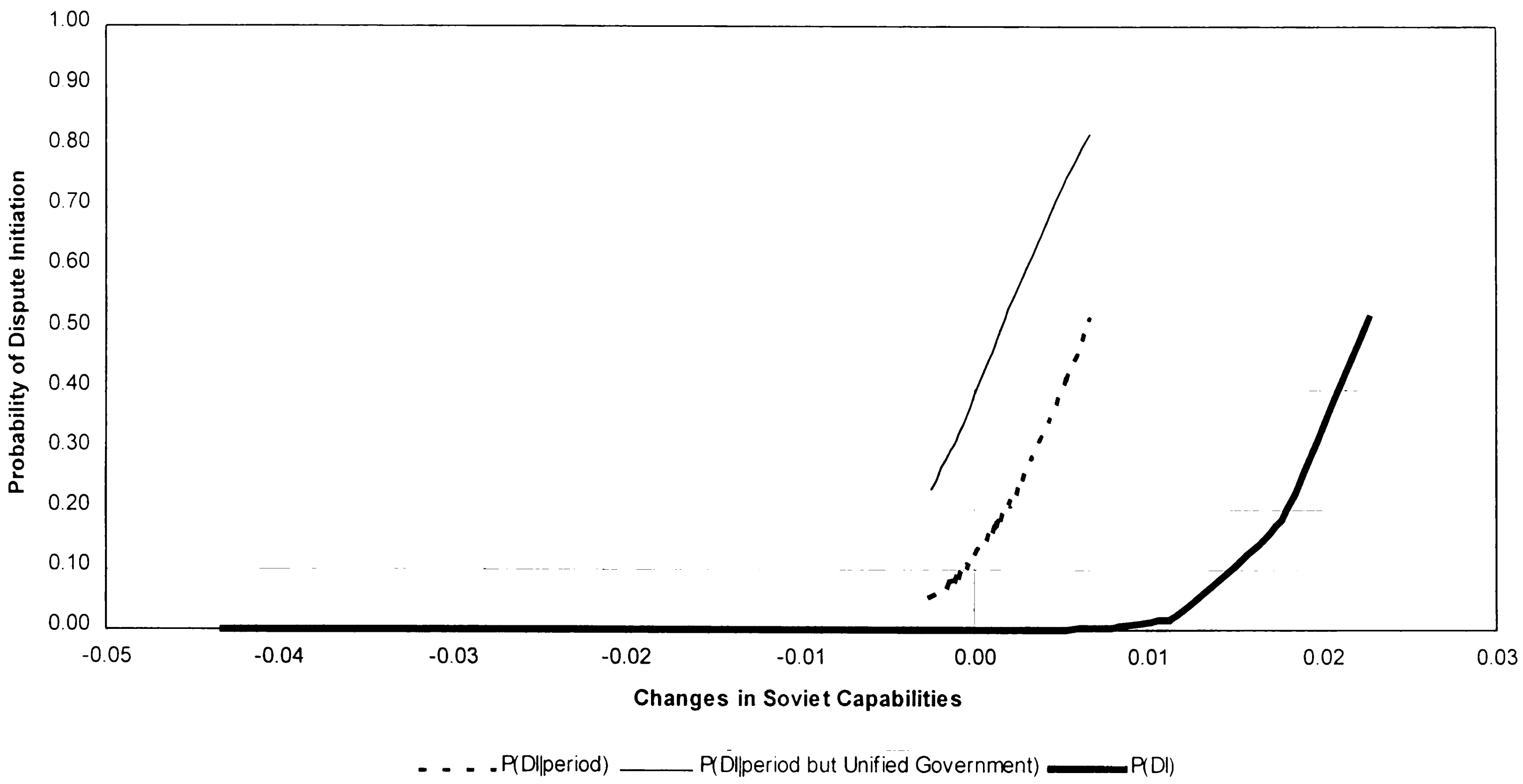

Figure 4.6. Marginal Effects of Changes in Soviet Capabilities on American Dispute Initiation

critical period of Cold-War history. Although the difference in predicted probabilities between these two conditions is large, it fits the theoretical argument made earlier that divided government presents a tacit obstacle to the use of force by the president. This finding is also consistent with the findings of Palmer and Regan (1999) regarding the effect of "complex coalitions" on the use of force by parliamentary governments.

Thus, the empirical results suggest that the likelihood of Soviet dispute initiation was lower during the eight-year period as a direct result of power-transition variables. The same variables also suggest that the United States was *more* likely, *ceteris paribus*, to initiate a dispute during the same time period. After controlling for domestic conditions in the United States, however, the probability of American dispute initiation was greatly diminished.

CONCLUSION

The preceding results lend support to the two hypotheses that were most closely derived from the logic of power-transition theory. The same results rejected the two hypotheses that were more tenuously derived from the theory. This suggests that the main arguments of power-transition theory can be usefully applied to lower levels of conflict between a hegemon and its principal challenger. Specifically, the international satisfaction of one's rival translated into one's own dissatisfaction. This dissatisfaction then increased the likelihood of dispute initiation without necessarily producing war. In addition, the growth rate of the challenger and *not* the decline of the hegemon was very important in explaining the dispute-initiation behavior of *both* states. Thus, the logic of power-transition theory can be linked theoretically and empirically to lower levels of conflict behavior than war.

Beyond these main findings, two other results bear reiteration. First, the relative satisfaction of the hegemon vis-à-vis the challenger was shown to be important in explaining the dispute-initiation behavior of the hegemon. This finding fits *theoretically* with notions of power transition, but it contradicts the received literature. The power-transition literature collectively *assumes* that the hegemon is satisfied. I would not contest that the hegemon is more likely to be satisfied than dissatisfied and is likely to be more satisfied than all other states. Indeed, my data on international influence suggest that this is the case for the United States. But this contrasts with Kim's (1991) measure of a challenger's dissatisfaction in which the hegemon's satisfaction is implicitly fixed at one (i.e., the most satisfied that it can be). My results suggest that more emphasis should be placed on measuring the hegemon's satisfaction rather than simply assuming that it is the most satisfied.

Second, the methodology employed here presents a technique for examining contingent decision-making within a unified model. The particular estimation technique—bivariate probit—also allows the researcher to parse out whether the decisions are in fact independent and, if they are not, the general direction of contingency. In the present study, I found that the decisions were not independent but were instead negatively correlated.

The approach and findings of this chapter suggest several areas of future research. In keeping with Lemke (1995), the dispute-initiation behavior between regional rivals could be examined. Looking backward, the present analytical approach could be applied to the dispute-initiation behavior between Great Britain and the United States or Germany. Looking forward, one could also examine conflict patterns between the United

States and its most likely challenger—China. In all of these projects it would be important to consider the meaning of "dyadic dissatisfaction." Diplomatic influence makes sense as a measure of satisfaction in the superpower rivalry since their main competition was over the loyalties of the other states in the system. The same measure may not translate into dyadic dissatisfaction in other contexts. The findings clearly show, however, that measuring dyadic dissatisfaction of *both* the challenger *and* the hegemon is fundamental to understanding dispute initiation.

CHAPTER 5. HISTORICAL EVALUATION AND CONCLUSION

This dissertation began with a straightforward question: When will great powers attempt to change the international status quo? This central question could have been addressed in a number of ways. One could have examined attempted changes within multilateral settings such as international organizations or multilateral treaties. One could also have examined the determinants of expansionist behavior within a multilateral framework. Alternatively, one could have studied the demand behavior of great powers within asymmetrical bilateral relationships—i.e., when a great power makes demands upon a minor power. I attempted to answer the central question within a general framework between any two states. I then applied this framework to the specific case of the superpower rivalry. The question was thus transformed theoretically and empirically: How does one go about predicting demand (or dispute) initiation within a dyad? The flip-side of this question is this: What conditions maintain the status quo?

Theoretically, I have examined the connections between strategic timing and status-quo evaluations in a general bilateral relationship. Several insights were brought forward from this examination. First, the possibility of negotiation is central to the maintenance of the status quo. If some outcome other than negotiation were expected from demand initiation, then one or both actors would have an incentive to make a demand and disrupt the status quo. Second, once a status-quo equilibrium has been reached—meaning that negotiation is now the off-the-equilibrium-path outcome—changes in negotiation advantage become a major motivating factor for demand initiation. These shifts in negotiation advantage would have one of two effects. Such a shift could make negotiation preferred by one actor over the status quo; this actor would then push for renegotiation. A sufficiently large shift could alter the expected outcome of demand initiation from negotiation to a more adversarial outcome (such as acquiescence). In either case, the shift in negotiation advantage would make demand initiation more likely. Third, a low value of the status quo (or a downward change in the evaluation of the status quo) would have a similar effect as a shift in negotiation. Specifically, this low evaluation could make negotiation more preferable to maintaining the status quo for the actor with the low evaluation.

These theoretical insights were then tested within the context of conflict behavior between the Cold-War rivals. Using militarized disputes between the superpowers as a measure of demand initiation, I found that changes in Soviet capabilities (as a proxy for shifts in negotiation advantage) had a positive effect both on Soviet dispute initiation and on American dispute initiation. This is consistent with the mixed effect of shifts in negotiation producing more demand-initiation behavior in either actor. I also found that the rival's level of diplomatic influence (as an inverse proxy for status-quo evaluations) had a positive effect on a superpower's likelihood of dispute initiation, as hypothesized. This also underlines the competitive nature of the superpower relationship since each was more responsive to the other's influence than to their own influence.

The remainder of this chapter speaks to unanswered questions raised during the inquiry of this dissertation. One of the questions raised in Chapter 1 explicitly asked why the conflict between the Cold-War rivals did not escalate even though each made military moves against the other. Since there was no war and very little escalation, this question could not be tackled empirically. In the next section, I take up this question using the work of John Lewis Gaddis and tying that work to the theoretical and empirical findings of this dissertation. In the third section I address the question, what do the findings and theory say regarding our future understanding of international relations? This question has two main parts. On the one hand, it asks about how general the empirical results are. Thus, we are concerned as to whether the findings during the Cold War have any bearing for Russian-American relations today and whether the findings apply to other bilateral hegemonic relationships of the past or into the future. On the other hand, it asks how general the theoretical inferences are. We wonder, for example, whether the theoretical hypotheses are pertinent to international interactions outside challenges to hegemonic rule setting. The final section concludes with implications of this dissertation beyond international relations.

RE-EXAMINING THE "LONG PEACE"

Why did the conflict between the Cold-War rivals not escalate even though each made military moves against the other? In other words, how do we go about explaining the "Long Peace" between the United States and the Soviet Union? More importantly, what does this dissertation add beyond the insights of John Lewis Gaddis? Gaddis pointed to five rules that "establish[ed] limits of acceptable behavior" and produced stability (Gaddis 1987, 238-242). One of these rules was avoiding direct military confrontation. Although the superpowers never fought one another in a declared war, direct military confrontation did take place. Thus, Gaddis's rules are insufficient for explaining the lack of escalation. He does acknowledge that the superpowers seemed to have a "mechanism" for managing crises based on their "nuclear deterrent", but this mechanism is left unspecified. The theoretical arguments of this dissertation can clarify what this mechanism might have been.

First and foremost, there was "direct military confrontation" as evidenced in the dependent variables in Chapter 4. The real question—given the frequency with which this rule was violated—is what prevented escalation once confrontation began. Gaddis argues that the rivals had a mechanism for managing crises and that the "nuclear deterrent provides that mechanism." He contrasts this Cold-War mechanism with the crises leading to World War I during which "[t]here were simply no mechanisms to put a lid on escalation: to force each nation to balance the short-term temptation to exploit opportunities against the long-term danger that things might get out of hand" (1987, 231). Beyond the intuitive idea of a nuclear deterrent and its accompanying pessimism, Gaddis does not specify how this mechanism worked.

To understand this mechanism, we need to return to Proposition 2.1: With complete information, war is the unique pure-strategy NE of the demand-initiation game if and only if (1) at least one actor has $C_j > N$ while the other has $C_i > W_j$ and (2) both actors have $W > A_i$. Given the presence of nuclear weapons, any general war between the superpowers would have been devastating—in game parlance, extremely costly. With that expectation, neither actor was likely to prefer war over self-acquiescence unless the size of a demand was excessive. War was not possible without that preference. Given the ideological underpinnings of the Cold War, excessive demands were not beyond imagining. Why were demands never excessive enough to produce war?

Gaddis argues that each side "muted" their ideological interests for "a common goal of preserving international order" (1987,234). The logic on the Soviet side was twofold. First, the prospect of nuclear war made Khrushchev (and subsequent Soviet leaders) believe that "the interests of world revolution, as well as those of the Soviet state, would be better served by working within the existing international order than by trying to overthrow it" (1987, 235). Alterations in the international status quo would still be sought, but never in the blind pursuit of ideological goals. Second, the international environment of the 1960s in particular seemed to be favoring a long-term Soviet outlook. "[T]he decline of colonialism and the rise of newly independent nations likely to be suspicious of the West" would aid in "the expansion of Soviet influence in the world" (1987, 235). If we agree that "systemic interests tend[ed] to take precedence over ideological interests" (Gaddis 1987, 237), then demands would have been moderated by "systemic interests" and were never excessive enough to produce war between the rivals.[1] If ideological interests had dominated decision-making, demands of both actors would likely have been larger; this could have helped satisfy the conditions of Proposition 2.1 and contributed to World War III.

Thus, the nuclear deterrent alone was not enough to create a "mechanism" for crisis management. Cooler tempers—i.e., small demands—were also required to prevent war. Proposition 2.1 shows that a high value of the status quo was not necessary for preventing war, but the perception of having a vested interest in the system may have produced the cooler tempers that were necessary.

[1] This is not to say that ideology was silent altogether; Gaddis has subsequently hypothesized that "Marxism-Leninism during the Cold War fostered authoritarian romanticism" in which "ideology often *determined* the behavior of Marxist-Leninist regimes" (1997, 289-90 emphasis in original).

FUTURE UNDERSTANDING

I made a bold claim in the introductory chapter that "by explaining the relative peace and its periodic disturbances, we may be able to avoid absolute war." This claim must be addressed in three domains. First, what can we expect in the future of Russian-American relations? Second, what are the implications for Sino-American relations? Finally, what do the findings suggest for the maintenance of the international status quo in general?

Russian-American Relations

Given the demise of the Soviet Union and its communist government, any rivalry between Russia and the United States will be fundamentally different than the previous superpower rivalry. Indeed, an odd aspect of the Cold War's end is that Russia's diplomatic influence (i.e., the real-world measure) is higher than Soviet diplomatic influence ever was. (See Figure 5.1.) At the same time of course, Russian conventional military reach and real international influence (i.e., the abstract concept) are at their lowest points since 1945. This emphasizes that measuring the value of the status quo is probably sensitive to the issues at stake.

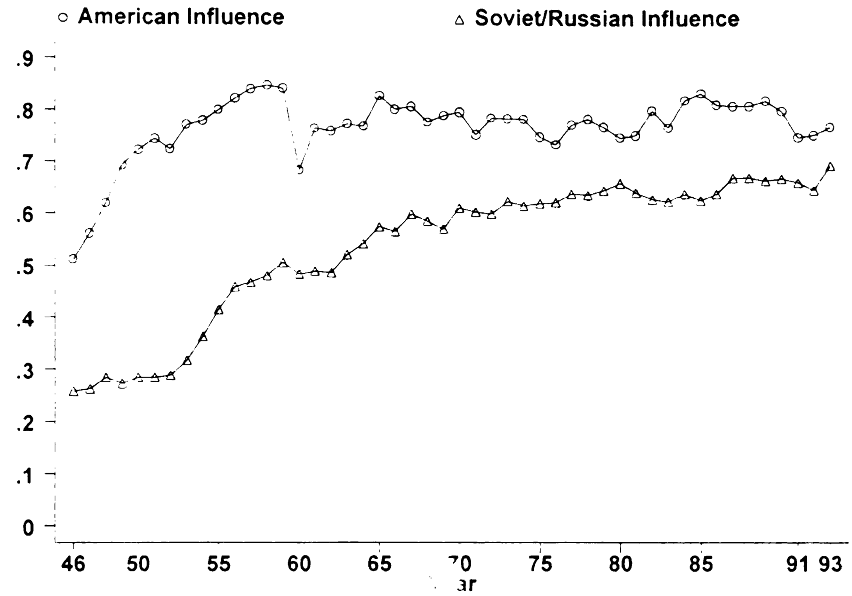

Figure 5.1. Diplomatic Influence

The empirical model tells us that the United States was more responsive to changes in Soviet capabilities than levels of Soviet influence. (Recall Figures 4.5 and 4.6.) This explains the lack of American dispute initiation after 1986—despite high degrees of Soviet influence—since Soviet capabilities were falling precipitously. (See Figure 5.2.) If diplomatic influence were to remain a valid measure of status-quo evaluations within the dyad, then a resurgence of Russian capabilities would make dispute initiation very likely (in both directions) and the rivalry would begin again. But the basis of a new rivalry may not revolve around the competition for influence that dominated the Cold War. The same is true for examining the status-quo evaluations between China and the United States.

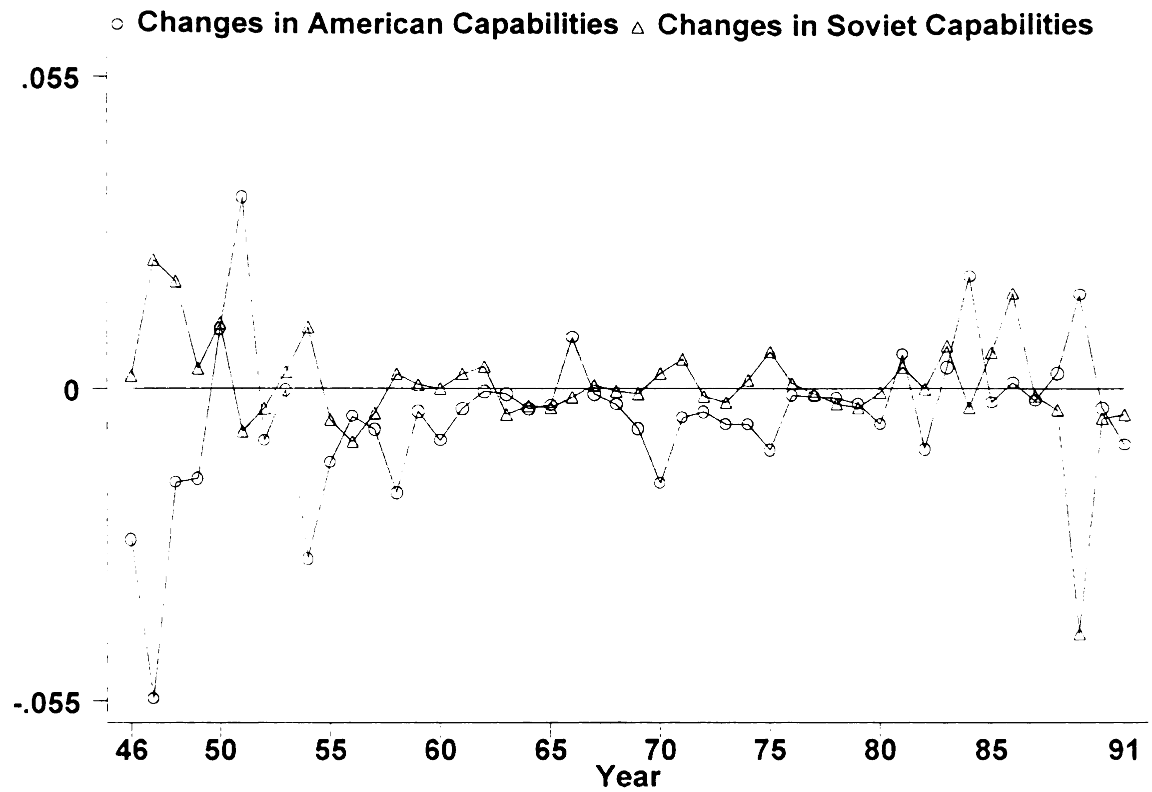

Figure 5.2. Changes in Capabilities

Sino-American Relations

Several indications suggest that relations between China and the United States could become more conflictual in the near future. General alarms raised by journalists (Bernstein and Munro 1998; Clough 1999) have perhaps fed the fears of more hawkish members of Congress. That the House of Representatives passed a resolution in February 2000 (HR 1838: The Taiwan Security Enhancement Act) that would dramatically increase American support of Taiwan against China and by an overwhelming margin (341 to 70) despite President Clinton's threatened veto provides evidence that Americans perceive a growing challenge from the People's Republic.[2] The salience of the alleged Chinese intelligence gathering at Los Alamos National Laboratory and other American nuclear weapons labs is another case in point.

The nature of the status quo between these two states is different from that between the Soviet Union and the United States. Although lingering Cold-War issues such as Taiwan and Korea are part of Sino-American relations, three elements set this hegemon-challenger relationship apart from the previous superpower rivalry. First, the Chinese have already opened its economy to a much greater extent than the Soviets ever did until Gorbachev. The Chinese do not have an open market, but the degree of openness produces different issues of concern. Such issues include human rights generally, labor rights, intellectual property rights, and other questions of fair trade. Second, Chinese aspirations appear limited to regional concerns—at least for the time being. Third, the standing of China as a "developing country" gives it an underdog quality that has helped insulate it from direct competition with the United States. These last two elements in particular mean that American diplomatic influence does not carry the same meaning for China as it did for the Soviet Union. Indeed, China's principal competitor for diplomatic influence is Taiwan. In this competition, the rival sovereigns are playing a largely zero-sum game that Taiwan is gradually losing.[3] (See Figure 5.3.)

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[2] "The measure [HR 1838] expands upon the Taiwan Relations Act, which for the last 21 years has committed the United States to the defense of Taiwan against the People's Republic of China. It directs the administration to step up arms sales to Taiwan, gives the Pentagon a seven-month window for planning joint U.S.-Taiwanese maneuvers, reserves slots for Taiwanese officers at U.S. academies and authorizes a secure hot line between Washington and Taipei." (*Washington Post*, February 13, 2000)

[3] Although this figure only plots Chinese diplomatic influence, the plot of Taiwanese diplomatic influence would show an inverse relationship.

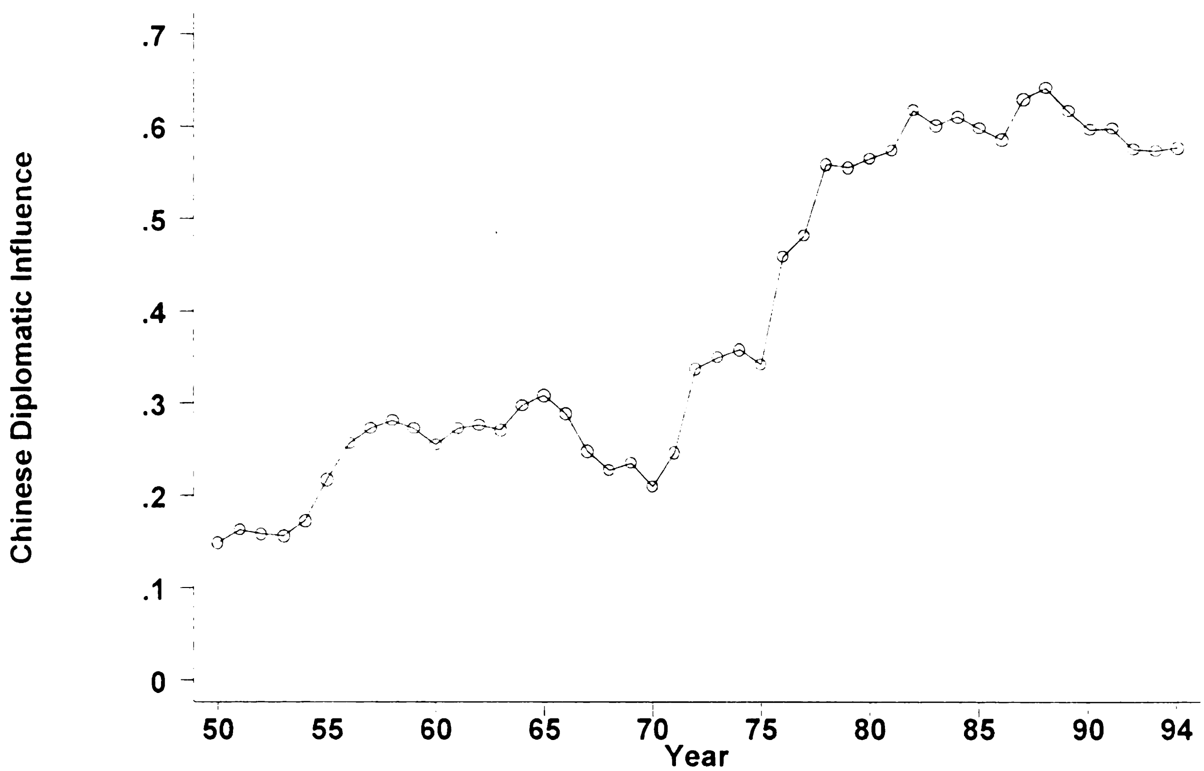

Figure 5.3. Chinese Diplomatic Influence

The issue of Taiwan is more than a Cold-War problem from the Chinese perspective. For both Beijing and Taipei, it is a matter of sovereign control. Until recently, it was a question of who was the legitimate sovereign of all of China. With the democratization of Taiwan in the 1990s, only the most hawkish Taiwanese still view the relationship with the mainland in this way. Now the question has become one of Taiwan's status in the international system. While it has been virtually independent since 1949, it is not recognized as such by the People's Republic. Since Beijing often links new trade relations with ending official diplomatic recognition with Taiwan, many countries in the world have opted for access to the mainland's market. Through this war of attrition, Taiwan is becoming more and more isolated in world affairs.

The United States, too, has opted for more open trade relations with China but maintains a unique relationship with Taiwan as its principal protector. Thus, the status of

Taiwan is the central component of the status quo between China and the United States. Unlike the diffuse status quo for international influence that characterized the superpower rivalry, the centrality of Taiwan makes the Sino-American relationship more tense. When conflict erupted among third-parties during the Cold War, the superpowers could sit on the sidelines knowing that this was merely one conflict among many. Similarly, third-parties could change loyalties without causing an outbreak of superpower war. Such changes were certainly setbacks for one side; with competition spread over the entire globe, individual setbacks could be tolerated. The situation between China and the United States is at once simpler and more delicate. It is simpler because the status of only one country dominates the status quo. It is more delicate for the same reason.

PROSPECTS FOR MAINTAINING THE CONTEMPORARY STATUS QUO

As noted in Chapter 1, there are different types of status quo. I have focused on bilateral relations; so, the status-quo evaluations of interest have been dyadic. The United States has had a considerable impact in producing the contemporary international status quo and has a considerable stake in its maintenance as a result. This status quo is multilateral and multidimensional in nature encompassing issues such as trade, human rights, weapons of mass destruction, and security issues in different regions. Modeling this multilateral problem is one direction for future research; even so, some insight can be gained from generalizing the findings of this dissertation to the current global status quo.

The contemporary status quo—dominated by a liberal trading regime—is largely the product of American success in the Cold War. The trading regime established by the United States for the "Free World" in the early years after World War II has since spread to the rest of the world. While economic benefits abound, detractors point to an uneven distribution of wealth produced, they argue, by the very same trading regime. Other detractors recognize the economic advantages of the current status quo but argue that the gains from trade are insufficient to offset the cultural costs of lost identity as local economies become more and more "Westernized." In addition, two elements of the contemporary status quo—namely the Security Council and the Non-Proliferation Treaty (NPT)—were established during the Cold War and reflect the past rather than the present.

In creating the post-World War order, President Roosevelt consciously incorporated "considerations of power" that he hoped would produce greater stability than the order established at Versailles (Gaddis 1987, 23-4). By granting special status to Soviet Russia within the new United Nations, the Soviets had a clear stake in participating within the system. Similarly, by allowing the transfer of China's Security-Council seat from the Republic of China to the People's Republic, the United States rationalized the power-sharing structure under the same principle. Within the economic sphere, the "Group of 7/8" has also changed in composition to reflect altered relationships. As often happens in systems of political order, however, interests become entrenched over time. With entrenched interests, the status quo becomes more difficult to move through negotiation and dissatisfaction more stark.

If a multilateral model bears any semblance to the model set forth in Chapter 2, then the shifting capabilities of states—coupled with dissatisfaction—will be a significant determinant in their active pursuit of change. India has been at the vanguard of the disaffected since its statehood in 1948. Its leadership of the Non-Aligned Movement is one case in point. Its nuclear tests in 1998 are yet another demonstration of both increased power and determined opposition to the established order.

The counter-examples of Germany and Japan are quite telling in themselves. Despite their rapid climb from defeated countries to economic powerhouses, neither country seems interested in altering the existing system in any momentous way. This inaction can be largely attributed to their relative satisfaction with the current order. The transformation in attitude of these two previous enemies is a monument to American strategic planning. I think it is critical to American interests and global stability that another such monument be erected with respect to India, Russia, China, and other powerful dissatisfied actors in the international arena. The task will, of course, be more difficult than dictating the future of an occupied state, but the benefits are beyond imagining.

CONCLUSION

The findings in this dissertation have implications beyond dispute initiation and beyond international relations. All of these implications revolve around our understanding of the status quo and its relation to strategic timing. I wish to note five implications dealing with (1) our understanding of war, (2) the importance of endogenous initiation, (3) short- versus long-term frameworks of strategic timing, (4) econometric modeling of strategic timing, and (5) recommendations for policy makers.

The first implication beyond dispute initiation, but still within the realm of international relations, deals with our understanding of war. I found that the conditions for war (in Proposition 2.1) are more general under endogenous initiation than under a prearranged sequence of action (in Bueno de Mesquita and Lalman's Proposition 3.1). In particular, the Domestic War Proposition of *War and Reason* has been subsumed within my Rational War Proposition. This does not necessarily mean that war is more likely under the revised framework.[4] It does mean, however, that the original model bypassed certain insights concerning the conditions for war (and other outcomes) due to a modeling assumption. This brings us to the second implication, one that extends beyond international relations.

Every model has its assumptions and care must be taken that a model's assumptions are valuable in some way to the production of knowledge and advances in understanding. The assumption of a fixed sequence of action has been an easy one make. It clearly simplifies equilibrium analysis, and the potential effects of initiator advantage can be discussed within the confines of such a model. As I have shown in this dissertation, however, the basic results of a model with an imposed sequence may be different from those of a model with endogenous initiation. Models having endogenous initiation are likely to tell us more than models with a prearranged sequence. As the appendices testify, endogenizing initiation has its own costs in terms of model complexity. Greater attention needs to be paid to weighing the potential benefits of endogenous initiation with its known costs.

The third implication beyond international relations is that shorter-term frameworks may be both acceptable and appropriate for modeling strategic timing. Bueno de Mesquita and Lalman made a "medium-term" assumption for their model such that the actors were "looking down the paths of a single confrontation" (1992, 37). The continuous-time game presented in Chapter 2 of this dissertation was an attempt to model a longer-term relationship. Even with this longer time horizon, the results of the

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[4] The Domestic War Proposition does not say anything with regard to *A*'s preference between C_b and *N* or *B*'s preference between C_b and W_a. Thus, it is possible for *A* to have $C_b > N$ while *B* has $W_a > C_b$. Under the original international interaction game, W_a is still the SPE. Under the Demand-Initiation Game, war is not in equilibrium.

continuous-time game suggest that collapsing basic timing decisions to the immediate time period is fundamentally sound. This provides logical grounds for accepting a "medium-term" approach to modeling strategic timing in any setting. Such logical grounds provide a foundation what is otherwise an unfounded—if reasonable—assumption.

The previous implication also provides a basis for modeling strategic timing decisions empirically. It suggests that little is lost by examining factors present at the moment of the decision while ignoring factors present in earlier periods or perceptions of future factors. This realization—combined with the need for a model that allowed interdependence—led me to bivariate probit as an appropriate empirical model of simultaneous dyadic decisions. This type of model would be equally appropriate to such decisions beyond international relations. Additionally, as multivariate probit becomes more easily estimable multilateral strategic decisions may be modeled empirically through this model.

Finally, there are some general policy recommendations that are relevant given status-quo evaluations and strategic timing. Although the purpose of this dissertation was to "predict disruptions in normal relations," predictions of disruptions made in real-time could be used to negotiate more effectively in many different settings. Such predictions made of an opponent could be used to make concessions at the last possible moment; thus, maximizing the benefits of the previous status quo and preventing an actual disruption in relations. Such predictions could also be used to stand firm against concessions if the opponent's bluff can be accurately called.

In the long-run, however, concessions are probably inevitable. Success at maintaining a stable relationship requires a keen and clear-eyed awareness of status-quo evaluations and of shifting negotiating power. The disaffected cannot be put off forever; nor can they be pacified with the occasional thrown bone or kept in place by force. A study of strategic timing in different settings may tells us when to expect disruptions, but it can also be a tool in preventing them. Awareness of the problems of strategic timing may be the very remedy to ushering in change without costly disruptions in order that are usually associated with social change. After all, there is nothing permanent except change.

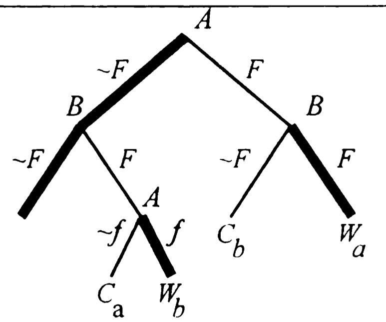
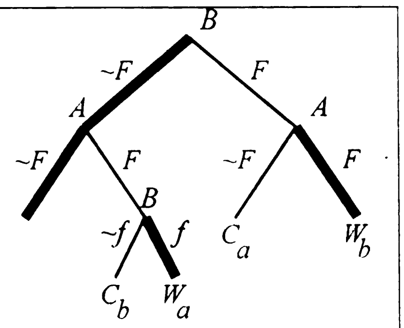
APPENDICES

APPENDIX A.

COMPARATIVE SPE ANALYSIS OF CRISIS SUBGAMES

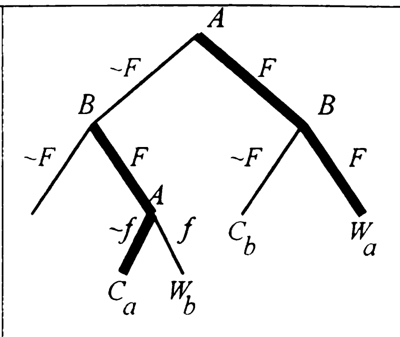
This appendix presents the equilibrium analysis of the crisis subgame (1) using the case conditions from the equilibrium analysis of the conflict-initiation subgame and (2) altering who goes first. The analysis under case 1.x (in which both actors are retaliators) and cases 2.x (in which *A* is pacific and *B* is retaliatory) proceed case by case. The analysis under cases 3.x (in which both actors are pacific) use a simplification—discussed below—to examine groups of related cases. For each case (or group of cases) examined, I present the case number, the conditions that produce SPE in the crisis subgame, and the SPE when *A* (and then *B*) moves first.

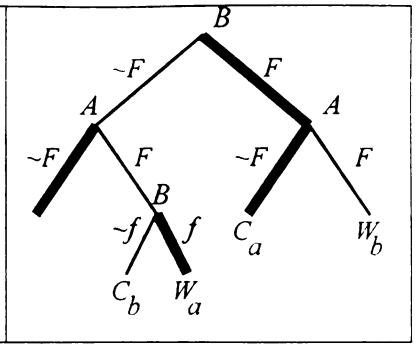
To facilitate the equilibrium analysis, I have included a graphic representation of backwards induction for each case and for each initiator. The bold branches of the game tree represent subgame-perfect decisions. As usual, the unbroken bold path from the top of the tree to an outcome represents the subgame-perfect equilibrium path. If any additional conditions were required to separate SPE, I note what the additional conditions are and why they are required. The analysis is summarized in Table 2.2 in chapter 2.

Case 1.0.0 <u>Conditions</u>: *A*: $W_b > C_a$ *B*: $W_a > C_b$ <u>SPE</u>: *A* moves first: *N* *B* moves first: *N*		

Case 2.11.0

Conditions:
A: $W > C_a > W_b$
B: $W_a > C_b$, $C_a > N$
SPE:
A moves first: W_a
B moves first: C_a

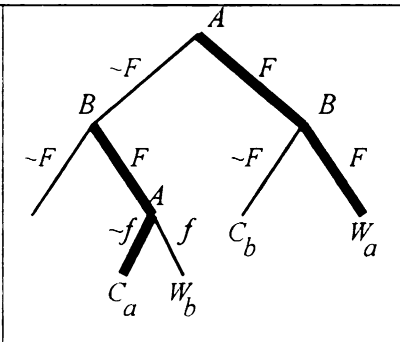


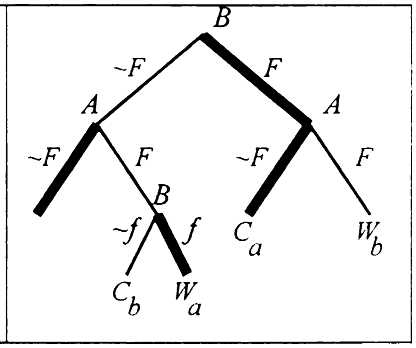


In case 2.12, the conditons that were sufficient to separate equilibria in the conflict-initiation subgame are *not* sufficient to separate the equilibria in the crisis subgame. When A moves first, the conditions of case 2.12 do not tell us whether A prefers W_a or C_a. Thus, if A has $W_a > C_a$ (case 2.12.1), then W_a is the SPE. Similarly, if A has $C_a > W_a$ (case 2.12.2), then C_a is the SPE.

Case 2.12.1

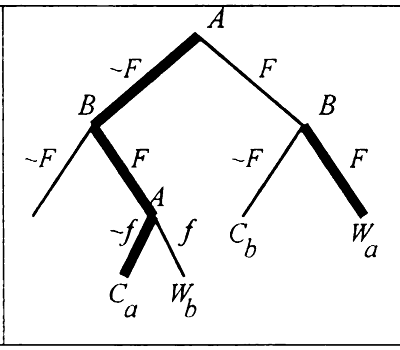
Conditions:
A: $W_a > C_a > W > W_b$
B: $W_a > C_b$, $C_a > N$
SPE:
A moves first: W_a
B moves first: C_a

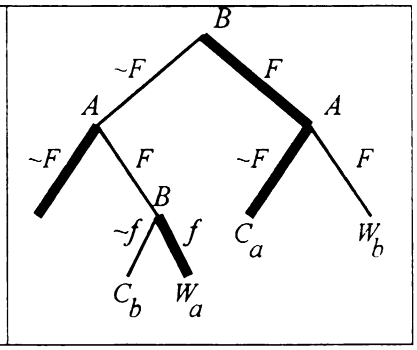




Case 2.12.2

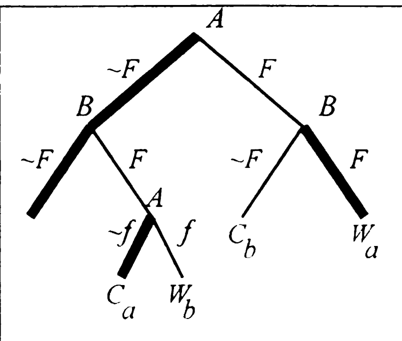
Conditions:
A: $C_a > W_a > W > W_b$
B: $W_a > C_b$, $C_a > N$
SPE:
A moves first: C_a
B moves first: C_a

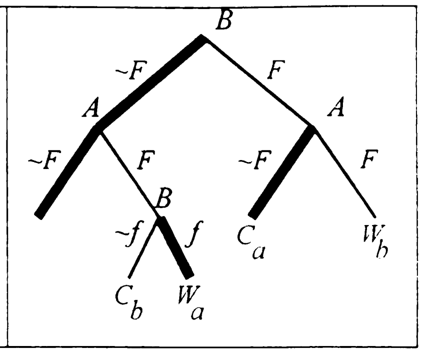




Case 2.21.0

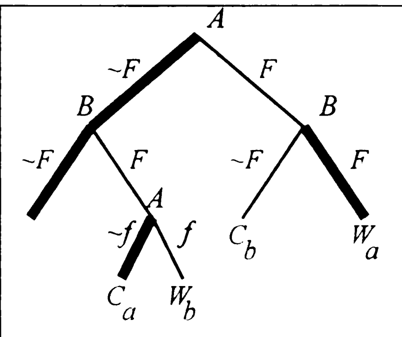
Conditions:
A: $W > C_a > W_b$
B: $W_a > C_b$, $N > C_a$
SPE:
A moves first: N
B moves first: N

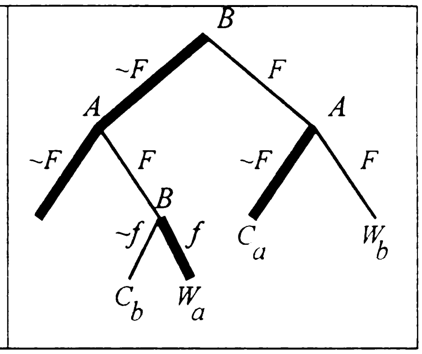




Case 2.22.0

Conditions:
A: $C_a > W > W_b$
B: $W_a > C_b$, $N > C_a$
SPE:
A moves first: N
B moves first: N

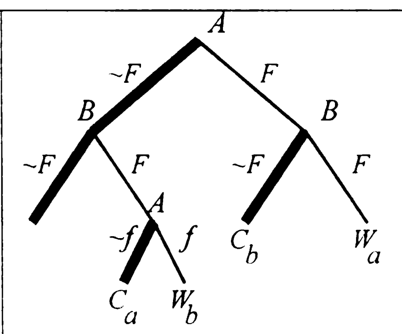


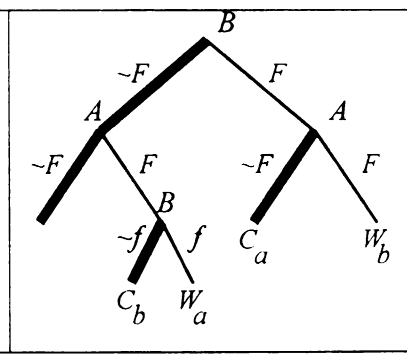


When both actors are pacific (cases 3.x), it is the degree of dovishness that determines the SPE in the crisis subgame. In cases 3.1x, for example, both actors are doves—meaning that neither will force the other to capitulate even though each would capitulate if attacked. Regardless of the other conditions that were necessary to separate equilibria in the conflict-initiation subgame, these two conditions are sufficient to produce negotiation as the SPE of the crisis subgame.

Cases 3.1x.0

Conditions:
A: $C_a > W_b$, $N > C_b$
B: $C_b > W_a$, $N > C_a$
SPE:
A moves first: N
B moves first: N

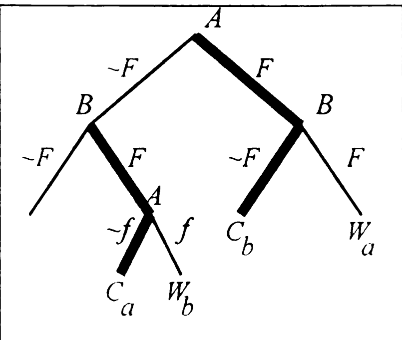


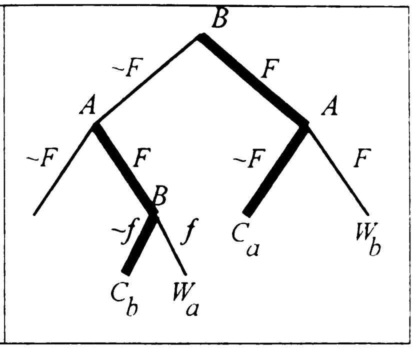


In cases 3.2x, both pacific actors are also hawks—meaning that each would like to force the other to capitulate. Each of these cases also exhibit the condition that both actors prefer $C_j > C_i$. Thus, initiation within the crisis subgame by actor i results in capitulation of actor j as the SPE.

Cases 3.2x.0

Conditions:
A: $C_b > N > C_a > W_b$
B: $C_a > N > C_b > W_a$
SPE:
A moves first: C_b
B moves first: C_a

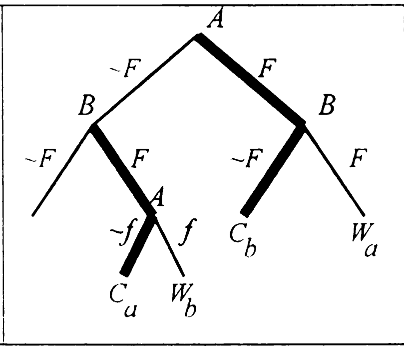


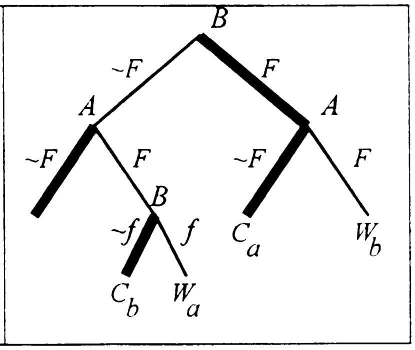


In cases 3.3x, A is a pacific dove while B is a pacific hawk. In this circumstance, when A moves first, B will force A to capitulate if A chooses not to use force at the first available opportunity. Within the crisis subgame, however, the conditions that have been laid down for some cases 3.3x are insufficient to determine actor A's preferences between C_i and C_j.[1] Although this seems an odd preference condition to examine, there is nothing in the international interaction game that restricts actors' preferences to have $C_j > C_i$. Within the assumptions of Bueno de Mesquita and Lalman (1992), if an actor has a particularly high adjusted domestic political cost for using force, then the reverse preference is quite reasonable. In cases 3.3x.1, A has $C_b > C_a$; in cases 3.3x.2, A has $C_a > C_b$.

Cases 3.3x.1

Conditions:
A: $N > C_b > C_a > W_b$
B: $C_b > W_a$, $C_a > N$
SPE:
A moves first: C_b
B moves first: C_a

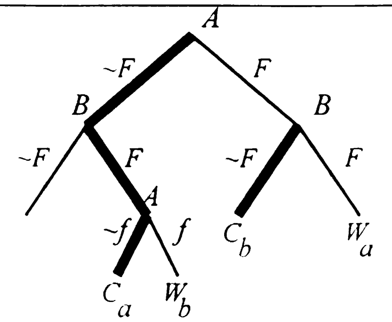


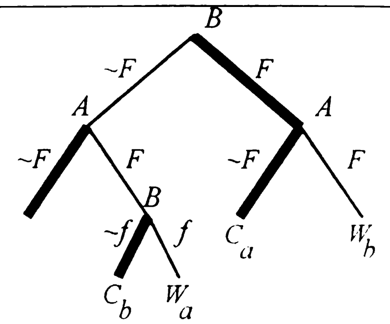


[1] In cases 3.31.1 and 3.323.1, A already has $C_b > C_a$.

Cases 3.3x.2

Conditions:
A: $C_a > W_b$, $N > C_b$, $C_a > C_b$
B: $C_b > W_a$, $C_a > N$
SPE:
A moves first: C_a
B moves first: C_a





APPENDIX B.

EQUILIBRIUM ANALYSIS OF THE DEMAND-INITIATION GAME

SOLVING THE DEMAND-INITIATION GAME

The demand-initiation game (see Figure 2.4) is solved in a manner similar to that of the conflict-initiation subgame. In the demand-initiation game, only one outcome is known without subsequent equilibrium analysis—namely the status quo. Three subgames require equilibrium analysis before solving the demand-initiation game. In two of these subgames, one actor clearly initiated interaction. Label these as SG_i for "the subgame initiated by actor i" where $i = \{A, B\}$ for actors A and B respectively. Each of these are subgames of complete and perfect information; hence, we will use backward induction to find the (SPE). SG_A and SG_B are *not* synonymous with the crisis subgames solved in Appendix A, but the SPE of those subgames (labeled CSG_A and CSG_B respectively in Figure B.1) will be use in the analysis of the demand-initiation subgames. In the third subgame—simply labeled SG, the actors made simultaneous demands. This subgame is the conflict-initiation subgame analyzed in Chapter 2. When all of the subgames have been solved, we can then solve the initiation problem as a simple two-by-two game matrix. Figure B.1 presents a truncated version of Figure 2.4 and demonstrates the subgame-perfection problem.

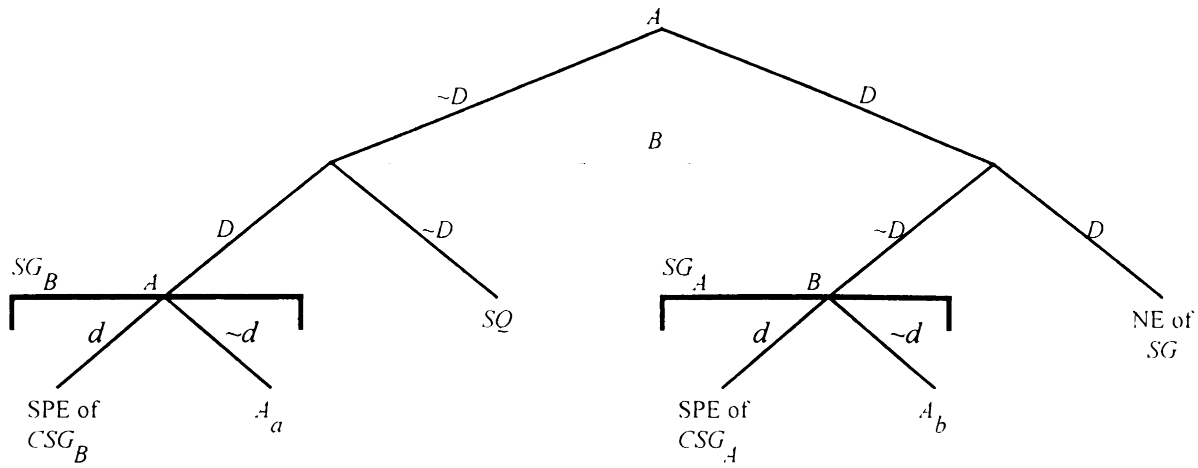


Figure B.1. Truncated Demand-Initiation Game

After solving for SG_A and SG_B, a series of two-by-two game matrices will result that are further truncations of the demand-initiation game. The NE of these game matrices are also the equilibria of the demand-initiation game. As in the analysis in Chapter 2, I apply the case conditions from the conflict-initiation subgame to the analysis of the full model.

SUBGAME EQUILIBRIA

For cases 1.0.0, 2.21.0, 2.22.0, and 3.1x.0, negotiation is the end result of both crisis subgames. Since negotiation is strictly preferred to self-acquiescence, negotiation will result after sequential demand initiation.

For case 2.11.0, if *A* makes the initial demand, W_a will result if *B* makes a counter-demand. It is not clear whether *B* prefers W_a or A_b; so, either is possible as a SPE. If *B* makes the initial demand, C_a will result. *A* always prefers self-acquiescence to capitulation; so A_a is the SPE in SG_B for this case. The logic for case 2.12.1 is the same as that for case 2.11.0.

When A makes the initial demand in Case 2.12.2, C_a is the SPE of the crisis subgame if B makes a counter-demand. Since B has $C_a > N$ and negotiation is strictly preferred self-acquiescence, C_a is the SPE of SG_A as well..

For cases 3.2x.0 and 3.3x.1, a crisis subgame initiated by actor i results in the capitulation of actor j. Faced with self-capitulation or self-acquiescence in SG_i, actor j will choose self-acquiescence. For cases 3.3x.2, both crisis subgames result in A's capitulation. As in case 2.12.2, B has $C_a > N > A_b$; so, C_a is the SPE of SG_A. When B makes the initial demand, A prefers self-acquiescence over self-capitulation.

Table B.1 summarizes the cases and preference conditions from Appendix A and the NE of the conflict-initiation subgame (i.e., the NE of SG). The table also provides the SPE of SG_A and SG_B.

DEMAND-INITIATION MATRICES

Given the equilibria of the different subgames, the demand-initiation game can be summarized in a two-by-two game matrix. (See matrix B.1 below.) As in Figure B.1, when A makes an initial demand without a simultaneous demand from B, the expected result is the SPE of SG_A. When B makes an initial demand without a simultaneous demand from B, the expected results is the SPE of SG_B. When both actors make simultaneous demands, the NE of the conflict-initiation subgame is the expectation. Finally, when neither actor makes a demand, the status quo continues. The cases listed in Table B.1 produce different game matrices following this summary format. In the analysis below, I discuss what cases generate each matrix (including any new preference conditions), show the matrix, and then solve the game (again adding any new preference conditions that produce unique cases).

Table B.1. Subgame Equilibria

Case	Conditions for A	Conditions for B	NE of SG	SPE of SG_A	SPE of SG_B
1.0.0	$W_b > C_a$	$W_a > C_b$	N, W	N	N
2.11.0	$W > C_a > W_b$	$C_a > N > W_a > C_b$	W	W_a, A_b	A_a
2.12.1	$W_a > C_a > W > W_b$	$C_a > N > W_a > C_b$	C_a	W_a, A_b	A_a
2.12.2	$C_a > W_a > W > W_b$	$C_a > N > W_a > C_b$	C_a	C_a	A_a
2.21.0	$W > C_a > W_b$	$N > C_a > W_a > C_b$	N, W	N	N
2.22.0	$C_a > W > W_b$	$N > C_a > W_a > C_b$	N	N	N
3.11.0	$N > C_b > W > C_a > W_b$	$N > C_a > W > C_b > W_a$	N, W	N	N
3.121.0	$N > C_b > C_a > W > W_b$	$N > C_a > C_b > W > W_a$	N	N	N
3.122.0	$N > C_b > C_a > W > W_b$	$N > C_a > W > C_b > W_a$	N	N	N
3.21.0	$C_b > N > W > C_a > W_b$	$C_a > N > W > C_b > W_a$	W	A_b	A_a
3.221.0	$C_b > N > C_a > W > W_b$	$C_a > N > C_b > W > W_a$	C_a, C_b	A_b	A_a
3.222.0	$C_b > N > C_a > W > W_b$	$C_a > N > W > C_b > W_a$	C_a	A_b	A_a
3.31.1	$N > C_b > W > C_a > W_b$	$C_a > N > W > C_b > W_a$	W	A_b	A_a
3.321.1	$N > C_b > C_a > W > W_b$	$C_a > N > C_b > W > W_a$	C_a	A_b	A_a
3.322.1	$N > C_b > C_a > W > W_b$	$C_a > N > W > C_b > W_a$	C_a	A_b	A_a
3.323.1	$N > C_b > W > C_a > W_b$	$C_a > N > C_b > W > W_a$	mixed	A_b	A_a
3.321.2	$N > C_a > C_b > W > W_b$	$C_a > N > C_b > W > W_a$	C_a	C_a	A_a
3.322.2	$N > C_a > C_b > W > W_b$	$C_a > N > W > C_b > W_a$	C_a	C_a	A_a

		B	
		~D	D
A	~D	*SQ*	SPE of SG_B
	D	SPE of SG_A	NE of *SG*

Matrix B.1. Solving the Demand-Initiation Game

For case 1.0.0, no additional preference conditions are required to generate a unique demand-initiation game matrix. Cases 2.21.0 and 3.11.0 produce demand-initiation matrices that look identical to matrix B.2 except that the expected value of simultaneous demands is different. I will consider each case in turn.

		B	
		~D	D
A	~D	*SQ*	*N*
	D	*N*	mix

Matrix B.2. Cases 1.0.0.0, 2.21.0.0, and 3.11.0.0

In all of the cases that produce matrix B.2, there are two NE of the conflict-initiation subgame—namely negotiation and war. In case 1.0.0.0, the actors are mixing over $\{N, W_a, W_b, W\}$; hence, the expected utility of mixing is strictly less than negotiation and (*D*, *D*) is not a NE. Three subcases remain. If both actors prefer *SQ* over *N* (case 1.0.0.0.1), then SQ is the NE. If both actors prefer *N* over *SQ* (case 1.0.0.0.2), then both negotiated outcomes are NE. Finally, if one actor has $SQ > N$ while the other has $N > SQ$ (case 1.0.0.0.3), then the actor preferring negotiation will make an initial demand—resulting in negotiation—while the other actor will not. In case 2.21.0.0, the actors are mixing over $\{N, C_a, W_a, W\}$. Since negotiation is strictly preferred to self-capitulation, *A*'s expected utility of mixing is strictly less than negotiation. In this case, *B* is a dove; so, *B*'s expected utility of mixing is also strictly less than negotiation. Having established these preferences, the subcases of 1.0.0.0.x apply equally to subcases 2.21.0.0.x. In case 3.11.0.0, the actors are mixing over $\{N, C_a, C_b, W\}$ and both actors are doves. Once again, the expected utility of mixing is strictly less than negotiation and the resulting subcases of 1.0.0.0.x apply equally to subcases 3.11.0.0.x.

For case 2.11.0, there are two possible SPE of SG_A—namely W_a and A_b—depending on B's preference over these outcomes. When B prefers W_a over A_b (case 2.11.0.1), matrix B.3 results. When B prefers A_b over W_a (case 2.11.0.2), matrix B.4 results. Cases 3.21.0.0 and 3.31.1.0 also produce matrix B.4. I will consider each case in turn.

		B: ~*D*	*B*: *D*
A	~*D*	SQ	A_a
	D	W_a	W

Matrix B.3. Case 2.11.0.1

In case 2.11.0.1, we know that B has a dominant strategy to make a demand since $A_j > SQ$ and $W > W_j$. Although A has $W > C_a$ and $A_a > C_a$, we do not know whether A prefers W or A_a. Hence, either is possible as a NE. If A has $W > A_a$ (case 2.11.0.1.4),[1] then W is the NE. If A has $A_a > W$ (case 2.11.0.1.5), then A_a is the NE.

		B: ~*D*	*B*: *D*
A	~*D*	SQ	A_a
	D	A_b	W

Matrix B.4. Cases 2.11.0.2, 3.21.0.0, and 3.31.1.0

In matrix B.4, both actors prefer A_j to SQ. As in case 2.11.0.1, the actors' preferences over A_i and W determine the NE. If both actors have $W > A_i$ (cases x.x.x.x.41),[2] W is the NE. If both actors have $A_i > W$ (cases x.x.x.x.52), then A_a and A_b

[1] In order to keep the subcases distinct for the demand-initiation game, I am following a slightly different format for this set of assumptions. For example, case x.x.x.x.1 has the preference condition that both players prefer SQ over N.
[2] The Xs in the cases numbers in this paragraph refer to the cases that generate matrix B.4.

are both equilibria. If A has $W > A_a$ while B has $A_b > W$ (cases x.x.x.x.42), then acquiescence by B is the unique NE. Finally, if A has $A_a > W$ whlie B has $W > A_b$ (cases x.x.x.x.51), then acquiescence by A is the NE.

Case 2.12.1 is similar to case 2.11.0 with respect to producing matrices. When B prefers W_a over A_b (case 2.12.1.1), matrix B.5 results. When B prefers A_b over W_a (case 2.12.1.2), matrix B.6 results. Cases 3.222.0.0, 3.321.1.0, and 3.322.1.0 also produce matrix B.6. I consider each in turn.

		B: ~D	B: D
A	~D	SQ	A_a
	D	W_a	C_a

Matrix B.5. Case 2.12.1.1

In case 2.12.1.1, B prefers $A_a > SQ$ and $C_a > W_a$ by the basic preference restrictions of the international interaction game. Similarly, A prefers self-acquiescence to self-capitulation. B has a dominant strategy to make a demand and A prefers to acquiesce; thus, A_a is the unique NE without any additional preference conditions (case 2.12.1.1.0).

		B: ~D	B: D
A	~D	SQ	A_a
	D	A_b	C_a

Matrix B.6. Cases 2.12.1.2, 3.222.0.0, 3.321.1.0, and 3.322.1.0

In matrix B.6, both actors prefer A_j over SQ. In addition, A prefers A_a over C_a. Thus, A_a is a NE for all of the relevant cases. There is no general preference restriction that informs us regarding B's preference between A_b and C_a. In all of the relevant cases, however, B prefers C_a over N. Since negotiation is strictly preferred to self-acquiescence, it is necessarily the case that B has $C_a > N > A_b$. Thus, A_a is the only NE for these cases.

Case 2.12.2 produces matrix B.7. Cases 3.321.2.0 and 3.322.2.0 also produce matrix B.7.

		B ~D	*D*
A	~D	*SQ*	A_a
	D	C_a	C_a

Matrix B.7. Cases 2.12.2.0, 3.321.2.0, and 3.322.2.0

In matrix B.7, *B* has a weakly dominant strategy to make an initial demand. *A* has a strictly dominant strategy *not* to make a demand since $SQ > C_i$ and $A_i > C_i$. Thus, A_a is the unique NE in all of these cases.

Cases 2.22.0.0, 3.121.0.0, and 3.122.0.0 all produce the same demand-initiation matrix (matrix B.8). In all three cases, any demand leads to negotiation. Although the underlying preferences that generated this matrix are different, the analysis of matrix B.8 is the same across all three cases.

		B ~D	*D*
A	~D	*SQ*	*N*
	D	*N*	*N*

Matrix B.8. Cases 2.22.0.0, 3.121.0.0, and 3.122.0.0

In matrix B.8, the negotiation produced my simultaneous demands is in the peculiar position of always being a NE. If both actors have $SQ > N$ (cases x.x.x.x.1), then *SQ* is also a NE and is Pareto superior to (*D*, *D*). If both actors have $N > SQ$ (cases x.x.x.x.2), then all three negotiated outcomes are NE. Finally, if one actor has $SQ > N$ while the other has $N > SQ$ (cases x.x.x.x.3), then the actor preferring negotiation has a weakly dominant strategy to make an initial demand and the negotiated outcomes within that column (or row) are both NE.

Cases 3.221.0.0 and 3.323.1.0 produce matrix B.9. In both cases, the actors are mixing over $\{N, C_a, C_b, W\}$ from the conflict-initiation subgame.

		B	
		~D	*D*
A	*~D*	*SQ*	A_a
	D	A_b	mix

Matrix B.9. Cases 3.221.0.0 and 3.323.1.0

In matrix B.9, both actors prefer A_j over *SQ*. Unlike the cases for matrix B.2 in which negotiating for sure was better than the expected utility of playing the conflict-initiation subgame, self-acquiescence is *not* preferred over the expected utility of the mixing. For case 3.221.0.0, both actors have the following preference ordering: $C_j > N > A_i > C_i > W$. For case 3.323.1.0, *A* has $N > C_b > W > C_a$ and *B* has $C_a > N > A_b > C_b > W$. For *A*, it is not clear whether it prefers A_a over *W* or the reverse; so, there are two possible preference orders. In each, A_a is greater than C_a. Define σ_i as actor *i*'s mixed-strategy probability of choosing *F* in the conflict-initiation subgame. Since A_i is in the middle of the rankings of the conflict-initiation-subgame outcomes, it is possible for an actor either to prefer the expected utility of the mixing—$EU_i(\sigma_i, \sigma_j)$—over self-acquiescence or self-acquiescence over the expected utility of the mixing. Thus, three subcases must be considered. If both actors have $EU_i(\sigma_i, \sigma_j) > A_i$ (cases x.x.x.x.6), then (*D*, *D*) is the demand-initiation NE. If both actors have $A_i > EU_i(\sigma_i, \sigma_j)$ (cases x.x.x.x.7), then A_a and A_b are both NE of the demand-initiation game. If *A* has $EU_A(\sigma_A, \sigma_B) > A_a$ while *B* has $A_b > EU_B(\sigma_B, \sigma_A)$ (cases x.x.x.x.8), then A_b is the NE. Finally, in the reverse of the previous assumption (cases x.x.x.x.9), A_a is the NE. This exhausts the set of cases. Table B.2 summarizes the conditions and cases associated with the NE of the demand-initiation game.

Table B.2. Demand-Initiation Equilibria

Case	Conditions for A	Conditions for B	NE
1.0.0.0.1	$SQ > N > W_b > C_a$	$SQ > N > W_a > C_b$	SQ
1.0.0.0.2	$N > SQ, W_b > C_a$	$N > SQ, W_a > C_b$	N
1.0.0.0.3*	$SQ > N > W_b > C_a$	$N > SQ, W_a > C_b$	N
2.11.0.1.4	$W > A_a > C_a > W_b$	$C_a > N > W_a > A_b > C_b$	W
2.11.0.1.5	$A_a > W > C_a > W_b$	$C_a > N > W_a > A_b > C_b$	A_a
2.11.0.2.41	$W > A_a > C_a > W_b$	$C_a > N > W > A_b > W_a > C_b$	W
2.11.0.2.52	$A_a > W > C_a > W_b$	$C_a > N > A_b > W > W_a > C_b$	A_a, A_b
2.11.0.2.42	$W > A_a > C_a > W_b$	$C_a > N > A_b > W > W_a > C_b$	A_b
2.11.0.2.51	$A_a > W > C_a > W_b$	$C_a > N > W > A_b > W_a > C_b$	A_a
2.12.1.1.0	$W_a > C_a > W > W_b$	$C_a > N > W_a > A_b > C_b$	A_a
2.12.1.2.0	$W_a > C_a > W > W_b$	$C_a > N > A_b > W_a > C_b$	A_a
2.12.2.0.0	$C_a > W_a > W > W_b$	$C_a > N > W_a > C_b$	A_a
2.21.0.0.1	$SQ > N > W > C_a > W_b$	$N > C_a > W_a > C_b$	SQ
2.21.0.0.2	$N > SQ, W > C_a > W_b$	$N > SQ, N > C_a > W_a > C_b$	N
2.21.0.0.3*	$SQ > N > W > C_a > W_b$	$N > SQ, N > C_a > W_a > C_b$	N
2.22.0.0.1	$SQ > N > C_a > W > W_b$	$SQ > N > C_a > W_a > C_b$	SQ
2.22.0.0.2	$N > SQ, C_a > W > W_b$	$N > SQ, N > C_a > W_a > C_b$	N
2.22.0.0.3*	$SQ > N > C_a > W > W_b$	$N > SQ, N > C_a > W_a > C_b$	N
3.11.0.0.1	$SQ > N > C_b > W > C_a > W_b$	$SQ > N > C_a > W > C_b > W_a$	SQ
3.11.0.0.2	$N > SQ, N > C_b > W > C_a > W_b$	$N > SQ, N > C_a > W > C_b > W_a$	N
3.11.0.0.3*	$SQ > N > C_b > W > C_a > W_b$	$N > SQ, N > C_a > W > C_b > W_a$	N
3.121.0.0.1	$SQ > N > C_b > C_a > W > W_b$	$SQ > N > C_a > C_b > W > W_a$	SQ
3.121.0.0.2	$N > SQ, N > C_b > C_a > W > W_b$	$N > SQ, N > C_a > C_b > W > W_a$	N
3.121.0.0.3*	$SQ > N > C_b > C_a > W > W_b$	$N > SQ, N > C_a > C_b > W > W_a$	N
3.122.0.0.1	$SQ > N > C_b > C_a > W > W_b$	$SQ > N > C_a > W > C_b > W_a$	SQ
3.122.0.0.2	$N > SQ, N > C_b > C_a > W > W_b$	$N > SQ, N > C_a > W > C_b > W_a$	N
3.122.0.0.3*	$SQ > N > C_b > C_a > W > W_b$	$N > SQ, N > C_a > W > C_b > W_a$	N
3.21.0.0.41	$C_b > N > W > A_a > C_a > W_b$	$C_a > N > W > A_b > C_b > W_a$	W
3.21.0.0.52	$C_b > N > A_a > W > C_a > W_b$	$C_a > N > A_b > W > C_b > W_a$	A_a, A_b
3.21.0.0.42	$C_b > N > W > A_a > C_a > W_b$	$C_a > N > A_b > W > C_b > W_a$	A_b
3.21.0.0.51	$C_b > N > A_a > W > C_a > W_b$	$C_a > N > W > A_b > C_b > W_a$	A_a
3.221.0.0.6	$C_b > N > A_a > C_a > W > W_b$, $EU_A(\sigma_A, \sigma_B) > A_a$	$C_a > N > A_b > C_b > W > W_a$, $EU_B(\sigma_B, \sigma_A) > A_b$	(D, D)
3.221.0.0.7	$C_b > N > A_a > C_a > W > W_b$, $A_a > EU_A(\sigma_A, \sigma_B)$	$C_a > N > A_b > C_b > W > W_a$, $A_b > EU_B(\sigma_B, \sigma_A)$	A_a, A_b

* This is an asymmetric case in which A: $SQ > N$ and B: $N > SQ$. If the conditions were reversed, the same NE of the demand-initiation game would hold.

Table B.2 continued. Demand-Initiation Equilibria

3.221.0.0.8	$C_b > N > A_a > C_a > W > W_b$, $EU_A(\sigma_A, \sigma_B) > A_a$	$C_a > N > A_b > C_b > W > W_a$, $A_b > EU_B(\sigma_B, \sigma_A)$	A_b
3.221.0.0.9	$C_b > N > A_a > C_a > W > W_b$, $A_a > EU_A(\sigma_A, \sigma_B)$	$C_a > N > A_b > C_b > W > W_a$, $EU_B(\sigma_B, \sigma_A) > A_b$	A_a
3.222.0.0.0	$C_b > N > C_a > W > W_b$	$C_a > N > W > C_b > W_a$	A_a
3.31.1.0.41	$N > C_b > W > A_a > C_a > W_b$	$C_a > N > W > A_b > C_b > W_a$	W
3.31.1.0.52	$N > C_b > A_a > W > C_a > W_b$	$C_a > N > A_b > W > C_b > W_a$	A_a, A_b
3.31.1.0.42	$N > C_b > W > A_a > C_a > W_b$	$C_a > N > A_b > W > C_b > W_a$	A_b
3.31.1.0.51	$N > C_b > A_a > W > C_a > W_b$	$C_a > N > W > A_b > C_b > W_a$	A_a
3.321.1.0.0	$N > C_b > C_a > W > W_b$	$C_a > N > C_b > W > W_a$	A_a
3.322.1.0.0	$N > C_b > C_a > W > W_b$	$C_a > N > W > C_b > W_a$	A_a
3.323.1.0.6	$N > C_b > W > C_a > W_b$, $EU_A(\sigma_A, \sigma_B) > A_a$	$C_a > N > A_b > C_b > W > W_a$, $EU_B(\sigma_B, \sigma_A) > A_b$	(D, D)
3.323.1.0.7	$N > C_b > W > C_a > W_b$, $A_a > EU_A(\sigma_A, \sigma_B)$	$C_a > N > A_b > C_b > W > W_a$, $A_b > EU_B(\sigma_B, \sigma_A)$	A_a, A_b
3.323.1.0.8	$N > C_b > W > C_a > W_b$, $EU_A(\sigma_A, \sigma_B) > A_a$	$C_a > N > A_b > C_b > W > W_a$, $A_b > EU_B(\sigma_B, \sigma_A)$	A_b
3.323.1.0.9	$N > C_b > W > C_a > W_b$, $A_a > EU_A(\sigma_A, \sigma_B)$	$C_a > N > A_b > C_b > W > W_a$, $EU_B(\sigma_B, \sigma_A) > A_b$	A_a
3.321.2.0.0	$N > C_a > C_b > W > W_b$	$C_a > N > C_b > W > W_a$	A_a
3.322.2.0.0	$N > C_a > C_b > W > W_b$	$C_a > N > W > C_b > W_a$	A_a

* This is an asymmetric case in which A: $SQ > N$ and B: $N > SQ$. If the conditions were reversed, the same NE of the demand-initiation game would hold.

For comparative purposes, it is necessary to apply the above cases to the international interaction game allowing A and then B to make the first move. This generates a table similar to Table 2.3 which compared the equilibria of the conflict-initiation subgame with the equilibria of the crisis subgame under differing actor orders. The equilibrium analysis uses information in Tables 2.3 and B.2 to find SPE in the truncated international interaction game in Figure B.2.

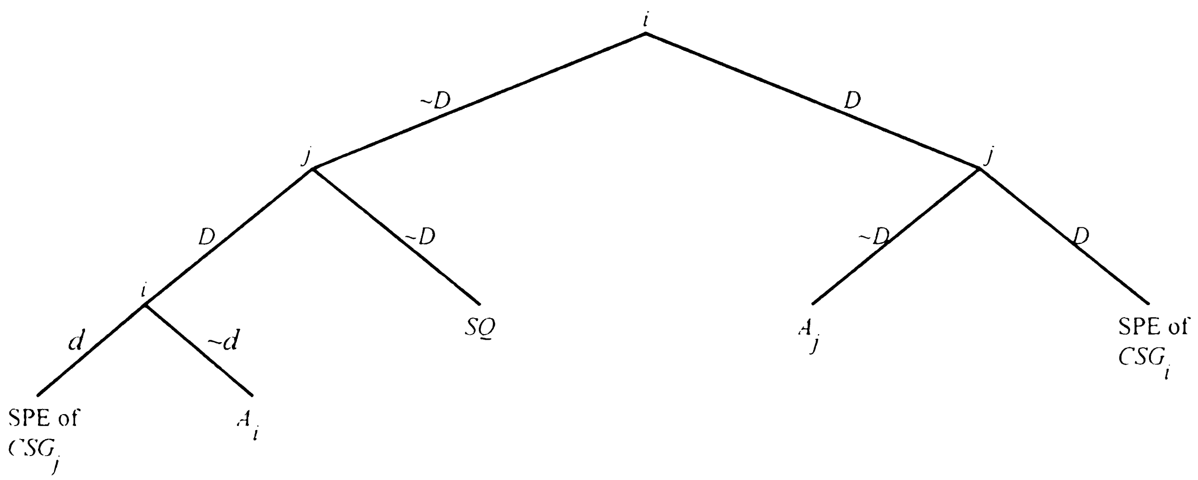


Figure B.2.Truncated International Interaction Game

Table B.3 summarizes the comparative results after conducting the backwards inductions of all cases. For cases 2.11.0.1.5 and 2.12.1.1.0, there are two SPE listed when A moves first—A_a and W_a. In each case, if A prefers A_a over W_a, then A_a is the unique SPE when A moves first. Conversely, if A prefers W_a over A_a, then W_a is the unique SPE when A moves first. The substantive implications of these comparative results are discussed in Chapter 2.

Table B.3. Comparing Model Results

Endogenous Initiation	IIG: *A* moves first	IIG: *B* moves first	Cases
SQ	SQ	SQ	1.0.0.0.1, 2.21.0.0.1, 3.11.0.0.1
SQ, N	SQ	SQ	2.22.0.0.1, 3.121.0.0.1, 3.122.0.0.1
N	N	N	1.0.0.0.2/3, 2.21.0.0.2/3, 3.11.0.0.2/3, 2.22.0.0.2/3, 3.121.0.0.2/3, 3.122.0.0.2/3
W	W_a	A_a	2.11.0.1.4
	A_b	A_a	2.11.0.2.41, 3.21.0.0.41, 3.31.1.0.41
A_a	A_a, W_a	A_a	2.11.0.1.5, 2.12.1.1.0
	A_b	A_a	2.11.0.2.51, 3.21.0.0.51, 3.31.1.0.51, 3.221.0.0.9, 3.323.1.0.9, 2.12.1.2.0, 3.222.0.0.0, 3.321.1.0.0, 3.322.1.0.0
	A_a	A_a	2.12.2.0.0, 3.321.2.0.0, 3.322.2.0.0
A_a, A_b	A_b	A_a	2.11.0.2.52, 3.21.0.0.52, 3.31.1.0.52, 3.221.0.0.7, 3.323.1.0.7
A_b	A_b	A_a	2.11.0.2.42, 3.21.0.0.42, 3.31.1.0.42, 3.221.0.0.8, 3.323.1.0.8
(D, D)	A_b	A_a	3.221.0.0.6, 3.323.1.0.6

APPENDIX C.

BEST-REPLY FUNCTIONS

The utility patterns characterized by L_i, F_i, and B_i can be analyzed to find best-reply functions. The first step is determining what utility patterns are possible under the game assumptions. The next step is analyzing each possible utility pattern first to find the maximum achievable utility and then to find the best-reply functions themselves. I only present examples of the eight best-reply functions and identify all utility patterns that correspond to each. In order to find the possible best-reply functions in the basic timing game, we must comprehend how the three utility functions operate.

The properties of a common asymptote, monotonic slopes, and inverse concavity tell us a great deal about what the three utility functions of each player look like. First, the three utility functions for a given player all converge to the same value over time, as in Figure C.1 below. This is simply a result of the status quo becoming a larger component of an actor's utility as time increases.

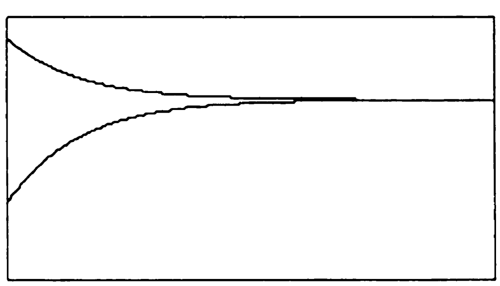


Figure C.1. Two Functions with a Common Asymptote

Since all three utility functions are monotonic—i.e., each is always increasing or always decreasing—and have common asymptotes, we know that a function starting above the asymptote must be decreasing and that a function starting below the asymptote must be increasing. Furthermore, these two properties restrict the overall pattern of an individual player's utilities. For example, if the third utility function were above the upper function in Figure C.1, we know that it, too, must be a decreasing function since it converges to the same asymptote. Similarly, if the third utility function were below the lower function in Figure C.1, we know that it must be an increasing function. If the third utility function were between the two functions in Figure C.1, then it could be increasing, decreasing, or flat, depending on whether it started below, above, or coincident with the asymptote respectively.

Assuming that no two functions are identical, the properties of common asymptote and monotonic functions assert that there are only four basic patterns of an individual's utility functions. These are (1) all three functions are decreasing, (2) two functions are decreasing while the lower-most function is increasing, (3) the upper-most function is decreasing while the lower functions are increasing, and (4) all three functions are increasing. These patterns are irrespective of the labels given to particular functions. Since there are three possible labels—namely "leader", "follower", or "both"—we must calculate best-reply functions for each of the six permutations of these labels times the four patterns of utility functions. Thus, there are twenty-four utility patterns that must be analyzed. These are summarized in Table C.1 along with their corresponding best-reply functions.

Each of the graphs on the following pages represents one utility pattern for one player. The x-axis represents time while the y-axis represents player i's utility. The utility functions are labeled "L" for the leader function, "F" for the follower function, and "B" for the simultaneous function. Darker lines and/or points represent player i's

Table C.1. Utility Patterns and Corresponding Best-reply Functions

Order of Utility Functions	Slopes of Respective Utility Functions*			Related Best-reply Function
$B_i > F_i > L_i$	+	+	+	BRF 1
	-	+	+	BRF 1
	-	-	+	BRF 1
	-	-	-	BRF 2
$B_i > L_i > F_i$	+	+	+	BRF 1
	-	+	+	BRF 1
	-	-	+	BRF 2
	-	-	-	BRF 2
$F_i > B_i > L_i$	+	+	+	BRF 3
	-	+	+	BRF 3
	-	-	+	BRF 3
	-	-	-	BRF 4
$F_i > L_i > B_i$	+	+	+	BRF 3
	-	+	+	BRF 3
	-	-	+	BRF 4
	-	-	-	BRF 4
$L_i > B_i > F_i$	+	+	+	BRF 5
	-	+	+	BRF 6
	-	-	+	BRF 6
	-	-	-	BRF 6
$L_i > F_i > B_i$	+	+	+	BRF 7
	-	+	+	BRF 8
	-	-	+	BRF 8
	-	-	-	BRF 8

* These slopes are read with respect to the "order of utility functions" column. Thus, for the second row of slopes, the B_i utility function is decreasing while the other two utility functions are increasing.

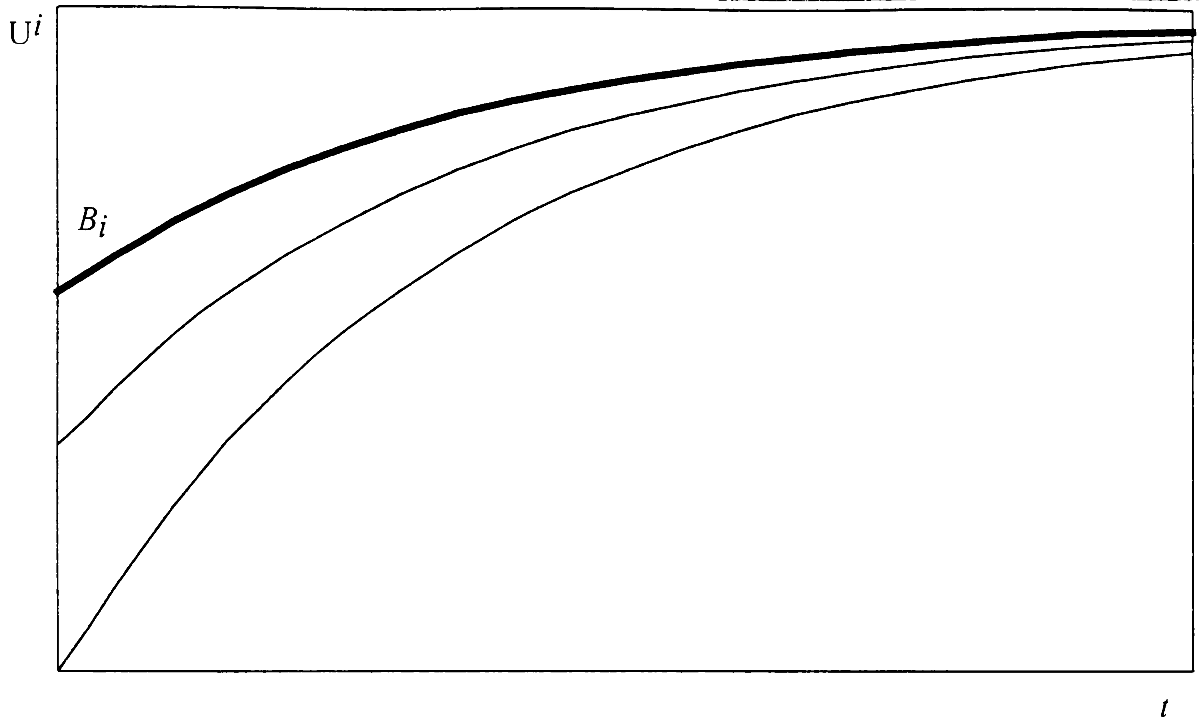
greatest achievable utility for each possible time choice of player j. A player's greatest achievable utility is what he or she would get when choosing a best reply. Since the two are related, we can deduce what a player's best reply is for each time point. The aggregation of this information yields a player's best-reply function. The best-reply function is then summarized as an equation in the form:

$$t_i^* \Big|_{t_j} .$$

This is read as "player i's best reply (i.e., t_i^*) given t_j". In some cases two or three equations are presented which depend on different values of t_j. In these cases, player i's best reply varies for different regions of t_j. Specifically, player i's best reply changes before and after some critical time point. This critical time point is specified in each case.

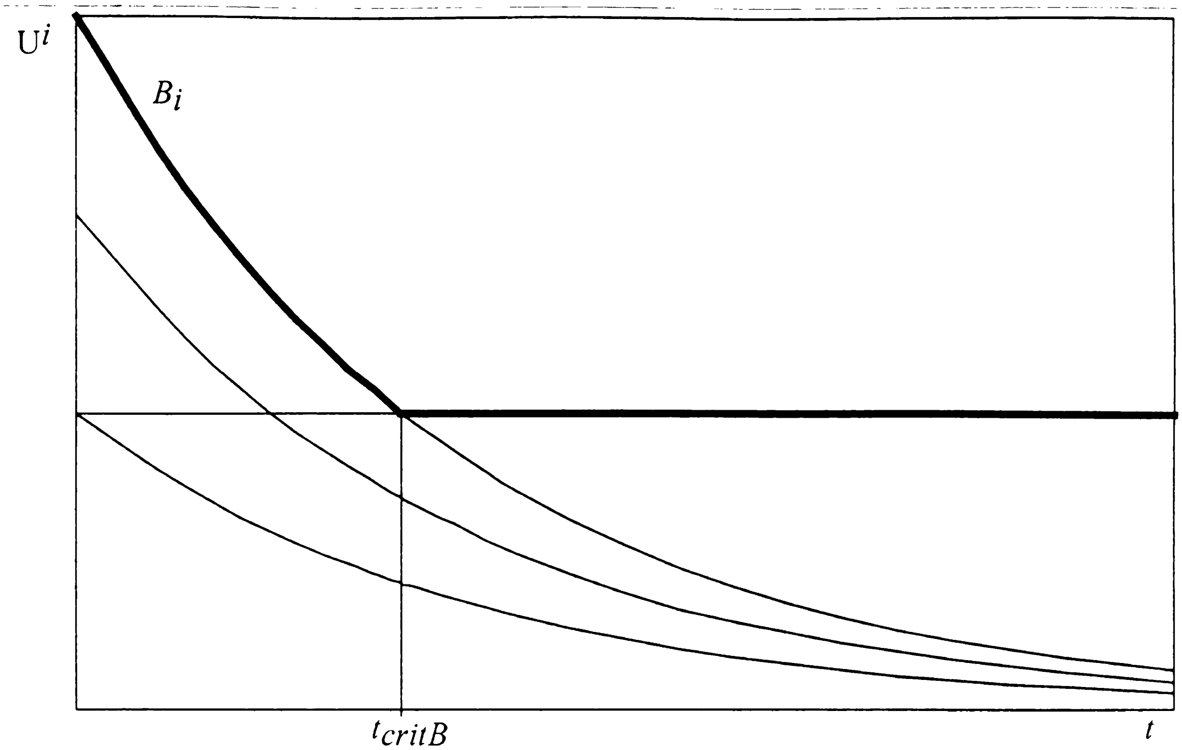
Figure C.2 is an example of BRF 1 in which $t_i^* \big|_{t_j} = t_j$. Utility patterns having this BRF have two fundamental features. These are $B_i > \{F_i, L_i\}$ and $\frac{\partial L_i}{\partial t} > 0$. Given these key features, this type of player would most prefer acting in conjunction with the other player. If $t_j = 0$, $B_i(0)$ is clearly better than $F_i(0)$. If $t_j = \infty$, i maximizes utility at $t_i = \infty$. If $t_j \in (0, \infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(t_j - \varepsilon)$. $B_i(t_j)$ is the maximum of this set. Thus, $t_i^* \big|_{t_j} = t_j$.

Figure C.3 is an example of BRF 2 in which $t_i^* \big|_{t_j} = \begin{cases} t_j & t_j \le t_{critB} \\ 0 & t_j \ge t_{critB} \end{cases}$. Utility patterns having this BRF have two fundamental features. These are $B_i > \{F_i, L_i\}$ and $\frac{\partial L_i}{\partial t} < 0$.



$$t_i^*\Big|_{t_j} = t_j$$

Figure C.2. Example of Best-reply Function 1



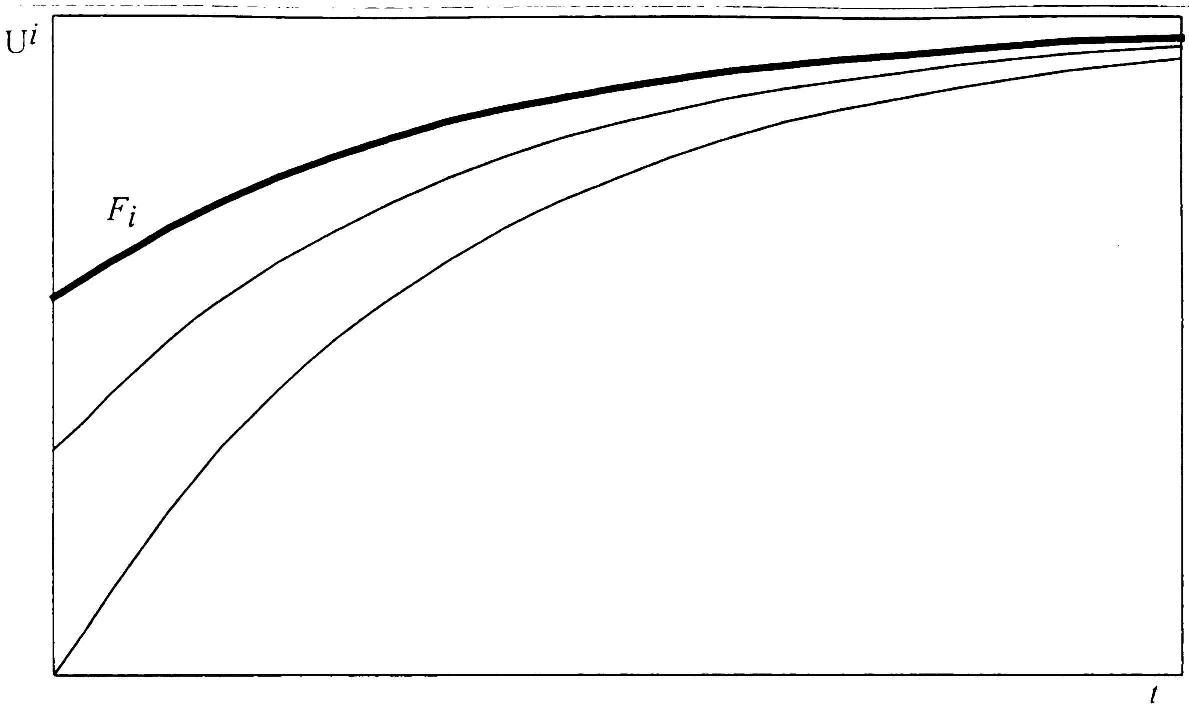
$$t_i^*\Big|_{t_j} = \begin{cases} t_j & t_j \le t_{critB} \\ 0 & t_j \ge t_{critB} \end{cases}$$

$$t_{critB} : L_i(0) = B_i(t_{critB})$$

Figure C.3. Example of Best-reply Function 2

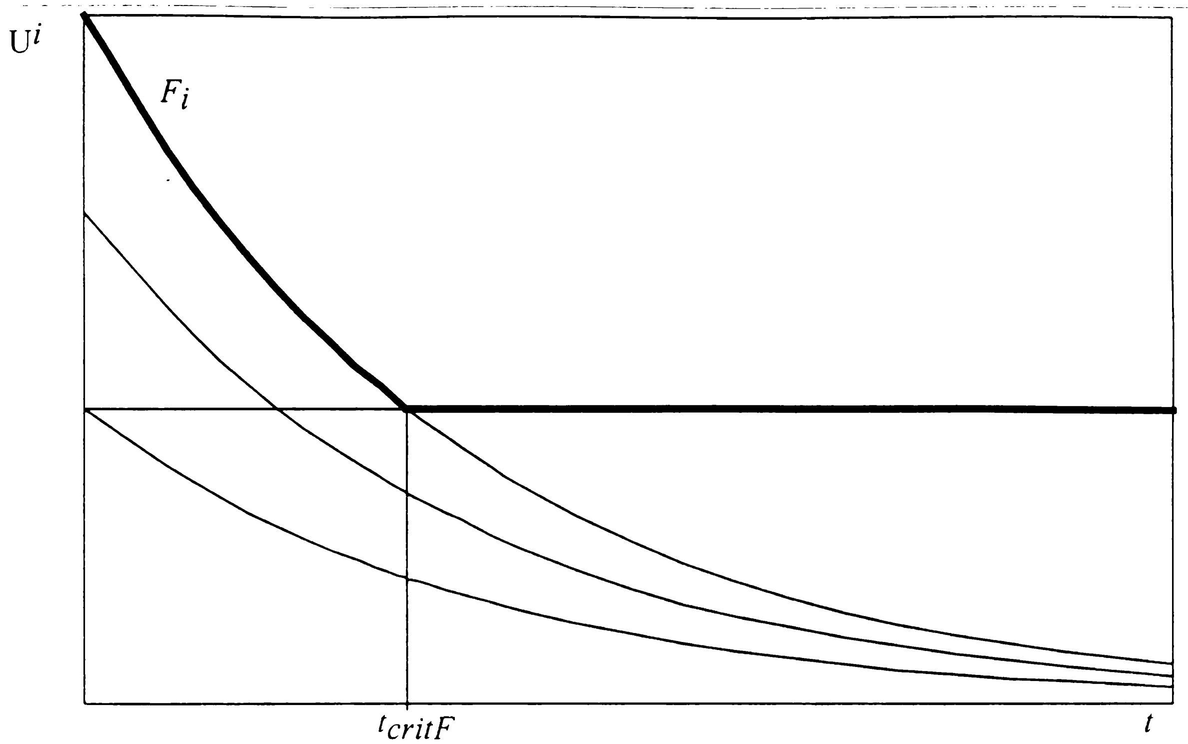
Given these key features, this type of player would prefer acting in conjunction with the other player only if that player moves before some critical point. Beyond that critical time for t_j, this type of player would prefer acting immediately. If $t_j = 0$, $B_i(0)$ is clearly better than $F_i(0)$. If $t_j = \infty$, i maximizes achievable utility at $t_i = 0$. For $t_j \in (0, \infty)$, we must consider two separate ranges. Specifically, if t_j is large enough, $t_i = 0$ nets a greater utility than coordinating moves. The critical time point (t_{critB}) at which t_j becomes "large enough" is defined as the time at which i is indifferent between acting immediately and coordinating with the other player. If $t_j \in (0, t_{critB})$, the analysis is the same as in BRF 1 and $t_i^* = t_j$. If $t_j \in (t_{critB}, \infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(0)$. $L_i(0)$ is the maximum of this set. Thus, $t_i^*\big|_{t_j} = \begin{cases} t_j & t_j \le t_{critB} \\ 0 & t_j \ge t_{critB} \end{cases}$.

Figure C.4 is an example of BRF 3 in which $t_i^*\big|_{t_j} = \infty$. Utility patterns having this BRF have two fundamental features. These are $F_i > \{B_i, L_i\}$ and $\frac{\partial L_i}{\partial t} < 0$. Given these key features, this type of player has a dominant strategy of waiting forever. If $t_j = 0$, $F_i(0)$ is clearly better than $B_i(0)$. If $t_j = \infty$, i maximizes utility at $t_i = \infty$. If $t_j \in (0, \infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(t_j - \varepsilon)$. Fi(tj) is the maximum of this set. Since all $t_i > t_j$ yield the same utility in $F_i(t_j)$, i has a large indifference set. We can simplify i's decision set to $t_i^* = \infty$ without loss of generality. Thus, $t_i^*\big|_{t_j} = \infty$.



$$t_i^*\Big|_{t_j} = \infty$$

Figure C.4. Example of Best-reply Function 3



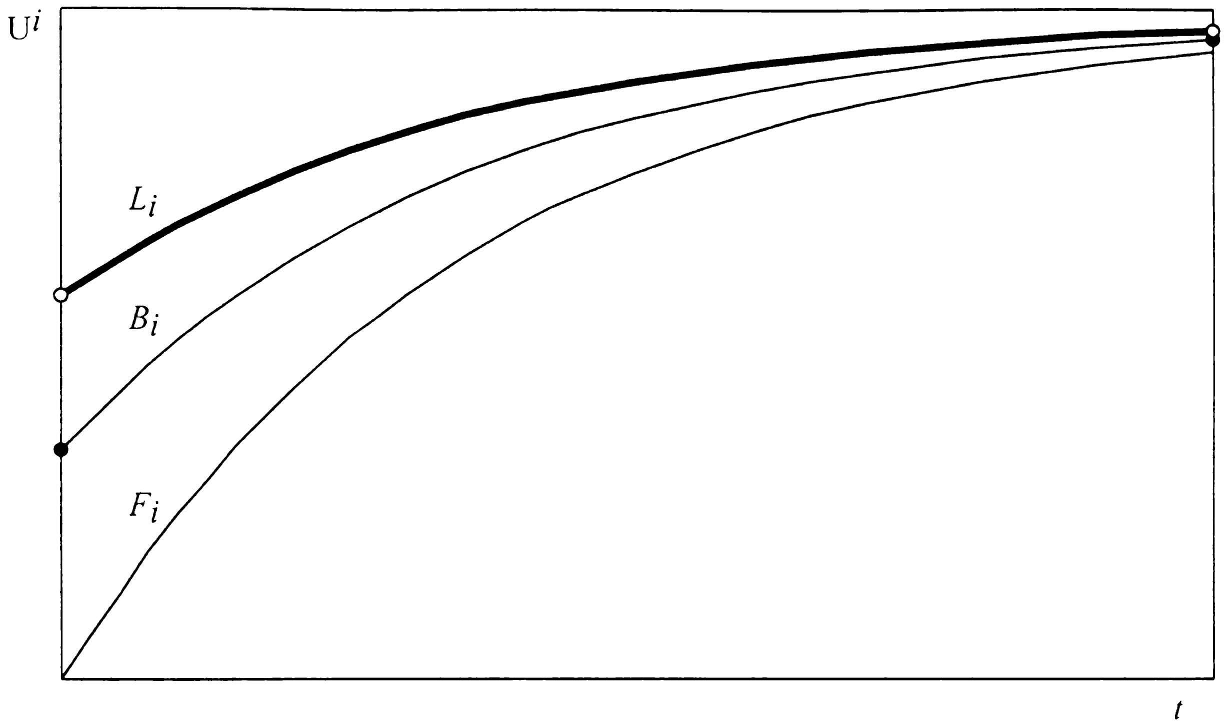
$$t_i^*\Big|_{t_j} = \begin{cases} \infty & t_j \le t_{critF} \\ 0 & t_j \ge t_{critF} \end{cases}$$

$$t_{critF} : L_i(0) = F_i(t_{critF})$$

Figure C.5. Example of Best-reply Function 4

Figure C.5 is an example of BRF 4 in which $t_i^*\big|_{t_j} = \begin{cases} \infty & t_j \le t_{critF} \\ 0 & t_j \ge t_{critF} \end{cases}$. Utility patterns having this BRF have two fundamental features. These are $F_i > \{B_i, L_i\}$ and $\frac{\partial L_i}{\partial t} > 0$. Given these key features, this type of player would acting after the other player only if that player moves before some critical point. Beyond that critical time for t_j, this type of player would prefer acting immediately. If $t_j = 0$, $F_i(0)$ is clearly better than $B_i(0)$. If $t_j = \infty$, i maximizes achievable utility at $t_i = 0$. For $t_j \in (0, \infty)$, we must consider two separate ranges. Specifically, if t_j is large enough, $t_i = 0$ nets a greater utility than letting the other player take the lead. The critical time point (t_{critF}) at which t_j becomes "large enough" is defined as the time at which i is indifferent between acting immediately and waiting for the other player to act. If $t_j \in (0, t_{critF})$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(0)$. $F_i(t_j)$ is the maximum of this set. If $t_j \in (t_{critF}, \infty)$, the greatest achievable utilities along each function are again $B_i(t_j)$, $F_i(t_j)$, and $L_i(0)$, but $L_i(0)$ is the maximum of this set. Once again, we can simplify i's indifference over waiting times. Thus, $t_i^*\big|_{t_j} = \begin{cases} \infty & t_j \le t_{critF} \\ 0 & t_j \ge t_{critF} \end{cases}$.

Figure C.6 is the only case of BRF 5 in which $t_i^*\big|_{t_j} = \begin{cases} 0 & t_j = 0 \\ t_j - \varepsilon & t_j \in (0, \infty) \\ \infty & t_j = \infty \end{cases}$. The features that make this utility pattern unique are $L_i > B_i > F_i$ and $\frac{\partial L_i}{\partial t} > 0$. Given these features, this type of player would (1) coordinate with the other player only if the other player acts immediately, (2) wait forever only if the other player also waits forever, and (3) attempt to move just before the other player in all other cases. If $t_j = 0$, $B_i(0)$ is clearly



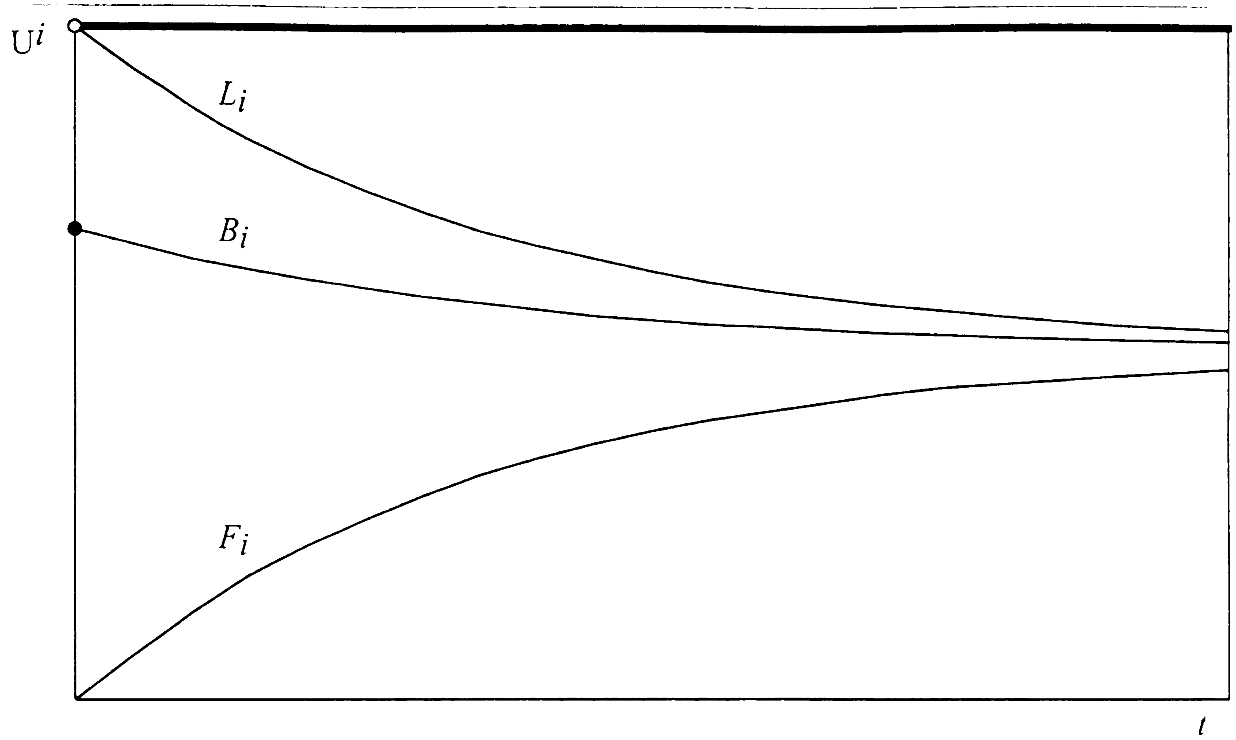
$$t_i^*\Big|_{t_j} = \begin{cases} 0 & t_j = 0 \\ t_j - \varepsilon & t_j \in (0,\infty) \\ \infty & t_j = \infty \end{cases}$$

Figure C.6. Example of Best-reply Function 5

better than $F_i(0)$. If $t_j = \infty$, i maximizes utility at $t_i = \infty$. If $t_j \in (0,\infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(t_j - \varepsilon)$. $L_i(t_j - \varepsilon)$ is the maximum of this set. Thus, $t_i^*\big|_{t_j} = \begin{cases} 0 & t_j = 0 \\ t_j - \varepsilon & t_j \in (0,\infty) \\ \infty & t_j = \infty \end{cases}$.

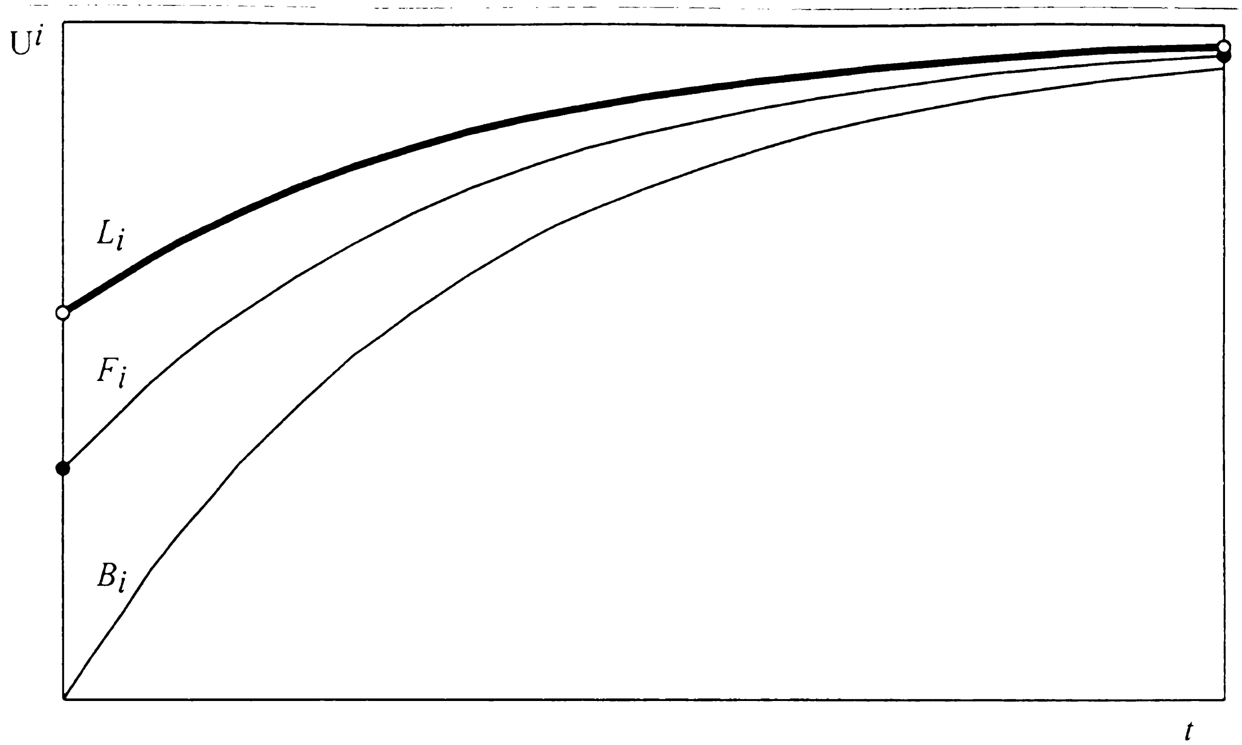
Figure C.7 is an example of BRF 6 in which $t_i^*\big|_{t_j} = 0$. Utility patterns having this BRF have two fundamental features. These are $L_i > B_i > F_i$ and $\frac{\partial L_i}{\partial t} < 0$. Given these key features, this type of player has a dominant strategy of acting immediately. If $t_j = 0$, $B_i(0)$ is clearly better than $F_i(0)$. If $t_j = 0$, i maximizes utility at $t_i = \infty$. If $t_j \in (0,\infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(0)$.. $L_i(0)$ is the maximum of this set. Thus, $t_i^*\big|_{t_j} = 0$.

Figure C.8 is the only case of BRF 7 in which $t_i^*\big|_{t_j} = \begin{cases} \infty & t_j = 0 \\ t_j - \varepsilon & t_j \in (0,\infty) \\ \infty & t_j = \infty \end{cases}$. The features that make this utility pattern unique are $L_i > F_i > B_i$ and $\frac{\partial L_i}{\partial t} > 0$. Given these features, this type of player would (1) wait if the other player acts immediately, (2) wait forever if the other player also waits forever, and (3) attempt to move just before the other player in all other cases. If $t_j = 0$, $F_i(0)$ is clearly better than $B_i(0)$. If $t_j = \infty$, i maximizes utility at $t_i = \infty$. If $t_j \in (0,\infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(t_j - \varepsilon)$. $L_i(t_j - \varepsilon)$ is the maximum of this set. Thus,



$$t_i^*\Big|_{t_j} = 0$$

Figure C.7. Example of Best-reply Function 6



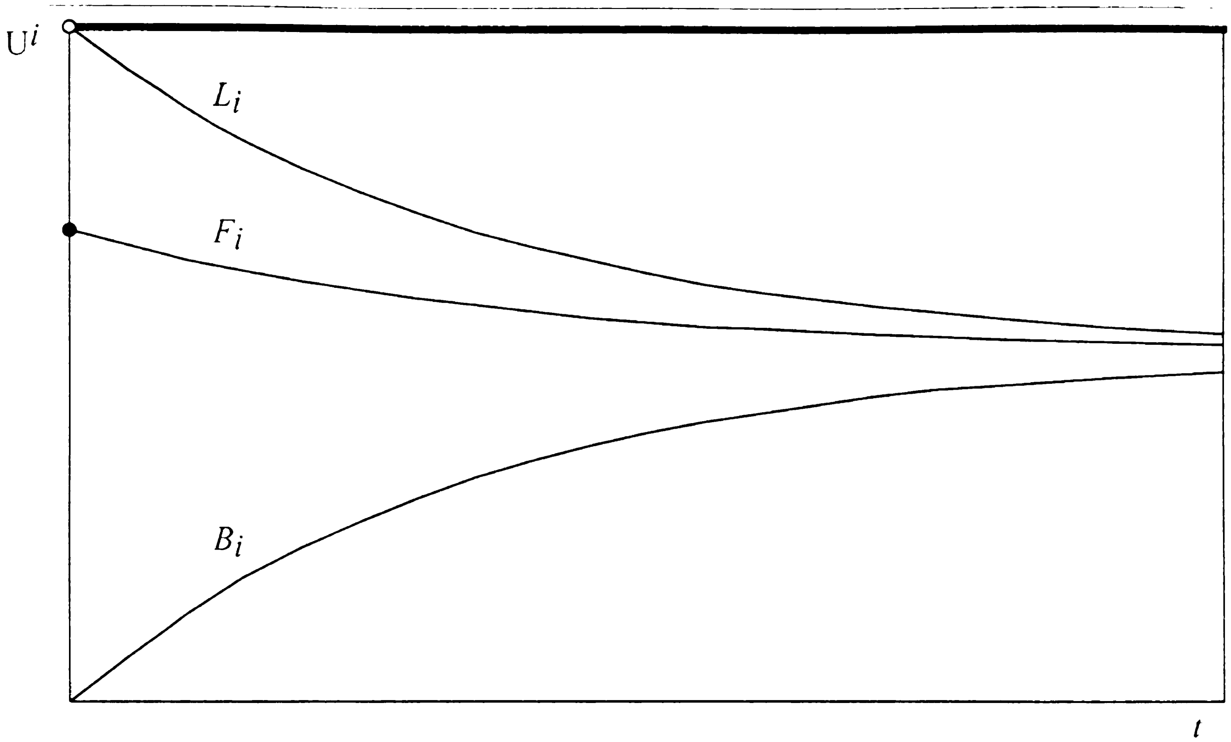
$$t_i^*\big|_{t_j} = \begin{cases} \infty & t_j = 0 \\ t_j - \varepsilon & t_j \in (0, \infty) \\ \infty & t_j = \infty \end{cases}$$

Figure C.8. Example of Best-reply Function 7

$$t_i^*\big|_{t_j} = \begin{cases} \infty & t_j = 0 \\ t_j - \varepsilon & t_j \in (0,\infty) \\ \infty & t_j = \infty \end{cases}.$$

Figure C.9 is an example of BRF 8 in which $t_i^*\big|_{t_j} = \begin{cases} \infty & t_j = 0 \\ 0 & t_j > 0 \end{cases}$. Utility patterns having this BRF have two fundamental features. These are $L_i > F_i > B_i$ and $\frac{\partial L_i}{\partial t} < 0$. Given these key features, this type of player would wait if the other player acts immediately but move immediately herself otherwise. If $t_j = 0$, $F_i(0)$ is clearly better than $B_i(0)$. If $t_j = 0$, i maximizes utility at $t_i = 0$. If $t_j \in (0,\infty)$, the greatest achievable utilities along each function are $B_i(t_j)$, $F_i(t_j)$, and $L_i(0)$. $L_i(0)$ is the maximum of this set. Once again, we can simplify i's indifference over waiting times. Thus, $t_i^*\big|_{t_j} = \begin{cases} \infty & t_j = 0 \\ 0 & t_j > 0 \end{cases}$.

This exhausts the set of possible utility functions and concludes the search for best-reply functions under the game's assumptions.



$$t_i^*\big|_{t_j} = \begin{cases} \infty & t_j = 0 \\ 0 & t_j > 0 \end{cases}$$

Figure C.9. Example of Best-reply Function 8

APPENDIX D.

THE UTILITY OF NEGOTIATION

The expected utility of negotiation as presented in Bueno de Mesquita and Lalman (1992, 42 and 47) is given by the following equation:

$$\mathrm{EU}^i(N) = P^i\,\mathrm{U}^i(\Delta_i) + (1 - P^i)\mathrm{U}^i(\Delta_j)$$

Although P^i and P^j—the subjective probabilities that i (or j) will realize its demand through negotiation or war—can vary from actor to actor without mathematical regularity, with complete information $P^i = 1 - P^j$. Thus $\mathrm{EU}^j(N)$ in terms of P^i is:

$$\mathrm{EU}^j(N) = (1 - P^i)\mathrm{U}^j(\Delta_j) + P^i\,\mathrm{U}^j(\Delta_i).$$

Recall that $\mathrm{U}^i(\Delta_i)$ and $\mathrm{U}^i(\Delta_j)$ are restricted by assumption 5 such that $\mathrm{U}^i(\Delta_i) > \mathrm{U}^i(SQ) > \mathrm{U}^i(\Delta_j)$ (1992, 40). Holding the utilities of the demands constant, we can easily see that:

$$\frac{\partial}{\partial P^i}\mathrm{EU}^i(N) = \mathrm{U}^i(\Delta_i) - \mathrm{U}^i(\Delta_j) > 0$$

and

$$\frac{\partial}{\partial P^i}\mathrm{EU}^j(N) = -\mathrm{U}^j(\Delta_j) - \mathrm{U}^j(\Delta_i) < 0.$$

Therefore, changes in P^i that advantage actor i increase $\mathrm{EU}^i(N)$ but decrease $\mathrm{EU}^j(N)$.

Very little is done in *War and Reason* to formalize the demands themselves—i.e., Δ_i and Δ_j. Under general utility theory (von Neumann and Morgenstern, 1944), Δ_i is a real-valued number and $\mathrm{U}^i(\cdot)$ is a function that translates that real-valued number into a utility. As a function, $\mathrm{U}^i(\cdot)$ has a one-to-one mapping relationship with Δ_i that translates a given Δ_i into a specific $\mathrm{U}^i(\Delta_i)$. Given the logic of assumption 5 and the intuition behind demands in general, it follows that $\frac{\partial}{\partial \Delta_i} \mathrm{U}'(\Delta_i) > 0$ and $\frac{\partial}{\partial \Delta_j} \mathrm{U}'(\Delta_j) < 0$. This merely states that $\mathrm{U}'(\cdot)$ is an increasing function with respect to Δ_i and a decreasing function with respect to Δ_j. Thus,

$$\frac{\partial}{\partial \Delta_i} \mathrm{EU}'(N) = P' \frac{\partial}{\partial \Delta_i} \mathrm{U}'(\Delta_i) > 0$$

and

$$\frac{\partial}{\partial \Delta_j} \mathrm{EU}'(N) = (1 - P') \frac{\partial}{\partial \Delta_j} \mathrm{U}'(\Delta_j) < 0 .$$

Given an increase in Δ_i to Δ_i', $\mathrm{EU}'(N|\Delta_i') > \mathrm{EU}'(N|\Delta_i)$ and $\mathrm{EU}'(N|\Delta_i') < \mathrm{EU}'(N|\Delta_i)$. A similar statement can be made regarding Δ_j in which an increase in Δ_j increases *j*'s expected utility of negotiation by reduces *i*'s expected utility of negotiation. So, any change in P', Δ_i, or Δ_j—with complete information—that increases the expected utility of negotiation for one actor necessarily decreases the expected utility of negotiation for the other actor.

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