The Political Economy of Alliances: Structure and Performance

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1. Introduction

In collective decision making, political alliances naturally arise and are critical to the negotiation processes that lead to the actual implementation of decisions. In the present context, an "alliance" refers simply to a group of political actors who share common, but not identical, interests against some adversary. In this paper we focus on the relationship among three constructs: the structure of an alliance, the context in which negotiations take place, and the performance of the alliance. The term "alliance structure" refers to the configuration of alliance members' preferences as well as to their bargaining attributes. The "context" of negotiation refers to the rules of the bargaining game, including such factors as the structure of admissible coalitions and the range of allowable policy proposals. "Alliance performance" refers to the alliance's effectiveness in furthering its members' common objectives through the negotiation. process For example, if the space of issues can be represented in an Edgeworth box, a natural measure of alliance performance might be the location of the negotiated solution along the contract curve.

For the model advanced in this paper, political discourse is restricted to issues that can be classified as one of two types: communal issues and factional issues. For communal issues, all members of the alliance have identical objectives and these objectives are diametrically opposed to the adversary's objectives, holding all other variables equal. A typical communal issue is the total quantity of resources to be transferred from the public sector to a political alliance. For factional issues, the objectives of subgroups of the alliance may not be aligned with those of other subgroups. Moreover, the interests of the adversary may be aligned with those of one of the subgroups, so that in this respect, holding communal issues constant, some alliance members have more in common with the adversary than with other alliance members. For example, given a fixed aggregate transfer level, members of a political alliance will no longer be aligned when the distribution of the transfer among alliance members becomes an issue.

The collective decision-making framework developed in this paper is motivated by a vast array of examples. Consider, for instance, the relationship between an alliance, consisting of the members of a university department, and an adversary, represented by their dean. In this case a natural dichotomy arises between a *transfer variable*—representing the total funds allocated to the department—and a *distribution variable*—which sets the allocation of funds between teaching and research, between theory and applications, etc.

Similar distinctions can be drawn in a wide variety of other negotiating contexts: the Clinton economic proposal of 1993; the soon-to-be-announced U.S. health care reform package; the NATO alliance versus the Soviet Union (prior to the latter's demise); the Afghanistan tribes' attempt to overthrow the Soviet occupation; the GATT negotiations; the alliance of politically liberal groups—such as the green movement, the labor movement, women's movement and the civil rights movement—against a conservative establishment.

More concretely, consider the case of the current GATT negotiations. Agriculture has been the major obstacle to a successful conclusion of the Uruguay Round. Over the last six years the United States has attempted to convince the European Community that the aggregate subsidy level should be reduced. It has been difficult indeed to determine the form that the subsidy reduction would take, e.g., internal support versus export subsidies. Along with the issue of the total subsidy reduction—this is the transfer variable in our terminology—there is the issue of the distribution of costs and benefits among different countries within the Community whose interests and desires are quite different.

Another example is the negotiations between airline carriers and the Federal Aviation Administration (FAA) regarding the assignment of property rights to landing slots. In this instance, the transfer variable represents the disposition of the proceeds from the sale of landing rights. The FAA's view was that these proceeds should be transferred to the public, while the carriers were unanimously opposed to this idea. The distribution variable represents the regulations governing the new market and landing slots, which determined the allocation of benefits among the various carriers. In this case, the carriers who were primarily sellers of landing rights could be viewed as one subgroup of the alliance; those who were primarily buyers could be viewed as another. Quite obviously, the distribution variable could be set in a way that benefits either one subgroup or the other.

Still another example is provided by the negotiations that have occurred between agribusiness interests and the government over export-enhancement programs. The goal of these programs is to assist US. agribusiness in gaining market shares relative to the European Community in certain selected locations. Specific targets are set, emphasizing those countries where the European Community is attempting to establish a market position. In this case, the transfer variable represents the total amount that will be spent on export enhancement. The Office of Management and Budget (the adversary) wants this total amount to be as small as possible, while agribusiness interests (the alliance) have the opposite objective. The distribution variable represents the allocation of expenditure among the various target countries. Different agribusiness companies have quite distinct and variable preferences over this distribution.

This paper reports on a series of Monte Carlo experiments, designed to investigate the comparative statics properties of the model. Simulation techniques are utilized rather than analytical calculus techniques, for a number of reasons. First, the model is designed to address issues and problems that are far too complicated to be analyzed by conventional techniques. Second, because of the nonconvexities and discontinuities that are inherent in these problems, the purely local information provided by calculus techniques is of limited usefulness. Accordingly, we are faced with two choices: either we embrace an alternative technology or we forever limit ourselves to the relatively narrow class of political and economic problems that can be studied using existing methodologies. Since there is a very rich class of problems that violates the typical assumptions needed to apply conventional techniques, there is a compelling case for allowing the problem to determine the method of analysis.

2. A Review of the Multilateral Bargaining Framework.

The theoretical foundations for this paper are laid out in Rausser-Simon [1991], which proposes a non-cooperative model of multilateral bargaining. The model can be viewed as an extension of the classical Stahl-Rubinstein bargaining game in which two players take turns proposing a division of a "pie."[1] In the classical game, one player proposes a division, which the other can accept or reject. If the division is accepted, the game ends and the division is adopted; if it is rejected, the second player then makes a proposal, which the first player then accepts or rejects. And so on. In Stahl's formulation, the game continues for a finite number of rounds; in Rubinstein's extension, the number of rounds is infinite. The Rausser-Simon generalization of this framework incorporates multiple players and multidimensional issue spaces. The ap-

[1] Stahl [1972, 1977] and Rubinstein [1982].

proach is to consider a sequence of games with finite bargaining horizons, and study the limit points of the equilibrium outcomes as the horizon is extended without bound.

In a *multilateral bargaining problem*, there is a finite collection of players, who meet together to select a *policy* from some collection of possible alternatives. In addition to these alternatives, there is a distinguished *disagreement policy*, which is imposed by default if players fail to reach agreement. Each player has a utility function defined on the set of possible policies. Players are presumed to be risk averse. (For simplicity, players do not discount the future, though this is in no way essential to the model.)

The specification of a multilateral bargaining problem includes a list of *admissible coalitions*. An admissible coalition is interpreted as a subset of the players that can impose a policy decision on the group as a whole. For example, in majority rule decision-making, a coalition is defined to be admissible if and only if it contains a majority of the group. More generally, the set of admissible coalitions may have a variety of structures. In particular, we will sometimes impose the restriction that one or more players belongs to *every* admissible coalition. In this case, we shall say that the bargaining problem has an *essential player*.

The *core* of a multilateral bargaining problem is defined in the obvious way. A policy is said to be *blocked* by a coalition if there is some alternative policy that each member of the coalition strictly prefers to the original one. The core is the set of policies that cannot be blocked by any admissible coalition.

A *multilateral-bargaining game* is derived from a multilateral bargaining problem by superimposing upon it a "negotiation process." Specifically, each bargaining game has a finite number of negotiating rounds. A distinction is drawn between odd-numbered rounds of negotiations, called *offer rounds*, and even-numbered rounds, called *response rounds*. In an offer round, each player chooses *a proposal*, consisting of a policy and an admissible coalition. In response rounds, each player who is invited to join a coalition in the previous round specifies whether or not she will accept the policy selected by the proposer in that round. We will sometimes refer to the set of policies that player i will accept in round t as player i's *acceptance region* in round t. A *strategy* for a player is a collection of functions from past histories of the game to current round actions, i.e., to proposals in offer rounds and to acceptance regions in even-numbered rounds.

Prior to each response round, a proposer is chosen randomly "by nature," according to an exogenously specified vector of *access probabilities*. These i.i.d. probabilities are interpreted as measures of players' relative political "effectiveness:" the higher a player's access weight, the more likely it is that she will "seize the initiative" in the negotiations. A player's high access might reflect the extent of her political power within the organization, or, perhaps, a talent for formulating issues in ways that can lead to workable compromises. Together with the vector of access probabilities, each profile of strategies uniquely identifies an *outcome,* which is a random variable defined on the set of policies. The outcome is defined as follows. After the first offer round, nature selects some player to be the proposer. If the policy selected by the proposer is approved by each member of the coalition selected by the proposer, then this policy is accepted on behalf of the group and negotiations are concluded. If some coalition member rejects the proposed policy then nature randomizes again to select a proposer for the following offer round and the process is repeated. If the last round of negotiations is reached without agreement having been reached, then the game ends and the "disagreement" policy is implemented by default. Clearly, the procedure just described defines a random variable that assigns positive probability to a finite number of policies.

Having defined strategies and outcomes, the specification of a multilateral bargaining game is completed by defining a solution concept. The standard solution concept for games of this kind is *subgame perfection.* In the present context, however, this concept has no predictive power: for any game in which at least two players are required for agreement, any policy that is weakly preferred by all players to the default outcome can be implemented with certainty as the outcome of subgame perfect equilibrium. Fortunately, almost all of these equilibria violate a natural rationality criterion and can be eliminated by a number of equilibrium refinements. Rausser-Simon adopt a particularly simple refinement, referred to as *the SEDS criterion* (Sequential Elimination of Dominated Strategies). The criterion first eliminates strategies that involve inadmissible (i.e., weakly dominated) play in the final response round. Next, it eliminates strategies that involve inadmissible play in the penultimate round, considering only strategies that survive the first round of elimination. And so on. A profile of strategies that survives this sequence of eliminations is called an *equilibrium* for the game.

There is a simple characterization of the set of equilibrium strategy profiles: in each response round, a player will accept a proposed policy if and only if it generates at least as much utility as her *reservation utility* in that round, that is, the utility she expects to receive if no agreement is reached and play continues into the following round. In each offer round, a player is faced with a two-part problem. For each admissible coalition, she maximizes her utility over the set of policies that provide each coalition member with at least her reservation utility in the following round.[2] She then selects a utility-maximal policy from among these maximizers. It is a simple matter to verify that an equilibrium always exists. An important property of the framework is that equilibrium *outcomes* are generically unique.[3]

A *multilateral bargaining model* is a sequence of multilateral bargaining games, which are all identical except for the number of negotiating rounds, which increases without bound as the sequence progresses. A *solution* to a multilateral bargaining model is any limit of a sequence of equilibrium outcomes for the games in the sequence. The payoff that a player obtains from the solution to a model will be referred to as the player's *solution utility* for that model. A solution will be called *deterministic* if the elements of the limit outcome vector are all identical. Solutions that are not deterministic will be called *stochastic.* When a solution exists, it is interpreted as a proxy for the equilibrium outcome of a bargaining game in which the number of negotiation rounds is finite but arbitrarily large.

A necessary condition for existence of a deterministic solution is that the underlying bargaining problem has a nonempty core. For generic multilateral bargaining models, if a solution exists then it is unique. Rausser-Simon [1991] identify two sets of sufficient conditions for existence of a deterministic solution. The first is that the space of policies for the underlying problem is one-dimensional and that decisions cannot be taken without the consent of a simple majority of the players. When the policy space is multidimensional, it is much more difficult to guarantee convergence. One relatively straightforward way restriction is that there is at least one essential player, i.e., a player who is a member of every admissible coalition. For every bargaining problem satisfying this restriction, the derived bargaining model has a deterministic solution.

In the abstract, the latter sufficiency condition is quite restrictive. For example, it clearly conflicts with the formal institutional procedure of decision-making by majority rule. However, in a wide variety of collective decision-making contexts, the condition is satisfied *de facto*, even when it is explicitly violated *de jure.* For example, it is difficult to imagine that a candidate could emerge as the White House nominee for a major

[2]This set is necessarily nonempty if players are risk averse, since each one strictly prefers the expected outcome of the lottery in the following offer round to the lottery itself.

[3]To be precise, fix a game form and a universe of possible utility functions, endowed with the sup norm metric. For an open, dense subset of these functions, the derived multilateral bargaining games have unique equilibrium outcomes.

political appointment without at least the tacit approval of the President. That is, in negotiations with the White House staff, the President would be an essential player. Similarly, in the current negotiations over the future of the former Soviet Union, essential status might be conferred upon Mr Yeltsin. More generally, whenever a group of negotiators has a clearly identified "leader," it may be appropriate to model this player as essential.

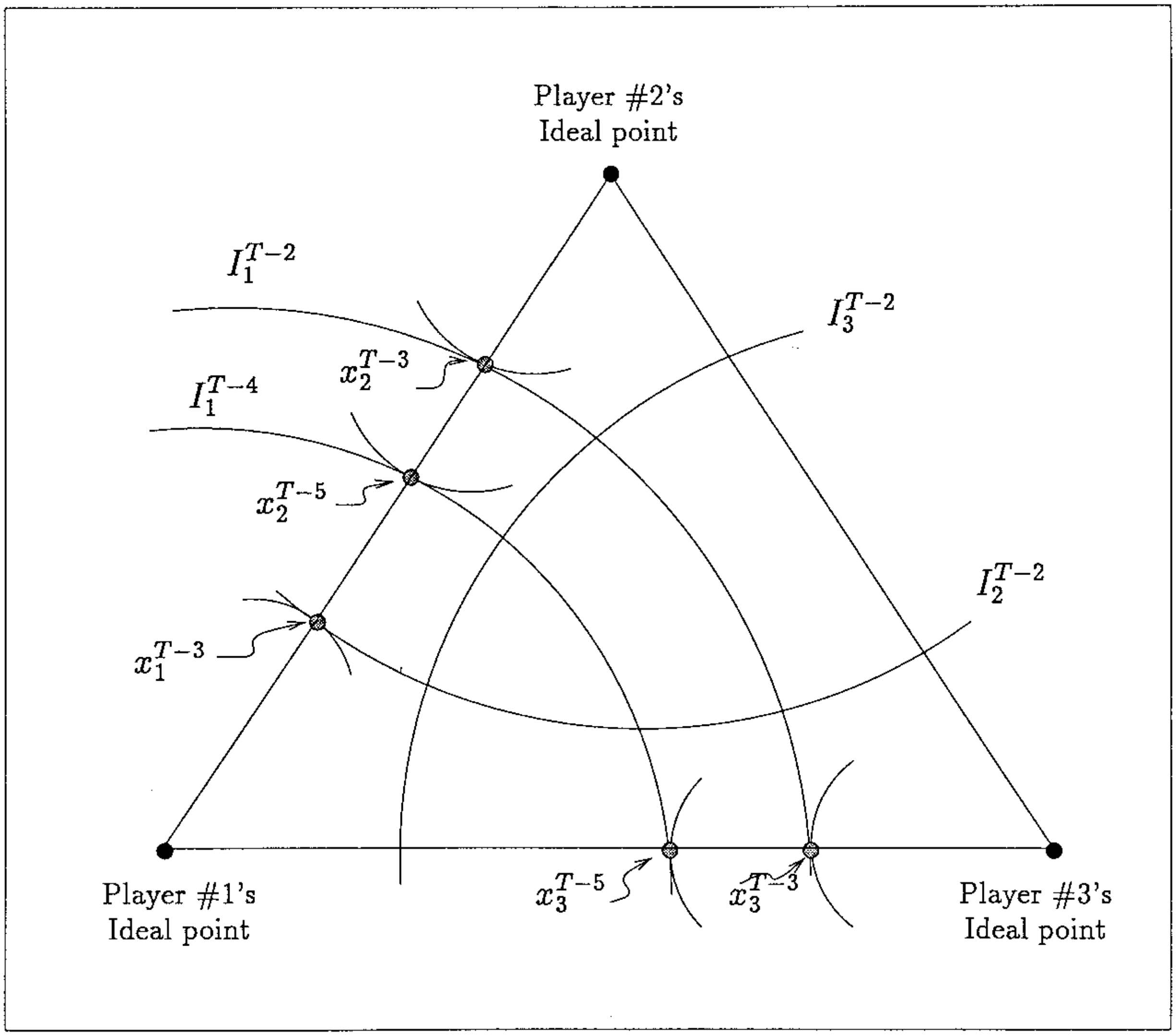

FIGURE 1. A three player, T-round game.

To provide some intuition about the internal workings of the model, we will discuss a simple example, illustrating why a deterministic solution must exist whenever there is at least one essential player. While the argument presented below is not a general one, it does indicate the flavor of the general proof. There are three players who meet together to divide up the unit simplex (see figure 1). We assume that player #1 is essential, so that the only admissible coalitions consist of either players #1 and #2, or #1 and #3. Players' ideal points are at the vertices of the triangle shown in figure 1. We assume that the default outcome yields all three players sufficiently low payoffs that in round T of the game, each player will accept any offer in the simplex, rather than incur the default payoff. In this case, each player will select her own ideal point in round T-1, if selected by nature to be the proposer. For each player i, the line I_i^{T-2} is the indifference curve corresponding to player i's *reservation utility* in round $T-2$: any policy in the set I_i^{T-2} yields player i the same payoff as the lottery she would face if negotiations were to continue to round $T-1$. In round $T-2$, player i will accept any policy in the convex hull of this set. In round $T-3$, players #2 and #3 must propose, respectively, the policies x_2^{T-3} and x_3^{T-3}. Player #1 has two choices: we will assume that she proposes x_1^{T-3}. Now consider round $T-4$. Since player #1 will realize at least her $T-2$-reservation utility if she reaches round $T-3$, and may realize a higher utility, her reservation utility in round $T-4$ must be higher than in round $T-2$. It follows that the indifference curve I_1^{T-4} must be closer to #1's ideal point than the curve I_1^{T-2}. In round $T-5$, players #2 and #3 must offer, respectively, the policies x_2^{T-5} and x_3^{T-5}. Player #1's own proposal in this round is not shown in the diagram: it depends on the locations of the two (unspecified) curves I_2^{T-4} and I_3^{T-4}. It is clear, however, that #1 can do strictly better than the line I_1^{T-4}. Applying this logic repeatedly, it follows that the sequence of indifference curves, $(I_1^{T-2}, I_1^{T-4}, \ldots)$, must contract towards player #1's ideal point. It can be shown that the *rate* at which these indifference curves contract is bounded away from zero. Hence, if T is sufficiently large, all of the locations proposed in the first round of negotiations will be arbitrarily close to player #1's ideal point. It follows that in the limit, #1's ideal point must be implemented with probability one.

3. A Parameterized Family of Bargaining Problems.

This section specifies the family of problems that will be analyzed in detail in the following section. We then discuss our methodology for analyzing the model and propose some hypotheses about its properties.

3.1. The Bargaining Problem. There are six players. All but one of these comprise an *alliance*. The remaining player (indexed by zero) will be referred to as the *adversary*. The interests of alliance members are all similar but not identical; the adversary's interests are partially, but not entirely, in conflict with those of the alliance members.

3.1.1. *The Policy Space:* The space of issues over which players negotiate is called the *policy space* and is denoted by X. A *policy* in X consists of a *distribution variable*, paired with a *transfervariable*. The transfervariable takes values in the unit interval; the distribution variable takes values in $[-1, 1]$. For heuristic purposes, it is convenient to think of the distribution variable as an indicator of political conservatism or liberalism: values to the left (resp. right) of the origin will be interpreted as representing left-wing (resp. right-wing) policies.

Alliance members all prefer the transfervariable to be as large as possible, while the adversary prefers it to be as small as possible. Players have Euclidean preferences over distribution vectors. That is, each player has an *ideal distribution*, and prefers distributions to be as close as possible to her ideal. The space of distribution vectors is normalized so that the adversary's ideal distribution, denoted by α_0, is the origin. Player i's ideal distribution is denoted by $\alpha_i \in [-1, 1]$. The alliance members are divided into *left-wingers* and *right-wingers*. Players #1 and #2 are are referred to collectively as "the left-wingers," because $\alpha_1, \alpha_2 < 0$; Similarly, players #4 and #5 are referred to as "the right-wingers," because $\alpha_4, \alpha_5 > 0$. Player #3's ideal point is also right-of-center, though closer to the center than #4 or #5. Thus, the right-wing faction controls a majority of the votes within the alliance. Observe that with regard to the distribution variable, the interests of individual alliance members may either coincide or conflict with the interests of the adversary.

This configuration admits a wide variety of interpretations. For example, consider the following stylized scenario about agricultural policy formation. Each alliance member is a legislator representing some agricultural district, while the adversary represents the Executive Branch. The transfervariable represents the total value of fiscal transfers to the agricultural sector. The distribution vector represents the attributes of the government's agricultural policy: distributions to the left of the origin could denote policies designed to benefit small and poor farmers, while those to the right of the origin denote "coupled" policies, whose benefits are proportional to output and so are favored larger agricultural producers.

3.1.2. *Preferences:* Alliance members' preferences are assumed to be (modified) Cobb-Douglas in the distribution and transfervariables. That is, player i's utility is the product of an affine function of the transfervariable with an affine function of i's Euclidean preferences over distribution vectors. Precisely, for $i = 1, ..., 5$, player i's utility function $u_i : X \rightarrow \Re$ is defined by:

$$u_i(x) \quad = \quad \eta_i \left\{ [\bar{\gamma} - \bar{\beta}(x_1 - \alpha_i)^2][\bar{\gamma} + x_2] \right\}^{1-\rho_i}$$

As noted above, $\alpha_i \in [-1, 1]$ is i's ideal distribution. The scalar $\bar{\beta}$ is restricted to lie in the interval $(0, 1]$. Clearly, alliance member i's utility is increasingly sensitive to the distribution variable, the larger is $\bar{\beta}$. Hence, we refer to $\bar{\beta}$ as the (common) *distribution sensitivity coefficient* for the alliance. The scalar $\bar{\gamma}$ is a positive constant whose only role is to guarantee that alliance members' utilities are always positive; it has no particular behavioral interpretation. Player i's risk aversion coefficient is $\rho_i \in (0, 1)$. The normalization constant η_i is calculated so that player i's utility always attains a maximum value of 100. Observe that given these restrictions on parameter values, u_i will be strictly concave.

The adversary's utility function is a (modified) constant elasticity of substitution function. Specifically, $u_0 : X \rightarrow \Re$ is defined by:

$$u_0(x) \quad = \quad \eta_0 \left\{ \beta_0[\gamma_0 - (x_1 - \alpha_0)^2]^{\xi_0} + (1 - \beta_0)[\gamma_0 - {x_2}^2]^{\xi_0} \right\}^{(1-\rho_0)/\xi_0} .$$

$$\equiv \quad \eta_0 \left\{ \beta_0[\gamma_0 - {x_1}^2]^{\xi_0} + (1 - \beta_0)[\gamma_0 - {x_2}^2]^{\xi_0} \right\}^{(1-\rho_0)/\xi_0} ,$$

since $\alpha_0 \equiv 0$. The parameters γ_0, η_0 and ρ_0 are the exact counterparts of $\bar{\gamma}$, η_i and ρ_i in the expression for u_i. Like $\bar{\beta}$, the scalar β_0 is restricted to lie in the interval $(0, 1]$. Though the roles that β_0 and $\bar{\beta}$ play in the respective utility expressions are somewhat different, the interpretation of the two parameters is similar. In particular, the adversary's utility becomes increasingly sensitive to distribution, as β_0 increases. Like $\bar{\gamma}$, γ_0 is chosen to ensure that u_0 is always positive. The *flexibility coefficient* $\xi_0 \in (-\infty, 1]$ determines the adversary's elasticity of substitution between the distribution and transfervariables.

3.1.3. *The Remaining Parameters:* To complete the specification of the multilateral bargaining model, we need to specify the set of admissible coalitions, the default option and the vector of access probabilities. We assume that a coalition is admissible if and only if it contains the adversary, together with a strict majority of the alliance members. As observed in Rausser-Simon [1991, Corollary 2], we can without loss of generality restrict attention to minimal admissible coalitions. Thus, with five alliance members there are ten admissible coalitions. We assume throughout that the default alternative yields each player a lower payoff than any element of the policy space. Hence, in the last response round of the game, each player will agree to any proposal rather than incur the default payoff. Conclude that in the last offer round, player i will propose the vector $(\alpha_i, 1)$ while the adversary will propose the vector $(0,0)$.

The canonical bargaining problem is represented schematically in figure 2. The distributionand transfervariables are plotted on the horizontal and vertical axes, respectively. Each solid bullet represents the indicated player's most preferred element of the policy space. The line joining the ideal points for players #0 and #3 denotes *the core* of the underlying bargaining problem. The line is the locus of mutual tangency points of #0's and #3's indifference curves. Adapting conventional terminology slightly, we will refer to this locus as the *contract curve* between the alliance and the adversary.

To see that any point on the line segment belongs to the core, consider the point labelled "A" in Figure 2. The lightly drawn curves through this point represent indifference curves for players #1, #2, #4 and #5. Thus there is no point that lies *below* #3's indifference curve through "A" that is preferred to "A" by a strict majority of alliance members. Moreover, by construction, there is no point that lies *above* #3's indifference curve through "A" that is preferred to "A" by the adversary. Since any admissible coalition must contain a strict majority of alliance members plus the adversary, there is no such coalition that can block the point "A". To see that the line segment characterizes the core, consider the point labelled "B" in the figure. The shaded lens to the left of point "B" is preferred to "B" by both #3 and #0. Moreover, any point in this region is also preferred to "B" by both left-wing members of the alliance. Thus, point "B" can be blocked by the coalition consisting of players #0, #1, #2 and #3.

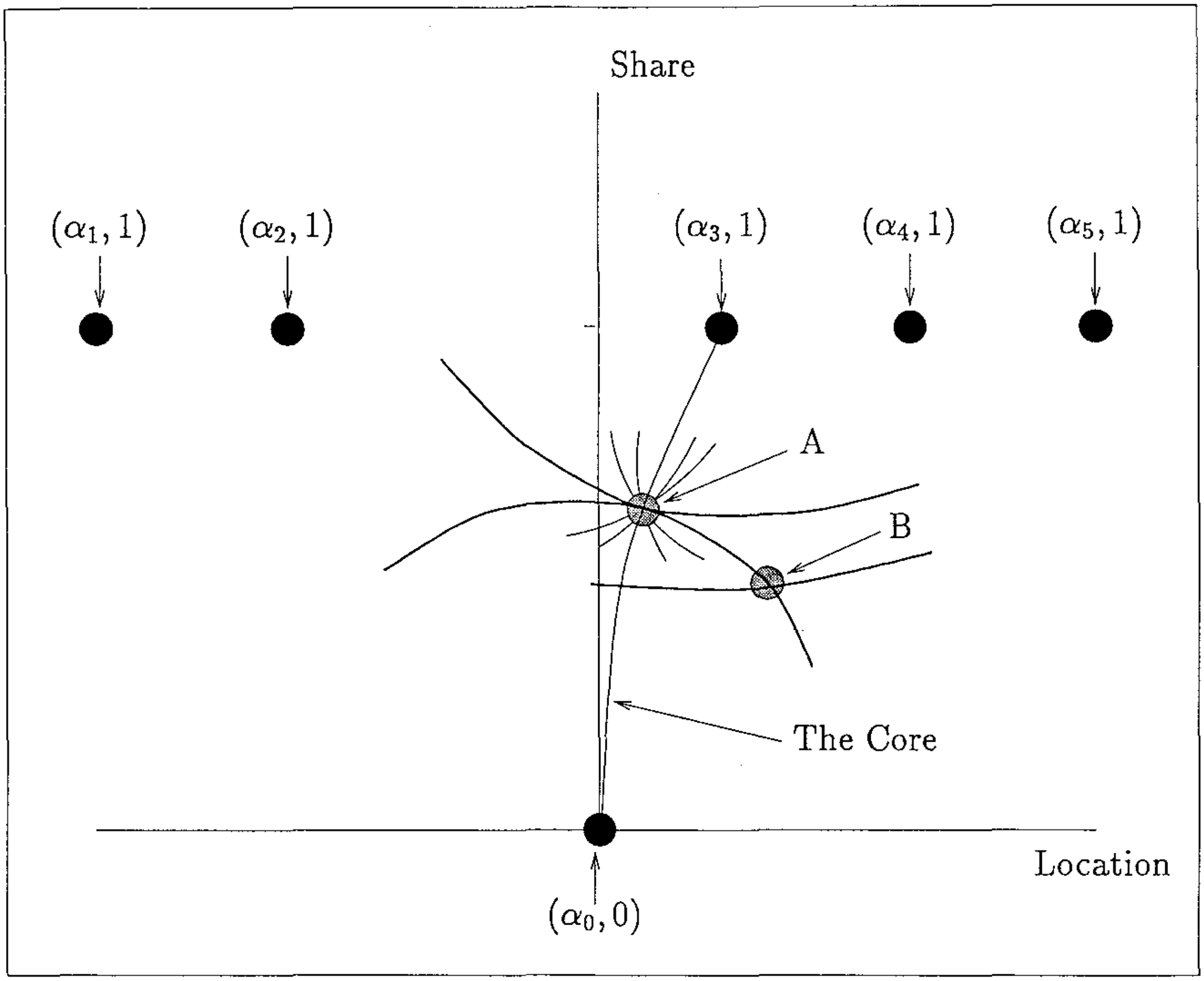

FIGURE 2. The canonical bargaining problem.

3.2. Research Methodology. Section 4 below reports the results of a series of Monte Carlo experiments, designed to investigate the comparative statics properties of the model presented above. Monte Carlo methods are utilized because for several reasons, standard calculus techniques are inappropriate in the present context, for several reasons. First, a solution to our bargaining model is a steady state of a relatively complex, high-dimensional, nonlinear, nondeterministic difference equation, involving a nested sequence of nonlinear programming problems. It is clearly impossible to obtain a closed form solution to this equation. To analyze rigorously the comparative statics properties of the model, therefore, it is necessary to study the properties of individual negotiation rounds, and apply a backward induction argument. But to analyze even a single round, a large number of special cases must be considered, taking into account each of the coalitions chosen by each proposer, and each of the possible combinations of constraints that may be binding on the proposer. Second, the model is sufficiently complex that even if analytic comparative statics expressions were available, it would not be possible to sign these expressions determinately. The signs would depend on the relative magnitudes of a multitude of competing effects. Finally, the map from parameters to solutions is highly discontinuous: at each stage of the game, each player must propose one of a finite set of coalitions; a discontinuity may arise whenever there is a change in some player's optimal proposal. Thus, even if certain comparative statics expressions could be signed, the purely local information provided by these signs would be of limited usefulness: they could not extrapolated to yield noninfinitesimal conclusions. In short, it appears that in the present context the cost/benefit ratio from a formal mathematical approach is prohibitively high.

In spite of its analytical intractability, our model has a number of striking properties that are rather transparent at an intuitive level. These properties can readily be demonstrated with the aid of a few well-chosen examples. Our Monte Carlo techniques provide a nonrigorous but nonetheless compelling methodology for testing the robustness of intuitions derived from the study of specific examples. Moreover, by studying the statistical regularities revealed by batteries of Monte Carlo experiments, we are led to further insights about the structure of the model. These insights suggest, in turn, more focused experiments, designed to test directly specific conjectures.

Our Monte Carlo study is organized into a series of numerical *comparative statics experiments*. Each experiment consists of twenty *simulation decatuples*. Each decatuple consists of ten individual simulations, called *iterations*, in which one parameter (or group of parameters) of the bargaining problem is systematically varied. The parameter being varied is referred to as the *target variable*. Each simulation decatuple is initialized by randomly selecting a value for each parameter of the game. Each parameter value is drawn from a uniform distribution over an interval that will be specified below. The initial list of parameter values defines the *base-case iteration* for the decatuple. Once a solution has been computed for the base-case iteration, the target variable is perturbed nine times. Each time, a new solution is computed. Thus, each simulation decatuple consists of a family of ten bargaining models, all identical except for the values of the target variable. By considering not one but several increments in the target variable, information is acquired that enables us to identify not just local effects but also noninfinitesimal trends.

3.3. Hypotheses. The focus of the paper is on the relationship between three constructs: the structure of the alliance, the context in which negotiations take place and the "performance" of the alliance. By "structure" we mean the configuration of alliance members' preferences as well as their bargaining attributes, such as access probabilities. The "context" of negotiations refers to the rules of the bargaining game, including such factors as the structure of the set of admissible coalitions and the range of allowable policy proposals. Our measure of alliance "performance" varies from experiment to experiment, depending on whether or not the core of the underlying bargaining problem is invariant to the perturbations being considered. When the core is invariant, the natural measure of alliance performance is the location of the negotiated solution along the fixed, one-dimensional contract curve. In general, as the solution moves northeast along this curve, the utilities of all alliance members increase while the adversary's utility decreases. In several of our experiments, however, the contract curve shifts from iteration to iteration. In this case, there is no definition of "alliance performance" that is entirely satisfactory, since in general, changes in structure and context will benefit some alliance members at the expense of others. In these instances, we will usually take as a proxy measure of performance the negotiated value of the transfervariable, since increases in this variable will, other things being equal, benefit all alliance members at the expense of the adversary. In either case, it is important to distinguish the normative measure we call "performance" from "social welfare." For example, the adversary might represent society as a whole while the alliance represents a group of special interests whose goals are antithetical to society's. In this case, alliance performance and social welfare will be inversely correlated.

The experiments reported in the following section were designed to test a number of specific hypotheses. Of these, some formalize themes that are implicit in the political science literature. Others simply reflect the "conventional wisdom" about the nature of alliances. Still others emerged as a result of our earlier research (reported in Rausser-Simon [1991] and Adams-Rausser-Simon [1992]). While many of the hypotheses are quite self-evident, to our knowledge there have been no previous attempts to test them any systematic way in the context of a formal model. One reason for this, presumably, is that except for the present model, there are few existing models of multilateral bargaining that predict a unique outcome. Obviously, the kinds of questions considered in this paper cannot be addressed unless this property is satisfied.

The first three hypotheses listed below concern the relationship between alliance structure and performance. The remaining two concern the relationship between context and performance.

Hypothesis A. Alliance performance will be greater, the greater the relative weight that its members assign to communal objectives rather than factional objectives.

In general, this hypothesis is self-evident: the alliance will be more successful, the more focussed are its members on the goals that are common to all of them and the less energy is expended on factional infighting.

Hypothesis B. If one faction of the alliance is more powerful than the other, then a shift in power that further enhances the relative power of the first faction will increase alliance performance.

This hypothesis is also intuitive. It seems natural that the more asymmetric is the distribution of power within an alliance, the more effective will be its leadership and, hence, the greater will be its performance. On the other hand, paralysis might result from an evenly balanced distribution of power.

Hypothesis C. Alliance performance will be greater, the more powerful are its more moderate members relative to the extreme members of each faction.

The basis for this hypothesis is that extreme members will assign relatively more weight to factional goals than will moderate members. Thus, the more highly polarized an alliance is, the less effective it is likely to be. In this sense, hypothesis C is a corollary of hypothesis A.

Hypothesis D. Alliance performance will be greater, and the results of negotiations less partisan, the larger the size of a minimal admissible coalition.

The first part of this hypothesis might be disputed on the grounds that the transactions costs of decision-making will increase with the number of parties whose consent is required. In our model, however, the transaction cost factor is not modelled. Since agreement is invariably obtained, increasing the minimal coalition size increases the pressure to subordinate factional conflict to communal goals. Moreover, since the proposals submitted by either faction must be approved by members of the other faction, there will be a tendency towards centrist positions (i.e., distributions closer to the origin).

> **Hypothesis E.** If the space of allowable policy proposals is restricted, then negotiators who strongly favor the policies excluded by the restriction may benefit at the expense of those who strongly oppose these policies.

Unlike the preceding hypotheses, this one is at least superficially counterintuitive. A related phenomenon was first observed in experiments reported in ARS[1991]. To the extent that it can be widely validated, the hypothesis has striking implications for practical negotiators. Protagonist often seek to manipulate the negotiating environment prior to the commencement of actual negotiation sessions, by excluding from the negotiation table agenda items that they vigorously oppose. The analysis presented in the following sections suggests that agenda-manipulation maneuvers of this kind may not always be advisable.

4. Results of the Experiments.

This section reports the results of the Monte Carlo experiments. Except when otherwise specified, the parameters for the base-case iteration of each experiment will be drawn from uniform distributions over the intervals specified in table 1. Several of the parameters are arranged in pairs, with restrictions applying to each pair. The restrictions are imposed to demonstrate more sharply certain key relationships between exogenous and endogenous variables. We will explain each line of the table 1 in turn.

Table 1. Restrictions on the Parameter Space.

Line no.	Description of variable pair	Vari able	Lower bound	Upper bound	Vari able	Lower bound	Upper bound	Restriction
				Utility Parameters:				
1	Sensitivity to distribution:	$\bar{\beta}$	0.0	1.0	β_0	0.0	1.0	$\bar{\beta} = 1 - \beta_0$
2	Constant term:	γ_0	10.0	10.0	$\bar{\gamma}$	10.0	10.0	
3	Substitution param:	ξ_0	-6.0	1.0				
				Alliance members' ideal distributions:				
4	Ideal pts for #1,5	α_1	-1.0	-0.7	α_5	0.7	1.0	$\alpha_1 = -\alpha_5$
5	Ideal pts for #2,4	α_2	-0.7	-0.4	α_4	0.4	0.7	$\alpha_2 = -\alpha_4$
6	Ideal pts for #3	α_3	0.1	0.4				
				Bargaining attributes:				
7	Access probabilities:	w_0	0.5	0.75	w_i	0.05	0.1	w_i's equal
8	Risk aversion coef:	ρ_0	0.0	1.0	ρ_i	0.0	1.0	ρ_i's equal

The restriction on line 1 specifies that the two distribution sensitivity coefficients are perfectly negatively correlated. This restriction is imposed because in many of the experiments, results turn out to be highly sensitive to the relative magnitudes of these two variables. The nature of this dependency is most starkly demonstrated when they are negatively correlated. The restriction on line 2 states that the constants $\bar{\gamma}$ and γ_0 are held fixed throughout. This restriction is imposed because these variables have no behavioral interpretation: their only role is to ensure that utilities are strictly positive. The restriction on line 3 imposes a lower bound on ξ_0. Some such restriction is necessary if ξ_0 is to be drawn from a uniform distribution; the choice of -6, however, is entirely arbitrary. Lines 4 and 5 specify that players #1 and #5 are equally extreme left- and right-wingers, while players #2 and #4 are equally moderate left- and right-wingers. Line 6 declares that player #3 is a right-winger, but more moderate than #4 or #5. Line 7 specifies that the aggregate alliance access probability cannot exceed 0.5. This restriction is imposed to reduce the frequency with which corner solutions arise. Lines 7 and 8 specify that the alliance members have identical bargaining attributes. The symmetry restrictions in line 4 and 5, together with the equality restrictions in line 7 and 8, are imposed to sharpen the focus on the balance of power between the left- and right-wing factions. Under the assumptions of table 1, the *only* distinction between the left- and the right-wing factions is that player #3's orientation is right-of-center. This ensures that in a strategic sense the right-wing is unambiguously more powerful than the left-wing.

Our comparative statics experiments are organized into several *clusters*, each consisting of a number of related experiments. The clusters can in turn be classified into two groups. The first group of experiments consists of three clusters which investigate the relationship between alliance performance and the internal structure of the alliance. The second group consists of two clusters, which consider the relationship between alliance performance and the context within which negotiations take place.

4.1. Experiment Cluster "$\mathcal{A}$"—Access probabilities. This cluster consists of four experiments in which the distribution of access among alliance members is perturbed. The four experiments are referred to as $\mathcal{A}(5,1)$, $\mathcal{A}(4,2)$, $\mathcal{A}(2,1)$ and $\mathcal{A}(4,5)$. In the base-case iteration of each simulation decatuple, an aggregate alliance probability of 0.5 is split equally among the members; that is, $w_i = 0.1$, for each i, while $w_0 = 0.5$.

In each subsequent iteration of experiment $\mathcal{A}(j,k)$, player j's access probability, w_j, is incremented by 0.002, player k's access is decremented by 0.002, and other players' probabilities are unchanged. Thus, experiments $\mathcal{A}(5,1)$ and $\mathcal{A}(4,2)$ transfer access from the left- to the right-wing, while experiments $\mathcal{A}(2,1)$ and $\mathcal{A}(4,5)$ transfer access from extreme members of each faction to moderate members.

Since the core of the underlying bargaining problem is invariant to the distribution of access, the natural measure of alliance performance in this experiment is the location of the solution along the fixed "contract curve" (see figure 2 above, p. 12). Since the right-wing faction is more powerful than the left-wing, hypothesis B predicts that in experiments $\mathcal{A}(5,1)$ and $\mathcal{A}(4,2)$ alliance performance should improve from iteration to iteration. As table 2 below demonstrates, the experimental data is consistent with this prediction. The table reports on the qualitative effects of the access transfer on solution values and on players' equilibrium utilities in experiment $\mathcal{A}(5,1)$. (The results for experiment $\mathcal{A}(4,2)$ are very similar, and so are not presented here.)

TABLE 2. Simulation results for experiment $\mathcal{A}(5,1)$: $w_5 \nearrow$; $w_1 \searrow$.

Simulation	Change in location	Change in share	Change in #1's utility	Change in #3's utility	Change in #5's utility	Change in #0's utility
1	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
2	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
3	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
4	++++--+++	++++--+++	++++--+++	++++--+++	++++--+++	----++---
5	-++++-++-	+++++++++	+++++++++	+++++++++	+++++++++	---------
6	-++-+++++	-++-+++++	-++-+++++	-++-+++++	-++-+++++	+--+-----
7	-++++++++	-++++++++	-++++++++	-++++++++	-++++++++	+--------
8	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
9	-++++++++	-++++++++	-++++++++	-++++++++	-++++++++	+--------
10	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
11	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
12	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
13	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
14	+-++-++--	+++++++++	+++++++++	+++++++++	+++++++++	---------
15	++--+++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
16	-++++++++	-++++++++	-++++++++	-++++++++	-++++++++	+--------
17	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
18	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------
19	+-++-+-++	+++++++++	+++++++++	+++++++++	+++++++++	---------
20	+-+++++++	+-+++++++	+-+++++++	+-+++++++	+-+++++++	-+-------

Columns two and three of table 2 report the qualitative changes in the distribution and transfervariables as β_0 is modified. For example, in the fourth row of the table the string "++++--+++" in both columns is interpreted as follows: the solution moves northeast up the contract curve for the first five iterations, then moves southwest for two iterations, then continues to climb again for the remaining iterations. Columns four through seven report the changes in selected players' solution utilities from iteration to iteration. In this particular experiment, northeasterly shifts in the solution policy invariably result in increases in all alliance members' utilities and a decrease in the adversary's utility. Result I below summarizes the data.

> **Result I.** The effect of an access transfer from a left-winger to her right-wing counterpart is to shift the solution northeast along the contract curve. Alliance members' solution utilities increase, while the adversary's utility decreases.

Note in particular that left-wingers' solution utilities increase in spite of the decline in their individual power. While their factional objectives are compromised, their "communal gain" offsets this loss.

The general intuition underlying Result I is quite transparent. The transfer in access has a "primary" and a "secondary" effect. In the final round of negotiation, the primary effect alone is in operation. In the preceding rounds, the primary and secondary effects operate in conjunction. The primary effect is, simply, that when access is transferred, more weight is assigned to a proposition that is relatively attractive to the dominant right-wing of the party, and less weight is assigned to a less attractive proposition. The secondary effect is a consequence of the primary effect. Because it has less to lose in later rounds of the game, the right-wing adopts a more aggressive bargaining stance in earlier rounds. The two types of effects are mutually reinforcing, and result ultimately in a shift northeast along the contract curve.

Table 3 below provides a concrete illustration of this general idea. The table compares the last three offer rounds of the first two iterations of simulation #1 in experiment $\mathcal{A}(5,1)$. While the example illustrates only one of the many possible types of special cases that can arise, it will be clear that the reasoning applies more generally. The table consists of six blocks of data. Each block is separated from the others by heavy horizontal lines. The first six rows of each block specifies the details of the proposition that would be proposed if the player listed in the first column were selected by nature to be the proposer. Column two lists the alliance members who would be included in the proposed coalition. (The adversary is an essential player, and is included in every coalition.) Columns three and four list the proposed policy. Columns five through ten specify the utilities that each player would receive if the proposition were implemented. An asterisk in a column indicates that the corresponding player's participation constraint is binding on the proposer. The last line of each block of data list each player's expected utility from the lottery that is about to be played out.

For example, consider the first row of the third block of data in table 3. If player #1 were selected by nature in round T-3 of the base-case iteration, then she would propose the coalition consisting of players #0, #1, #2 and #3. The first component of her proposition would be the distribution value −0.4781; the second component would be the transfervalue 0.7245. Her proposal would be on the boundary of player #0's and #3's acceptance sets (observe that for each of these players, the utility value of #1's proposal is the same as the player's expected utility in the following round); for player #2, the proposal would be an interior point of her acceptance set (i.e., its utility value strictly exceeds #2's expected utility in the following round).

We now consider the table in detail. In the final offer round, players propose their most preferred policies. Hence, the first two blocks of the table are identical except for their last lines. Right-wingers do better in the second iteration, because #5's proposal—which they favor—is weighted more heavily, while #1's proposal is weighted less heavily. For example, #3's expected utility increases from 94.8450 to 94.8580. Similarly, left-wingers do worse. For the adversary, on the other hand, the proposals announced by #1 and #5 are equidistant from her ideal distribution. Hence the adversary is unaffected by the change in access probabilities.

The third and fourth blocks of table 3 compare round T-3 in each of the two iterations. Observe that in this round, player #3's participation constraint is binding both on player #1 and on the adversary. Because #3's participation constraint is tighter in the second iteration than in the base-case, both #1's and #0's proposals are more favorable to the right-wing faction. For the remaining players in this round, only the adversary's constraint is binding. Since this constraint is unchanged, their proposals are the same in both iterations. Once again, however, player #5's proposal is weighted more heavily, and #1's less heavily in the second iteration. Hence in this round there are three distinct effects, all of which benefit the right-wing faction. For the adversary, the only difference between the two iterations is that she derives less utility from

TABLE 3. Simulation #1, Exp $\mathcal{A}(5,1)$: last three offer rounds.

Pr	Co	Offers:		Utilities:					
sr	al	x_1	x_2	u_1	u_2	u_3	u_4	u_5	u_0
Round T-1 of base-case iteration: $w_5 = w_1 = 0.1$.									
1	145	−0.9486	1.0000	100.0000	99.0617	91.7729	89.5663	81.9519	97.0043
2	245	−0.5072	1.0000	99.0617	100.0000	96.4601	94.9968	89.5663	97.5328
3	345	0.3475	1.0000	91.7729	96.4601	100.0000	99.8773	98.2566	97.6274
4	145	0.5072	1.0000	89.5663	94.9968	99.8773	100.0000	99.0617	97.5328
5	145	0.9486	1.0000	81.9519	89.5663	98.2566	99.0617	100.0000	97.0043
0	145	0.0000	0.0000	88.8968	91.8042	92.4167	91.8042	88.8968	100.0000
Expected utilities:				90.6837	93.9106	94.8450	94.2523	91.3320	98.6701
Round T-1 of second iteration: $w_5 = 0.102$; $w_1 = 0.098$.									
1	145	−0.9486	1.0000	100.0000	99.0617	91.7729	89.5663	81.9519	97.0043
2	245	−0.5072	1.0000	99.0617	100.0000	96.4601	94.9968	89.5663	97.5328
3	345	0.3475	1.0000	91.7729	96.4601	100.0000	99.8773	98.2566	97.6274
4	145	0.5072	1.0000	89.5663	94.9968	99.8773	100.0000	99.0617	97.5328
5	145	0.9486	1.0000	81.9519	89.5663	98.2566	99.0617	100.0000	97.0043
0	145	0.0000	0.0000	88.8968	91.8042	92.4167	91.8042	88.8968	100.0000
Expected utilities:				90.6476	93.8916	94.8580	94.2713	91.3681	98.6701
Round T-3 of base-case iteration: $w_5 = w_1 = 0.1$.									
1	123	−0.4781	0.7245	97.0363	98.0784	94.8450*	93.4563	88.2645	98.6701*
2	124	−0.3761	0.7460	96.6801	98.1517	95.7460	94.5166	89.7827	98.6701*
3	135	0.2626	0.7625	91.2989	95.5277	98.3139	98.0649	96.1124	98.6701*
4	245	0.3761	0.7460	89.7827	94.5166	98.2290	98.1517	96.6801	98.6701*
5	345	0.6420	0.6715	85.4810	91.4168	97.3035	97.6259	97.2694	98.6701*
0	345	0.1611	0.2872	89.3037	92.9540	94.8450*	94.4559	92.1528	99.8047
Expected utilities:				90.6797	94.2461	95.8663	95.4095	92.8873	99.2374
Round T-3 of second iteration: $w_5 = 0.102$; $w_1 = 0.098$.									
1	123	−0.4767	0.7248	97.0325	98.0804	94.8580*	93.4714	88.2857	98.6701*
2	124	−0.3761	0.7460	96.6801	98.1517	95.7460	94.5166	89.7827	98.6701*
3	345	0.2626	0.7625	91.2989	95.5277	98.3139	98.0649	96.1124	98.6701*
4	245	0.3761	0.7460	89.7827	94.5166	98.2290	98.1517	96.6801	98.6701*
5	345	0.6420	0.6715	85.4810	91.4168	97.3035	97.6259	97.2694	98.6701*
0	345	0.1616	0.2889	89.3091	92.9623	94.8580*	94.4697	92.1686	99.8025
Expected utilities:				90.6590	94.2371	95.8789	95.4262	92.9153	99.2363
Round T-5 of base-case iteration: $w_5 = w_1 = 0.1$.									
1	123	−0.1699	0.5871	94.2705	96.5878	95.8663*	94.9685	91.1986	99.2374*
2	123	−0.1699	0.5871	94.2705	96.5878	95.8663*	94.9685	91.1986	99.2374*
3	345	0.2327	0.5789	90.4507	94.4926	97.0009	96.7105	94.6582	99.2374*
4	345	0.3311	0.5600	89.1597	93.6300	96.9285	96.7851	95.1460	99.2374*
5	345	0.5512	0.4803	85.6806	91.1148	96.1765	96.3598	95.6362	99.2374*
0	345	0.1996	0.4234	89.7960	93.6494	95.8663*	95.5303	93.3641	99.5876
Expected utilities:				90.2812	94.0660	96.1170	95.7444	93.4658	99.4125
Round T-5 of second iteration: $w_5 = 0.102$; $w_1 = 0.098$.									
1	123	−0.1681	0.5877	94.2619	96.5866	95.8789*	94.9838	91.2212	99.2363*
2	123	−0.1681	0.5877	94.2619	96.5866	95.8789*	94.9838	91.2212	99.2363*
3	345	0.2328	0.5794	90.4525	94.4950	97.0040	96.7137	94.6616	99.2363*
4	345	0.3312	0.5605	89.1610	93.6320	96.9315	96.7883	95.1496	99.2363*
5	345	0.5515	0.4808	85.6798	91.1153	96.1790	96.3628	95.6401	99.2363*
0	345	0.2001	0.4251	89.8028	93.6585	95.8789*	95.5435	93.3788	99.5844
Expected utilities:				90.2659	94.0598	96.1273	95.7577	93.4876	99.4103

her own offer in the latter. Hence conditional on reaching round T-3, the adversary's expected utility is lower in the second iteration.

The fifth and sixth blocks of the table compare round T-5. As a consequence of the effects just described, player #3's participation constraint is tighter in the second iteration, while the adversary's is slacker. Hence the effects in round T-5 amplify those in T-3. Proceeding backwards along the inductive chain, the primary and secondary effects continue to accumulate, ultimately resulting in a northeasterly shift in the solution.

For the left-wing, the effect of the access shift is less straightforward, because the primary and secondary effects operate in opposite directions. As table 3 indicates, the primary effect of the access shift is that left-wingers' expected utilities conditional on reaching round T-1 are significantly lower. In round T-3, the decline in left-wing expected utilities is smaller, because the secondary effect—weakening the adversary and strengthening the alliance—partially offsets the primary effect. Proceeding further along the backward inductive chain, the positive secondary effect eventually dominates the negative primary effect, so that in the limit, the left-wingers actually do better in the second iteration than in the first.

As table 2 indicates, there are a few individual iterations in which the qualitative effects summarized in Result I are all reversed. In simulation #4, for example, the solution values of both the transferand the distribution variables are lower in the sixth iteration than in the fifth. Reversals of this kind occur because at some It turns out that whenever a reversal of this kind occurs, there point, some player switches from one coalition to another. For example, in round T-3 of simulation #4, the adversary selects the coalition {345} for the first five iterations, then switches to the coalition {125}. This switch has the obvious effect: having been bypassed in round T-2, the bargaining positions of players #3 and #4 are weakened in round T-5and earlier. This effect has ramifications that are transmitted all the way back up the game tree.

We now consider experiments $\mathcal{A}$(2,1) and $\mathcal{A}$(4,5). Table 4 reports on the outcome of experiment $\mathcal{A}$(2,1). (Once again, the results for experiment $\mathcal{A}$(4,5) are very similar, and are not reported.) Since player #2 (resp. #4) is more moderate than player #1 (resp. #5), hypothesis C predicts that alliance performance should improve from iteration to iteration. As the table demonstrates, the experimental data is consistent with the hypothesis only if $\bar{\beta}$ is large relative to β_0 (recall from table 1 that $\beta_0 = 1 - \bar{\beta}$). Result II below summarizes the data in the table.

TABLE 4. Simulation results for experiment $\mathcal{A}(2,1)$: $w_2 \nearrow$; $w_1 \searrow$.

Simulation	Change in location	Change in share	Change in #1's utility	Change in #3's utility	Change in #5's utility	Change in #0's utility	Value of $\bar{\beta}$
15	-------+-	---------	---------	---------	---------	+++++++++	0.035
11	---------	---------	---------	---------	---------	+++++++++	0.179
17	---------	---------	---------	---------	---------	+++++++++	0.197
14	---------	---------	---------	---------	---------	+++++++++	0.201
5	--+-+-+-+	---------	---------	---------	---------	+++++++++	0.254
2	---------	---------	---------	---------	---------	+++++++++	0.314
8	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.412
9	+----++-+	++--+++++	++--+++++	++--+++++	++--+++++	--++-----	0.435
7	-++++++++	-++++++++	-++++++++	-++++++++	-++++++++	+--------	0.484
10	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.626
20	++++++++-	++++++++-	++++++++-	++++++++-	++++++++-	--------+	0.692
1	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.693
16	+++++-+++	+++++-+++	+++++-+++	+++++-+++	+++++-+++	-----+---	0.718
12	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.757
4	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.801
18	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.808
6	+++++-+++	+++++-+++	+++++-+++	+++++-+++	+++++-+++	-----+---	0.814
19	++-+++++-	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.847
3	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.899
13	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.948

Result II. When alliance members' distribution sensitivity coefficient, $\bar{\beta}$, is high relative to the adversary's coefficient, β_0, the effect of an access transfer from an extreme member to a moderate member of either faction is to shift the solution northeast along the contract curve. Alliance members' equilibrium utilities increase, while the adversary's utility decreases. When alliance members' distribution sensitivity coefficient is relatively small, all these effects are reversed.

While the data does not support hypothesis C, it would be consistent with a qualified statement, which took into account the relative sensitivity of the alliance and the adversary to distribution.

Once again, the basic intuition is very straightforward. The primary effect of the shift in access benefits both the adversary and player #3: for both players, a relatively favorable proposition is assigned more weight at the expense of a relatively unfavorable proposition. Which party gains more from the shift depends on their relative sensitivity to distribution, i.e., on the relative magnitudes of $\bar{\beta}$ and β_0. The secondary effect of the shift favors whichever party gains more from the primary effect. For example, if $\bar{\beta}$ is larger than β_0 then in earlier rounds, #3's bargaining stance will be toughened relative to the adversary's stance and the secondary effect will benefit #3, but harm the adversary. Result II follows easily from this reasoning.

4.2. Experiment Cluster "$\mathcal{R}$"—risk aversion. Experiment cluster $\mathcal{R}$ consists of four experiments in which the risk aversion coefficients of alliance members are perturbed. The four experiments will be referred to as $\mathcal{R}$(5,1), $\mathcal{R}$(4,2), $\mathcal{R}$(2,1) and $\mathcal{R}$(4,5). The design of this cluster parallels the design of cluster $\mathcal{A}$. In the base-case iteration of each experiment, each alliance member has the same risk aversion coefficient, randomly drawn from the interval $[0.1, 0.9]$. In each subsequent iteration of experiment $\mathcal{R}(j,k)$, alliance member j's risk aversion coefficient, ρ_j, is decremented by 0.01, while player k's is incremented by an equal amount. All other players' coefficients remain unchanged.

Our original expectation was that the results of this cluster of experiments would would be very similar to those of cluster "$\mathcal{A}$". It would appear that a player's "political power" should be affected by a change in her risk aversion coefficient in much the same way that it is affected by an change in her access probability. It turns out, however, that there is a critical difference between the two kinds of bargaining attributes. As we observed in the preceding subsection, when the access probability of, say, a right-winger is increased, there is a *primary* effect that benefits each of the other right-wingers and hurts each of the left right-wingers. Specifically, in the last round of bargaining, a policy favored by *all* right-wingers and opposed by *all* left-wingers is assigned greater weight in the calculation of players' participation constraints, stiffening right-wing resolve—and weakening left-wing resolve—in the penultimate and prior negotiating rounds. On the other hand, if right-winger i becomes less risk averse, player i alone experiences a primary effect. Other players may benefit or be hurt by the change, but only through its secondary effects. Specifically, the decrease in i's risk aversion will toughen her bargaining stance in the penultimate round, but all other players will be unaffected. There may be secondary effects but only to the extent that i is invited to vote on other players' proposals. In the extreme event that i is *never* called upon to vote, a change in i's risk aversion coefficient will have no effect whatsoever on the outcome of negotiations.

There is a second difference between the two experiment clusters, which is closely related to the first.

As we have seen, a change in one player's access probability affects other members of the player's faction more or less equally, while a change in one player's risk aversion coefficient affects them only indirectly. As a consequence of this difference, perturbations in risk aversion have much sharper impacts on alliance members' "competitiveness" relative to each other than perturbations in their access probabilities. The principal consequence of these changes is that other players may be induced to change their coalition choices. Specifically, suppose that in round t of the base-case iteration of an experiment, player j proposes a coalition containing player i. A relatively small decrease in i's risk aversion coefficient may induce j to switch to a coalition that excludes i. This kind of affect operates in an asymmetric way, however: an *increase* in i's risk aversion coefficient would reinforce j's preference for the original coalition containing i.

Based on these remarks, we should expect qualitatively different results from experiments in this cluster, depending on whether "key" members of "critical coalitions" become more or less "competitive" in the sense described above. For the particular model studied in this paper, there are indeed two critical coalitions: in the base-case iteration, when alliance members' bargaining attributes are all identical, the adversary almost invariably selects one of the following pair of coalitions: {345} or {125}. Whenever the former coalition is chosen, player #3 is the key member: her's is invariably the only binding constraint. Whenever the latter coalition is chosen, players #2 and #5 are both "key" players in this sense. It turns out that the results in this cluster are indeed qualitatively different, depending on whether either player #2 or #5 becomes more or less risk averse.

Table III below reports the data for experiment $\mathcal{R}(5,1)$ and $\mathcal{R}(4,2)$ and result III summarizes the data. (The data from experiments $\mathcal{R}(2,1)$ and $\mathcal{R}(5,1)$ are very similar, as are the data from $\mathcal{R}(4,5)$ and $\mathcal{R}(4,2)$.) The table reports the adversary's coalition choice in each of the last few offer rounds of each iteration.[4] Throughout the cluster, the adversary selects from the following subset of the set of admissible coalitions (the alphanumeric codes will be used to identify the coalitions in the table): {345} (R); {125} (2); {123} (L); {145} (4); {124} (M). For example, in round T-3 of the third simulation of experiment $\mathcal{R}(5,1)$, the adversary selects the coalition {125} for the first four iterations, then switches to the coalition {145} for the

[4]Her choice in the final offer round (T-1) is not reported, since in this round every coalition will accept every proposal

remaining six. The performance data contained in columns four through seven of tables 2 and 4 is omitted from table 5. This information can readily be inferred, however, from the first two columns: for example, when both distribution and transferincrease performance improves at the expense of the adversary.

> **Result III.** In experiments $\mathcal{R}(5,1)$ and $\mathcal{R}(2,1)$, either player #2 or #5 becomes less risk averse. In these experiments, alliance performance improves *provided* that in the last few offer rounds the adversary continues to select the coalition {125}. After the adversary switches to another coalition, however, alliance performance begins to deteriorate. In experiments $\mathcal{R}(4,2)$ and $\mathcal{R}(4,5)$, either player #2 or #5 becomes more risk averse. The adversary virtually never switches away from coalition { 1 2 5 } and alliance performance almost invariably deteriorates.

These results contrast sharply with experiment cluster $\mathcal{A}$and bear little relationship to the predictions of hypotheses B and C. For example, hypothesis B predicted—correctly—that alliance performance would improve in experiments $\mathcal{A}(5,1)$ and $\mathcal{A}(4,2)$. In experiment $\mathcal{R}(5,1)$, by contrast, alliance performance improves only slightly more often than it deteriorates, while in experiment $\mathcal{R}(4,2)$ it almost invariably deteriorates.

It is clear from table 5 that the dominant factor in determining the comparative statics of this cluster is the adversary's pattern of coalition choices. In six of the simulation decatuples in experiment $\mathcal{R}(5,1)$—#1, #8, #10, #13, #16 and #20—the adversary proposes the same coalition in each iteration of each of the last few offer rounds. In each of these simulations except #8, the adversary alternates between coalition {345} (R) and {125} (2) and alliance performance improves monotonically. In these instances, the adversary's initial preference for coalition {125} is sufficiently strong that #5 is never "priced out of the market." Whenever coalition {125} is chosen, #5's constraint is binding and this constraint becomes tighter from iteration to iteration. The alliance as a whole benefits from the secondary effect of the change in #5's risk aversion: in the rounds in which {125} is chosen, the adversary's proposal becomes more favorable to the alliance in each iteration. Note that though player #1 is becoming increasingly risk averse from iteration to iteration, this fact has no bearing whatsoever on the outcome of negotiations: since at no time is #1's participation constraint binding, the fact that this constraint is becoming slacker is immaterial.

TABLE 5. Simulation results for experiments $\mathcal{R}(5,1)$ and $\mathcal{R}(4,5)$.

Sim #	Change in location	Change in share	Adv's Coal Round T-3	Adv's Coal Round T-5	Adv's Coal Round T-7	Adv's Coal Round T-9	Adv's Coal Round T-11
Experiment $\mathcal{R}(5,1)$: ρ_5 increases; ρ_1 decreases.							
1	+++++++++	+++++++++	RRRRRRRRRR	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222
2	+++++++++	+++++++++	RRRRRRRRRR	2222222224	2222222222	RRRRRRRRRR	2222222222
3	++++-----	++++-----	2222444444	RRRRRRRRRR	RRRRRRRRRR	2222222222	2222222222
4	++++++++-	++++++++-	2222222244	RRRRRRRRRR	RRRRRRRRRR	2222222222	2222222222
5	++---++++	++---+++-	22444444MM	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR	2222222222
6	++++++---	++++++---	2222222444	RRRRRRR444	RRRRRRR444	2222222RRR	RRRRRRR222
7	+++++----	+++++----	2222244444	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR	2222222222
8	+-+-++++-	+--+-+++-	LLLLLLLLLL	LLLLLLLLLL	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR
9	+-----+--	+--------	2444444444	RRR4444444	222RRRRRRR	RRR2222222	2222222222
10	+++++++++	+++++++++	RRRRRRRRRR	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222
11	+--------	+--------	2444444444	RRRRRRR444	2222444RRR	2222444444	RRRRRRR444
12	+-----+--	+-+---+--	2444444444	2224444444	2222222444	RRR2222224	222RRRRRRR
13	+++++++++	+++++++++	2222222222	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR	2222222222
14	++-------	++-------	2244444444	RRRRRRRRRR	2222222222	2222222222	2222222222
15	+---+----	+---+----	2444444444	4244444444	2222244444	RR22222444	22RRRRRRRR
16	+++++++++	+++++++++	2222222222	RRRRRRRRRR	RRRRRRRRRR	2222222222	2222222222
17	-+++++++-	-+++-----	244MMMMMMM	2LLMMMMMMM	RRRRRRRRRR	RRRRRRRRRR	2222244444
18	+++++++++	+++++++++	RRRRRRRRRR	2222222222	2222222222	2222222RRR	RRRRRRR222
19	++++++---	++++++---	2244444444	2222224444	2222222222	2222222222	2222222222
20	+++++++++	+++++++++	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222	2222222222
Experiment $\mathcal{R}(4,2)$: ρ_4 increases; ρ_2 decreases.							
1	---------	---------	RRRRRRRRRR	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222
2	---------	---------	RRRRRRRRRR	2222222222	2222222222	RRRRRRRRRR	2222222222
3	---------	---------	2222222222	RRRRRRRRRR	RRRRRRRRRR	2222222222	2222222222
4	---------	---------	2222222222	RRRRRRRRRR	RRRRRRRRRR	2222222222	2222222222
5	----+++++	---------	2222222222	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR	2222222222
6	---------	---------	2222222222	RRRRRRR222	RRRRRRRRRR	2222222222	RRRRRRRRRR
7	---------	---------	2222222222	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR	2222222222
8	+++-++-++	-+--+---+	LLLLLLLLLL	LLLLLLLLLL	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR
9	---------	---------	2222222222	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222
10	-------+-	---------	RRRRRRRRRR	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222
11	---------	---------	2222222222	RRRRRRRRRR	2222222222	2222222222	RRRRRRRRRR
12	---------	---------	2222222222	2222222222	2222222222	RRRRRRRRRR	2222222222
13	---------	---------	2222222222	RRRRRRRRRR	RRRRRRRRRR	RRRRRRRRRR	2222222222
14	---------	---------	2222222222	RRRRRRRRRR	2222222222	2222222222	2222222222
15	---------	---------	2222222222	4222222222	2222222222	RRRRRRRRRR	2222222222
16	---------	---------	2222222222	RRRRRRRRRR	RRRRRRRRRR	2222222222	2222222222
17	---+++++-	--+------	2222222222	2222222222	RRRRRRRRRR	RRRRRRRRRR	2222222222
18	---------	---------	RRRRRRRRRR	2222222222	2222222222	2222222222	RRRRRRRRRR
19	---------	---------	2222222222	2222222222	2222222222	2222222222	2222222222
20	---------	---------	RRRRRRRRRR	2222222222	RRRRRRRRRR	2222222222	2222222222

A striking feature of the data for experiment $\mathcal{R}(5,1)$ is the frequency of sign reversals for the distribution and transfervariables. Almost invariably, these changes can be linked to coalition switches by the adversary. Simulation #7 is the cleanest example: the adversary switches coalitions exactly once, in round T-3. For the first five iterations, she chooses coalition $\{125\}$ in this round; thereafter, she switches to $\{145\}$. Before the switch, #2's and #5's constraints are binding; afterwards, #1's and #4's are binding. Before the switch, the adversary's proposal becomes increasingly favorable to the alliance, for the reason discussed above. After the switch, the trend is reversed because now, player #1 is becoming *more* risk averse, while #4's risk aversion remains unchanged.

The data from experiment $\mathcal{R}(4,2)$ contrasts sharply with that of experiment $\mathcal{R}(5,1)$. In virtually every simulation, alliance performance declines monotonically. Moreover, the adversary virtually always chooses either coalition $\{125\}$ (2) or coalition $\{345\}$ (R). By now, the explanation for the performance trend will be clear: whenever coalition $\{125\}$ is chosen, #2's participation constraint is binding, and in this case #2 becomes increasingly risk averse with each iteration. The explanation for the regularity in the coalition data is that with each iteration in this experiment, the adversary's original coalition choice of $\{125\}$ becomes increasingly attractive relative to the alternatives. For example, as we observed above, in simulation #7 of experiment $\mathcal{R}(5,1)$, player #5 eventually becomes too demanding in the coalition $\{125\}$, and this coalition is replaced by $\{145\}$. In the corresponding simulation of experiment $\mathcal{R}(4,2)$ (apart from the ρ_i's, the parameters in these simulations are identical), the adversary sticks with coalition $\{125\}$ throughout.

The discussion above highlights a point raised earlier (p. 13) regarding the limited usefulness of calculus as a tool for analyzing our model. In simulation #7 of experiment $\mathcal{R}(5,1)$, for example, calculus predicts that if the adversary were to continue to select coalition $\{125\}$ in round T-3, alliance performance would continue to improve. For sufficiently small perturbations, this caveat would have been innocuous. For our purposes, however, it is the noninfinitesimal consequences of the perturbations in this experiment that are of greatest interest. Our alliance members are, effectively, engaged in competition with each other for membership in critical coalitions. The fact that changes in relative risk aversion sharply affect the nature of this competition, while changes in access probabilities do not, is the principle lesson from the experiment. Because the number of coalitions is finite, and because coalition switches result in discontinuous changes in outcomes, this lesson could not have been learned by exclusive reliance on analytic techniques.

4.3. Experiment Group "$\mathcal{L}$"—distributions. This cluster consists of a pair of experiments, in which alliance members' ideal distributions are perturbed. The two experiments are labelled $\mathcal{L}$(4,2) and $\mathcal{L}$(5,1). As in clusters "$\mathcal{A}$" and "$\mathcal{R}$," these experiments are designed to investigate the relationship between the internal balance of power within the alliance and alliance performance. In the base-case iteration of each experiment, players' ideal distributions are randomly drawn from the intervals specified in table 1. In each subsequent iteration of experiment $\mathcal{L}(j,k)$, the ideal distributions for alliance members j and k are shifted to the left by 0.01.

These experiments can be interpreted as increasing the degree of extremism within the left-wing, while reducing it in the right-wing. Hypotheses B and C together imply that changes of this kind should enhance the performance of the alliance. The latter hypothesis predicts that as it becomes more extreme, the bargaining power of the left-wing will become increasingly diluted.[5] Conversely the relative power of the right-wing will increase. Since initially the right-wing is more powerful, the former hypothesis predicts that increasing the asymmetry in the balance of power should increase alliance performance. In this sense, then, experiment $\mathcal{L}$(5,1) is analogous to experiments $\mathcal{A}$(5,1) and $\mathcal{R}$(5,1).

It turns out that the results of these experiments depend in a delicate way on a number of factors, and so are more complex to analyze than the preceding clusters. To focus the discussion more sharply, we divide the simulations into three subclasses, each consisting of ten simulation decatuples. In each subclass, $\bar{\beta}$is restricted to lie in a different subset of its admissible range. In simulations #1 through #10, $\bar{\beta}$ is restricted to the subset $[0, 0.1]$; in simulations #11 through #20, $\bar{\beta} \in [0.4, 0.6]$; in simulations #21 through #30, $\bar{\beta} \in [0.9, 1.0]$. As usual, we maintain the restriction that $\beta_0 = 1 - \bar{\beta}$. Table 6 below reports the data for experiment $\mathcal{L}$(4,2) (experiment $\mathcal{L}$(5,1) yields similar results). In this table, the simulations are sorted in ascending order of alliance members' distribution sensitivity coefficient, $\bar{\beta}$. The values of this variable are

[5] Anecdotal evidence suggests that as the British Labour Party moved further to the left in the 'eighties, its relative power was weakened, leaving the Tories relatively unencumbered in its pursuit of its agenda.

reported in the final column. Result IV summarizes the data.

TABLE 6. Simulation results for experiment $\mathcal{L}(4,2)$: $\alpha_{4,1}$ and $\alpha_{2,1}$ shift left.

Sim #	Change in location	Change in share	Change in #1's utility	Change in #3's utility	Change in #5's utility	Change in #0's utility	Value of $\bar{\beta}$
4	+++++++-+	000000000	-------+-	+++++++-+	+++++++-+	-------+-	0.001
9	-+++-++-+	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.018
2	+-+-+---+	+-+++-+-+	+-+++-+-+	+-+++-+-+	+-+++-+-+	-+---+-+-	0.035
8	-+-++-+--	-++++++++	-++++++++	-++++++++	-++++++++	+--------	0.043
5	-+-++----	++++++---	++++++---	++++++---	++++++---	------+++	0.044
3	-++++++++	-++++++++	-++++++++	-++++++++	-++++++++	+--------	0.046
6	+---++-++	-++++++++	-++++++++	-++++++++	-++++++++	+--------	0.047
10	-+---++-+	-++++++++	--+++++++	-++++++++	-++++++++	+--------	0.062
7	+-++--+-+	-++++++++	-++++++++	-++++++++	-++++++++	+--------	0.083
1	-+++-+-++	-++++++++	-++++++++	-++++++++	-++++++++	+--------	0.089
19	---+-----	---+-----	---+-----	---+-----	---+-----	+++-+++++	0.408
16	----+---+	----+----	----+----	----+----	----+----	++++-++++	0.523
17	---+-----	---+-----	---+-----	---+-----	---+-----	+++-+++++	0.533
11	-----++-+	-----++--	-----++--	-----++--	-----++-+	+++++--++	0.536
20	+---+-+-+	+---+----	+--------	+---+----	+---+----	-+++-++++	0.549
15	-----+---	-----+---	-----+---	-----+---	-----+---	+++++-+++	0.557
18	---------	---------	---------	---------	---------	+++++++++	0.567
13	---------	---------	---------	---------	---------	+++++++++	0.572
14	+--------	+--------	+--------	+--------	+--------	-++++++++	0.584
12	---------	---------	---------	---------	---------	+++++++++	0.584
27	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.909
26	++++++-++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.909
23	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.913
25	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.922
24	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.928
21	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.937
30	++-++-++-	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.955
28	+++++++++	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.960
22	++----+--	------+--	------+--	------+--	------+--	++++++-++	0.974
29	++--+-++-	+++++++++	+++++++++	+++++++++	+++++++++	---------	0.995

Result IV. When alliance members are either highly insensitive to distribution relative to the adversary, or highly sensitive (i.e., $\bar{\beta} \in [0.0, 0.1] \cup [0.9, 1.0]$), then equal leftward shifts in the ideal points of players #2 and #4 result in a rightward shift in the distribution variable, an increase in the transfervariable and enhanced alliance performance. For intermediate levels of sensitivity ($\bar{\beta} \in [0.4, 0.6]$), all these effects are reversed.

This division of the result into three parts clearly distinguishes result IV from the preceding ones. We will briefly explain the results for low and intermediate values of $\bar{\beta}$, then discuss in some detail the most interesting case in which $\bar{\beta}$ is high. Since, as usual, the fortunes of the alliance are intimately related to those of player #3, we will focus attention on the relative effects of the perturbations on #3 and on the adversary.

First assume that $\bar{\beta}$ is close to zero (so that β_0 is close to unity). As usual, each player specifies her ideal policy in the final offer round. Because of the difference in their sensitivities to distribution, the adversary is significantly more affected than player #3 to the shifts in #2's and #4's proposed distributions. Specifically, the adversary's utility gain as #4's proposal shifts towards the origin is more than offset by her utility loss as #2's proposal shifts away from it.[6] In the penultimate offer round, therefore, the adversary's bargaining position is weakened relative to player #3. The secondary effects of this shift in bargaining positions lead ultimately in an improvement in alliance performance.

Next, consider the case in which player #3 and the adversary are more or less equally sensitive to distribution. We will compare the effects of the distribution shifts on these two players in the final offer round. Because #3's ideal distribution lies to the right of the adversary's, the difference between $(\alpha_4 - \alpha_3)$ and $(\alpha_3 - \alpha_2)$ is greater the difference between $(\alpha_4 - \alpha_0)$ and $(\alpha_0 - \alpha_2)$. Since utilities are strictly concave, the disparity between the negative effect of the shift in α_2 and the positive effect of the shift in α_4 is greater for player #3 than it is for the adversary. The perturbations therefore weaken #3's bargaining position relative to the adversary's, reversing the direction of the secondary effects in the penultimate offer round. It would appear that further increases in the size of $\bar{\beta}$ relative to β_0 could only amplify this trend. As table 6 demonstrates, however, this is not the case: when $\bar{\beta}$ is very large relative to β_0, the perturbations result in enhanced alliance performance. The explanation for this reversal is provided below, with the aid of table 7 and figure 3.

As the first two blocks of table 7 indicate, the effect of the perturbations in round T-1 is qualitatively the same as effect for intermediate values of $\bar{\beta}$. Player #3's expected utility conditional on reaching round T-1 is lower in the second iteration than the base-case iteration (93.4919 vs 93.4938) while the adversary's

[6] In the base-case iteration, #2's and #4's ideal distributions are initially equidistant from the adversary's ideal distribution. Hence the first perturbation of their distributions has only a second-order effect on the adversary. This fact explains why in six out of the first ten rows of Table 6, the signs associated with the first perturbation are reversed in subsequent perturbations.

TABLE 7. Simulation #1, Experiment $\mathcal{L}(4,2)$; $\bar{\beta} = 989$.

Pr	Co	Offers:		Utilities:					
sr	al	x_1	x_2	u_1	u_2	u_3	u_4	u_5	u_0
Round T-1 of base-case iteration: $-\alpha_{2,1} = \alpha_{4,1} = 0.624$.									
1	145	−0.9486	1.0000	100.0000	99.2745	91.4035	82.3330	73.7015	96.9112
2	245	−0.6236	1.0000	99.2745	100.0000	95.7472	89.0615	82.3330	96.9257
3	345	0.1601	1.0000	91.4035	95.7472	100.0000	98.5219	95.6951	96.9338
4	145	0.6236	1.0000	82.3330	89.0615	98.5219	100.0000	99.2745	96.9257
5	145	0.9486	1.0000	73.7015	82.3330	95.6951	99.2745	100.0000	96.9112
0	145	0.0000	0.0000	87.1391	90.4630	92.7935	90.4630	87.1391	100.0000
Expected utilities:				87.5825	91.0305	93.4938	91.1422	87.7552	99.3805
Round T-1 of second iteration: $\alpha_{2,1} = -0.634$; $\alpha_{4,1} = 0.614$.									
1	145	−0.9486	1.0000	100.0000	99.3185	91.4035	82.5671	73.7015	96.9112
2	245	−0.6336	1.0000	99.3185	100.0000	95.6369	89.0615	82.0971	96.9254
3	345	0.1601	1.0000	91.4035	95.6369	100.0000	98.5852	95.6951	96.9338
4	145	0.6136	1.0000	82.5671	89.0615	98.5852	100.0000	99.2291	96.9260
5	145	0.9486	1.0000	73.7015	82.0971	95.6951	99.2291	100.0000	96.9112
0	145	0.0000	0.0000	87.1391	90.3819	92.7935	90.5428	87.1391	100.0000
Expected utilities:				87.5937	90.9536	93.4919	91.2161	87.7439	99.3805
Round T-3 of base-case iteration: $-\alpha_{2,1} = \alpha_{4,1} = 0.624$.									
1	123	−0.4763	0.4539	94.7062	96.0393	93.4938*	88.0472	82.3359	99.3805*
2	123	−0.4763	0.4539	94.7062	96.0393	93.4938*	88.0472	82.3359	99.3805*
3	135	0.1583	0.4562	87.9569	92.1269	96.1987	94.7656	92.0381	99.3805*
4	345	0.6149	0.4520	79.3750	85.7998	94.8006	96.1684	95.4333	99.3805*
5	345	0.7921	0.4484	75.0995	82.4867	93.4938*	95.9565	95.9824	99.3805*
0	345	0.1480	0.0752	85.6346	89.6410	93.4938*	92.0399	89.3448	99.9826
Expected utilities:				85.7824	89.8135	93.6553	92.1520	89.4012	99.8614
Round T-3 of second iteration: $\alpha_{2,1} = -0.634$; $\alpha_{4,1} = 0.614$.									
1	123	−0.4765	0.4539	94.7076	96.0197	93.4919*	88.1941	82.3315	99.3805*
2	123	−0.4765	0.4539	94.7076	96.0197	93.4919*	88.1941	82.3315	99.3805*
3	345	0.1583	0.4562	87.9569	92.0210	96.1987	94.8267	92.0381	99.3805*
4	345	0.6051	0.4521	79.5951	85.7973	94.8602	96.1696	95.3905	99.3805*
5	345	0.7924	0.4484	75.0938	82.2817	93.4919*	95.9330	95.9828	99.3805*
0	345	0.1480	0.0749	85.6335	89.5381	93.4919*	92.0985	89.3426	99.9827
Expected utilities:				85.7902	89.7172	93.6560	92.2122	89.3974	99.8615
Round T-5 of base-case iteration: $-\alpha_{2,1} = \alpha_{4,1} = 0.624$.									
1	123	−0.1994	0.2155	90.8262	93.3258	93.6553*	90.0582	85.7722	99.8614*
2	123	−0.1994	0.2155	90.8262	93.3258	93.6553*	90.0582	85.7722	99.8614*
3	123	0.1558	0.2159	86.4377	90.5228	94.4975	93.0750	90.3851	99.8614*
4	345	0.5105	0.2095	80.1683	85.9475	93.6553*	94.3695	93.2058	99.8614*
5	345	0.5105	0.2095	80.1683	85.9475	93.6553*	94.3695	93.2058	99.8614*
0	125	0.1424	0.0921	85.8275	89.8135*	93.6137	92.1242	89.4012*	99.9743
Expected utilities:				85.7989	89.8136	93.6560	92.1769	89.4550	99.9515
Round T-5 of second iteration: $\alpha_{2,1} = -0.634$; $\alpha_{4,1} = 0.614$.									
1	123	−0.1992	0.2155	90.8233	93.2679	93.6560*	90.1687	85.7755	99.8615*
2	123	−0.1992	0.2155	90.8233	93.2679	93.6560*	90.1687	85.7755	99.8615*
3	123	0.1558	0.2158	86.4372	90.4186	94.4970	93.1348	90.3846	99.8615*
4	345	0.5103	0.2095	80.1730	85.7970	93.6560*	94.3827	93.2039	99.8615*
5	345	0.5103	0.2095	80.1730	85.7970	93.6560*	94.3827	93.2039	99.8615*
0	125	0.1420	0.0922	85.8338	89.7172*	93.6141	92.1837	89.3974*	99.9742
Expected utilities:				85.8040	89.7157	93.6563	92.2368	89.4520	99.9515

expected utility is unchanged (93.3805 vs 93.3805).[7] After the perturbation, therefore, player #3 is left in round T-3 in a *weakened* bargaining position relative to the adversary.

This adverse effect on the alliance is offset by events that occur in round T-3. These events are reported in the third and fourth blocks of table 7 and represented schematically in figure 3 below. The black bullets at the top of the figure represent alliance members' most preferred policies in the base-case iteration. The two heavily shaded bullets represent the perturbations of #2's and #4's most preferred policies. The heavily drawn curve labelled I_0^{T-2} indicates the boundary of the adversary's acceptance region in response round T-2. I_3^{T-2} is the corresponding boundary for player #3. In fact, these boundaries are change slightly from the base-case to the second iterations, but in the figure we treat them as the same.

The key observation is that in round T-3, player #3's participation constraint is binding on player #2 but not on player #4. The asymmetry arises because when $\bar{\beta}$ is very high, player #3's interests are much more closely aligned with #4 than they are with player #2. Because #4 is not constrained by #3, her proposal in round T-3 of the second iteration moves along the boundary of #0's acceptance region, to a position more favorable to player #3. (In figure 3, x_4^{T-3} denotes #4's proposal in the base-case iteration; y_4^{T-3} denotes her proposal in the second iteration. The lightly drawn curves through these two points represent #4's indifference curves in the two iterations.) Because #2 is constrained, her proposal in the second iteration is the same as in the base-case. (In figure 3, x_2^{T-3} denotes #2's proposals in both iterations. In this case, the lightly drawn curves represent #2's indifference curves before and after the perturbation.) Thus, when $\bar{\beta}$ is sufficiently high, #3 benefits from the shift in #4's proposal without experiencing an offsetting loss due to the shift in #2's proposal. As a result, #3's expected payoff conditional on reaching round T-3 is higher in the second iteration than in the base-case (93.6560 vs. 93.6553). The adversary's expected payoff conditional on reaching this round is essentially unchanged, so that in round T-5, #3's bargaining position is strengthened relative to the adversary's.

4.4. Experiment Cluster "$\mathcal{C}$"—Minimal Coalition Size. This cluster consists of just one experiment. It is qualitatively different from the other experiments, because the variables being perturbed is discrete

[7] There is a second-order decline in the adversary's utility but it is obscured by rounding.

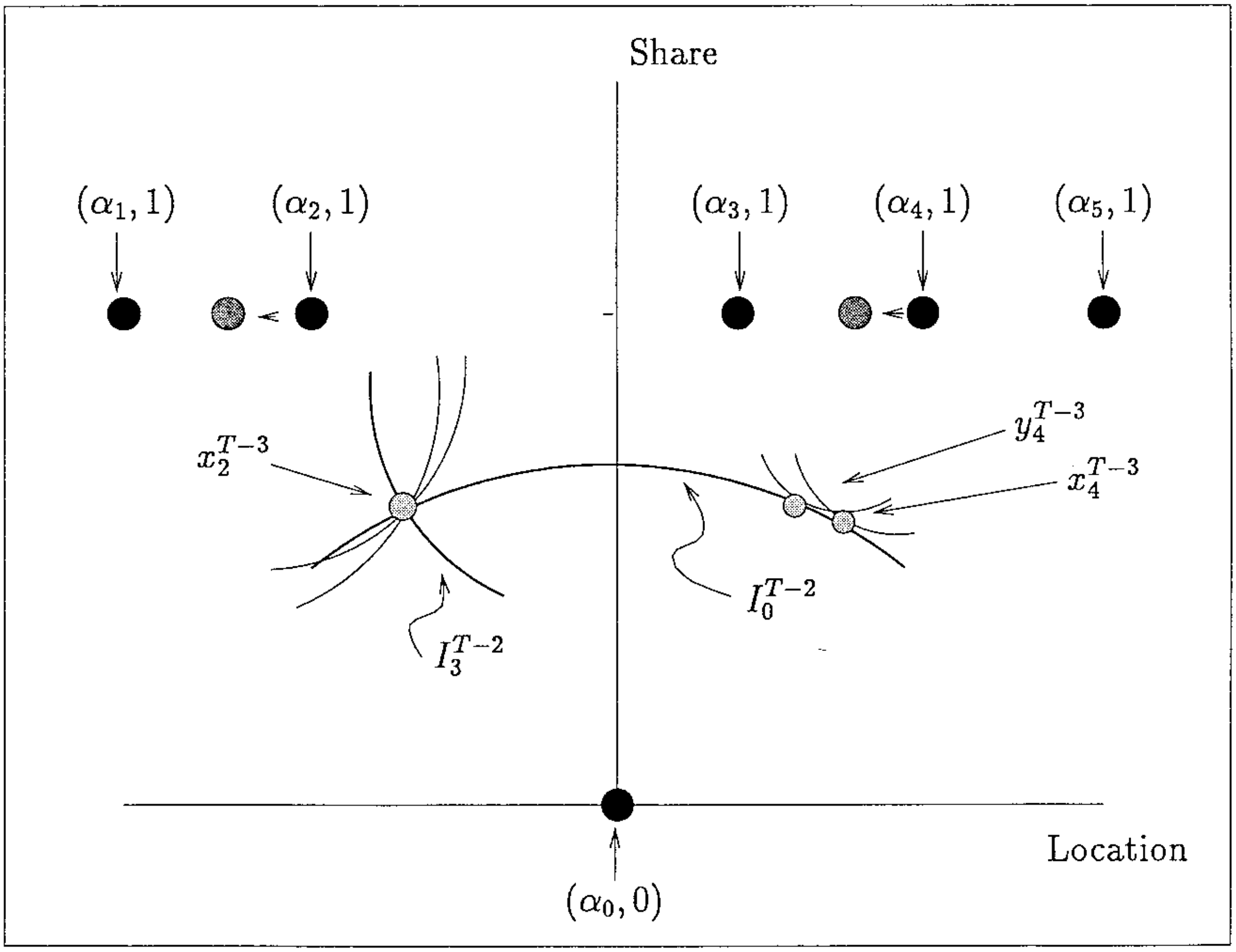

FIGURE 3. Round T-3 in experiment $\mathcal{L}(4,2)$; high value for $\bar{\beta}$

rather than continuous. In the base-case iteration, we presume, as usual, that three out of the five alliance members must consent to any proposal. In the second iteration, the number of alliance members required for consent is increased to four. Hypothesis D predicts that this change should enhance alliance performance, and result in a less partisan solution. The results strongly support this hypothesis, except that the right-wing of the alliance may be harmed by the change. Table 8 below reports the data for experiment $\mathcal{C}$ and result V summarizes the data.

TABLE 8. Simulation results for experiment C: increasing coalition size.

Simulation	Change in location	Change in share	Change in #1's utility	Change in #3's utility	Change in #5's utility	Change in #0's utility	Value of $\bar{\beta}$
13	+	+	+	+	+	-	0.057
8	+	+	+	+	+	-	0.090
18	-	+	+	+	-	-	0.263
16	-	+	+	+	-	-	0.299
10	-	+	+	+	+	-	0.360
2	-	+	+	+	-	-	0.492
19	-	+	+	+	-	-	0.556
11	-	+	+	+	-	-	0.577
15	-	+	+	+	-	-	0.644
5	-	+	+	+	-	-	0.653
1	-	+	+	+	-	-	0.693
12	-	+	+	+	-	-	0.699
14	-	+	+	+	-	-	0.710
4	-	+	+	+	-	-	0.753
9	-	+	+	+	-	-	0.779
17	-	+	+	+	-	-	0.786
7	-	+	+	+	+	-	0.813
3	-	+	+	+	-	-	0.857
20	-	+	+	+	-	-	0.912
6	-	+	+	+	-	-	0.921

Result V. An increase in minimal admissible coalition size results in an increase in the transfervariable, increases in the utilities of left-wing alliance members and a decrease in the utility of the adversary. Unless alliance members are extremely insensitive to distribution, the distribution variable shifts to the left. The utilities for player #3 and for the left-wing of the alliance increase, but right-wingers' utilities tend to decline.

This experiment is more difficult to analyze than the previous ones, for several reasons. First, the difference between the two iterations is discrete rather than local. Second, the coalitions that players propose are, necessarily, quite different in the second iteration, and it is harder to make comparisons across coalitions than within a given coalition. Finally, because we have only two iterations rather than ten, it is more than usually difficult to identify general trends.[8] In spite of these problems, we will, as usual, explain the basic intuition for the result with the aid of a single example, adding the caveat that in this experiment, the detailed arguments we present may not be as robust as in other instances. The example, displayed in table 9 below, compares both iterations of simulation #3. Since the final offer rounds of the two iterations are

[8] In contrast to the other experiments, there is in this case a natural limit on the number of iterations we can consider.

identical, the details for this round are suppressed.

TABLE 9. Simulation #3, Experiment C—last three offer rounds.

Pr	Co	Offers:		Utilities:					
sr	al	x_1	x_2	u_1	u_2	u_3	u_4	u_5	u_0
Round T-3 of base-case iteration: coalitions of three									
1	123	−0.4851	0.5270	99.3942	99.5021	99.1078*	98.4619	97.8489	97.3252*
2	123	−0.4851	0.5270	99.3942	99.5021	99.1078*	98.4619	97.8489	97.3252*
3	345	0.1672	0.5567	98.6063	99.0332	99.5430	99.3857	99.1292	97.3252*
4	345	0.4985	0.5249	97.8105	98.4321	99.4302	99.5023	99.4005	97.3252*
5	345	0.6928	0.4850	97.1886	97.9432	99.2521	99.4596	99.4455	97.3252*
0	345	0.1155	0.1548	98.2753	98.6728	99.1078*	98.9152	98.6348	99.7789
Expected utilities:				98.3348	98.7341	99.1605	98.9558	98.6639	99.0622
Round T-3 of second iteration: coalitions of four									
1	1234	−0.295	0.548	99.2625	99.4580	99.3264	98.8321	*98.3337	97.3254
2	1234	−0.295	0.548	99.2625	99.4580	99.3264	98.8321	*98.3337	97.3254
3	1234	0.167	0.556	98.6065	99.0334	99.5436	99.3851	99.1293	97.3254
4	2345	0.309	0.547	98.3012	98.8076	*99.5225	99.4648	99.2752	97.3254
5	2345	0.309	0.547	98.3012	98.8076	*99.5225	99.4648	99.2752	97.3254
0	1245	0.011	0.167	98.4642	98.8076	*99.0988	98.8321	*98.5000	99.7631
Expected utilities:				98.5468	98.8971	99.2004	98.9382	98.6078	99.0511
Round T-5 of base-case iteration: coalitions of three									
1	123	−0.2006	0.3229	98.9218	99.1616	99.1605*	98.7392	98.2952	99.0622*
2	123	−0.2006	0.3229	98.9218	99.1616	99.1605*	98.7392	98.2952	99.0622*
3	345	0.1487	0.3274	98.4000	98.8159	99.2983	99.1285	98.8637	99.0622*
4	345	0.4291	0.2831	97.7389	98.3153	99.2050	99.2291	99.0959	99.0622*
5	345	0.4867	0.2662	97.5710	98.1834	99.1605*	99.2243	99.1174	99.0622*
0	125	0.1031	0.1969	98.3430	98.7341*	99.1520	98.9505	98.6639*	99.6575
Expected utilities:				98.3335	98.7322	99.1651	98.9685	98.6842	99.4836
Round T-5 of second iteration: coalitions of four									
1	1234	−0.055	0.334	98.7450	99.0551	99.2537	98.9380	*98.5711	99.0519
2	1234	−0.055	0.334	98.7450	99.0551	99.2537	98.9380	*98.5711	99.0519
3	2345	0.089	0.332	98.5123	98.8970	*99.2962	99.0859	98.7912	99.0519
4	2345	0.089	0.332	98.5123	98.8970	*99.2962	99.0859	98.7912	99.0519
5	2345	0.089	0.332	98.5123	98.8970	*99.2962	99.0859	98.7912	99.0519
0	1245	0.019	0.257	98.5489	98.8970	*99.1986	98.9380	*98.6096	99.4373
Expected utilities:				98.5655	98.9156	99.2223	98.9639	98.6372	99.3247

The first two blocks of table 9 compare round T-3 in the two iterations. The change in coalition structure has two implications. First, when coalitions contain four alliance members, player #4's participation constraint is binding on the two left-wingers, while player #2's is binding on the two right-wingers. In the second iteration, consequently, right-wingers do better, and left-wingers do worse, when left-wingers make proposals. The reverse is true when right-wingers make proposals. Second, the adversary's proposal must appeal to a more diverse group of alliance members. To accomplish this, the adversary proposes a larger value for the transfervariable and a more central distribution, raising left-wingers' payoffs but reducing right-wingers' payoffs. Because the first pair of effects cancel each other out, the net result of all of them together is that conditional on reaching round T-3, left-wingers' expected utilities are higher, and right-wingers' are lower, in the second iteration than in the base-case. The adversary derives less utility when she herself proposes, because she faces an additional constraint. The effects on the adversary of the changes in alliance members' offers again cancel each other out, so that the adversary's expected utility conditional on reaching round T-3 is lower in the second iteration. In round T-5 of the second iteration, the secondary effects reinforce the primary effects, as usual: the bargaining position of the left-wing in round T-5is enhanced relative to that of the right-wing, and the bargaining strength of the adversary is weakened. These trends continue to accumulate as the backward induction proceeds, so that in the second iteration, the ultimate solution to the model is unambiguously better for the left-wing and worse for the adversary. The right-wing does better or worse, depending on the relative strength of the two effects.

4.5. Experiment Cluster "$\mathcal{P}$"—Restricting the Policy Space. This cluster consists of two experiments, in which restrictions are imposed on the set of allowable distribution proposals. To sharpen the analysis, we assume that at the outset, the set of allowable distribution proposals is so tightly restricted that no member of the alliance can propose her ideal distribution. Specifically, in the base-case iteration, proposals are confined to interval $[-0.1, 0.1]$.[9] In each subsequent iteration of experiment $\mathcal{P}(\mathrm{L})$, the lower bound of the allowable range is incremented by 0.01, while the lower bound remains the same. In experiment $\mathcal{P}(\mathrm{U})$, the upper bound is successively decremented by 0.01, while the lower bound remains the same.

The two experiments have quite different properties. In experiment $\mathcal{P}(\mathrm{L})$, the incremental restrictions on the policy space adversely affect only the left-wing of the alliance. The right-wing of the alliance benefits from the discipline imposed on the minority; the adversary benefits also, since she prefers distributions closer to the origin. Whether the right-wing or the adversary benefits more depends, as usual, on their relative sensitivities to the distribution variable. In experiment $\mathcal{P}(\mathrm{U})$, on the other hand, the dominant right-wing is itself increasingly penalized by the restrictions on the policy space, while from the adversary's perspective, the restrictions in the two experiments are symmetric. Intuitively, therefore, it seems improbable that the

[9] In all other experiments, the range of allowable distributions is $[-1, 1]$.

restrictions in $\mathcal{P}(\mathrm{U})$ could possibly benefit the alliance. Based on results obtained elsewhere (Adams-Rausser-Simon [1991]), however, we suspected that this intuition would prove invalid (cf hypothesis E).

Table 10 below reports the data for experiment $\mathcal{P}(\mathrm{L})$ and result VI summarizes the data.

TABLE 10. Experiment $\mathcal{P}(\mathrm{U})$: decreasing the maximum admissible location.

Sim #	Change in location	Change in share	Change in #1's utility	Change in #3's utility	Change in #5's utility	Change in #0's utility	Value of $\bar{\beta}$
4	-+--++---	---------	---------	---------	---------	+++++++++	0.001
9	-+-+---+-	---------	---------	---------	---------	+++++++++	0.018
2	--------+	---------	---------	---------	---------	+++++++++	0.035
8	----+-+--	---------	---------	---------	---------	+++++++++	0.043
5	---------	---------	---------	---------	---------	+++++++++	0.044
3	--------+	---------	---------	---------	---------	+++++++++	0.046
6	---------	---------	---------	---------	---------	+++++++++	0.047
10	-----+---	---------	---------	---------	---------	+++++++++	0.062
7	---------	---------	---------	---------	---------	+++++++++	0.083
1	---------	---------	---------	---------	---------	+++++++++	0.089
19	---------	+++++++++	+++++++++	---------	---------	+++------	0.408
16	---------	+++++++++	+++++++++	---------	---------	---------	0.523
17	---------	+++++++++	+++++++++	---------	---------	+--------	0.533
11	---------	+++++++++	+++++++++	---------	---------	---------	0.536
20	---------	+++++++++	+++++++++	---------	---------	---------	0.549
15	---------	+++++++++	+++++++++	---------	---------	---------	0.557
18	---------	+++++++++	+++++++++	---------	---------	---------	0.567
13	---------	+++++++++	+++++++++	---------	---------	---------	0.572
14	---------	+++++++++	+++++++++	---------	---------	---------	0.584
12	---------	+++++++++	+++++++++	---------	---------	---------	0.584

Result VI. When alliance members are highly insensitive to distribution, tightening the lower bound on the set of allowable distribution proposals shifts the solution southwest along the contract curve, benefiting the adversary at the expense of the alliance. If alliance members are sufficiently sensitive to distribution, all these effects are reversed.

A striking aspect of this result is that if the alliance is sufficiently insensitive to distribution, the left-wing actually benefits when its "freedom of expression" is curtailed. This is, of course, a recurring theme of this investigation. In experiment cluster $\mathcal{A}$, for example, we observed that the left-wing could gain by ceding some of its bargaining power to the right-wing. In this experiment, the left-wing's bargaining power is reduced by the restrictions that are imposed on the actions that are available to it, rather than by depleting its bargaining resources.

We now turn to experiment $\mathcal{P}(\mathrm{U})$. As in experiment $\mathcal{L}(4,2)$, we divide the simulations into three subclasses, each consisting of ten simulation decatuples. In each subclass, $\bar{\beta}$is restricted to lie in a different subset of its admissible range. In simulations #1 through #10, $\bar{\beta} \in [0.0, 0.1]$; in simulations #11 through #20, $\bar{\beta} \in [0.3, 0.4]$; in simulations #21 through #30, $\bar{\beta} \in [0.9, 1.0]$; As usual, $\beta_0 = 1 - \bar{\beta}$. Table 11 below reports the data for the experiment and result VII summarizes the data.

TABLE 11. Experiment $\mathcal{P}(\mathrm{U})$: reducing the maximum admissible location.

Sim #	Change in location	Change in share	Change in #1's utility	Change in #3's utility	Change in #5's utility	Change in #0's utility	Value of $\bar{\beta}$
4	-+--++--+	---------	---------	---------	---------	+++++++++	0.001
9	---------	---------	---------	---------	---------	+++++++++	0.018
2	-+-+----+	---------	---------	---------	---------	+++++++++	0.035
8	---------	---------	---------	---------	---------	+++++++++	0.043
5	+------+-	---------	---------	---------	---------	+++++++++	0.044
3	---------	---------	---------	---------	---------	+++++++++	0.046
6	---------	---------	---------	---------	---------	+++++++++	0.047
10	---------	---------	---------	---------	---------	+++++++++	0.062
7	---------	---------	---------	---------	---------	+++++++++	0.083
1	----+----	---------	---------	---------	---------	+++++++++	0.089
19	-++++++--	--+++++-+	--+++++-+	--+++++--	--+++++--	++-----++	0.304
16	+++++++--	+++++++-+	+++++++-+	+++++++--	+++++++--	-------++	0.361
17	-+++++++-	-++++++++	-++++++++	-+++++++-	-+++++++-	+-------+	0.366
11	++++-++--	+++++++-+	+++++++-+	+++++++--	+++++++--	-------++	0.368
20	+++++++--	+++++++++	+++++++++	++++++++-	++++++++-	--------+	0.374
15	++++-+---	++++++-++	++++++-++	++++++---	++++++---	------++-	0.378
18	-+++-----	++++--+++	++++--+++	++++-----	++++-----	----++++-	0.383
13	+--+-+---	+++++-+++	+++++-+++	+++++----	+++++----	-----+++-	0.386
14	+++++++--	+++++++-+	+++++++++	+++++++--	+++++++--	-------+-	0.392
12	+++-++---	++++++-++	++++++-++	++++++---	++++++---	------++-	0.392
27	---------	+++++++++	+++++++++	---------	---------	---------	0.909
26	---------	+++++++++	+++++++++	---------	---------	---------	0.909
23	---------	+++++++++	+++++++++	---------	---------	---------	0.913
25	---------	+++++++++	+++++++++	---------	---------	---------	0.922
24	---------	+++++++++	+++++++++	---------	---------	---------	0.928
21	---------	+++++++++	+++++++++	---------	---------	---------	0.937
30	---------	+++++++++	+++++++++	---------	---------	---------	0.955
28	---------	+++++++++	+++++++++	---------	---------	---------	0.960
22	---------	+++++++++	+++++++++	---------	---------	---------	0.974
29	---------	+++++++++	+++++++++	---------	---------	---------	0.995

Result VII. When alliance members are highly insensitive to distribution, ($\bar{\beta} \in [0.0, 0.1]$), tightening the upper bound on the set of allowable distribution proposals shifts the solution southwest along the contract curve, benefiting the adversary at the expense of the alliance. For intermediate levels of sensitivity ($\bar{\beta} \in [0.3, 0.4]$), these effects are all reversed, at least for the first few iterations. When alliance members are highly sensitive to distribution, ($\bar{\beta} \in [0.9, 1.0]$), tightening the upper bound shifts the distribution variable to the left, increases the transfervariable and benefits the left-wing of the alliance, at the expense of the remaining players.

When $\bar{\beta} \in [0.0, 0.1]$, the analysis is very simple. In the final offer round, all three right-wingers propose the maximum allowable value for the distribution variable. As the upper bound is tightened, the shift to the left in their distribution proposals benefits the adversary and weakens the alliance. In all other offer rounds, alliance members assign so little weight to distribution that they concede almost entirely to the adversary along this dimension: their proposals are so close to the origin that even in the final iteration, the upper bound on distributions never binding. Thus, in this case the perturbation being considered has a direct impact on negotiations *only* in the final offer round. Because the adversary's bargaining position in round T-3 is strengthened relative to the alliance, the solution shifts southeast along the contract curve.

When $\bar{\beta} \in [0.9, 1.0]$, the analysis is even simpler. In this case, it is the adversary that concedes almost entirely to the right-wing along the distribution dimension. Consequently, for most policies that are in the core of the unconstrained bargaining problem, the distribution variable exceeds 0.1. As the upper bound on allowable distribution proposals becomes tighter, the core of the constrained bargaining problem shifts further and further away from the unconstrained core. Potential gains to trade are sacrificed and everybody except the left-wing of the alliance suffers.

The intermediate case is the most interesting of the three. When $\bar{\beta} \in [0.3, 0.4]$, decreasing the upper bound on allowable distribution proposals can actually benefit the entire alliance at the expense of the adversary. This is of course paradoxical since with each iteration, there is an increase in the gap between the maximum allowable policy proposal and right-wingers' ideal distributions. Simply put, the intuition for the result is that while player #3 is indeed negatively affected by the restriction, she benefits even more from the discipline that it imposes on the right-wing alliance members. Indeed, the right-wingers themselves ultimately benefit from the curtailment of their own freedom of expression!

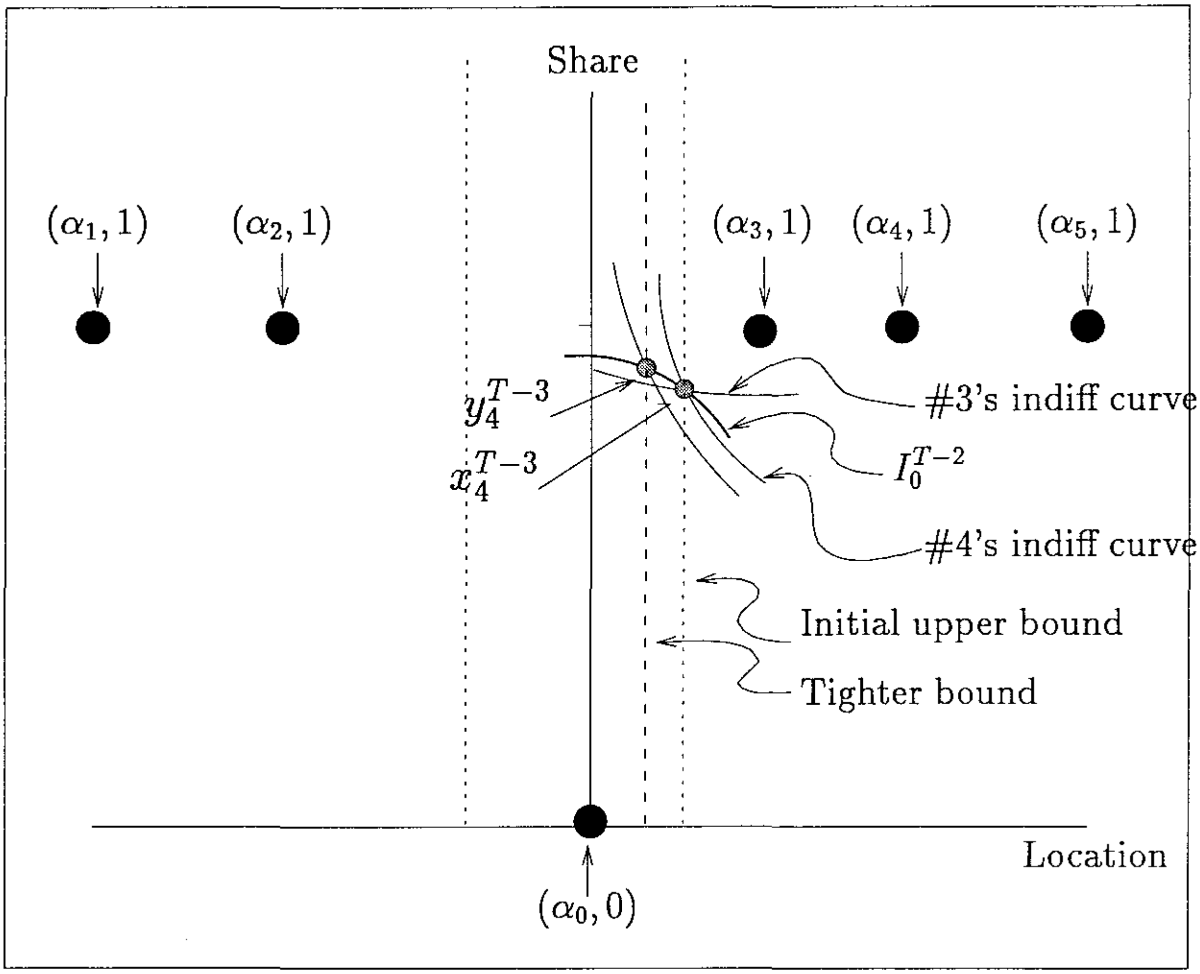

FIGURE 4. Decreasing the upper bound on allowable policies: experiment $\mathcal{P}$(U)

The above intuition is developed in figure 4 above, which schematically represents player #4's decision problem in round T-3. The dotted and dashed vertical lines represent the upper bounds on allowable distributions in the base-case and second iterations. The heavily drawn curve labelled I_0^{T-2} indicates the boundary of the adversary's acceptance region in response round T-2. In fact, these boundaries are change slightly from the base-case to the second iterations, but in the figure we treat them as the same. As the upper bound on allowable distributions is tightened, player #4 in round T-3 is obliged to slide northwest along

I_0^{T-2}, from x_4^{T-3} to y_4^{T-3}, and experiences a utility decline in the process. If player #3's indifference curve through x_4^{T-3} is sufficiently flat, however, her utility from y_4^{T-3} will exceed her utility from x_4^{T-3}. It turns out that except in the last few iterations of simulations #11 to #20, this factor dominates all the negative effects of the restriction on the alliance, and leads ultimately to an improvement in alliance performance.

Table 12 provides a numerical illustration of the preceding argument. The table compares the first two iterations of simulation #20 in experiment $\mathcal{P}$(U). Observe that in round T-1 of the second iteration, as a result of the leftward shifts in the three right-of-center proposals, player #3's expected utility conditional on reaching round T-1 declines slightly from 97.0857 to 97.0856. The adversary, on the other hand, benefits from these leftward shifts, so that her expected utility conditional on reaching round T-1 increases from 98.8482 to 98.8496.

In round T-3 of the second iteration, there are five factors affecting player #3's payoff relative to the first iteration, all but one of which are negative. First, the adversary's participation constraint is, as usual, binding on every alliance member, and this constraint is tighter than in the first iteration. Second, the two left-wing players, whose distribution proposals are constrained by the fixed lower bound, are obliged to reduce the levels of their transferproposals to satisfy #0's tighter participation constraint, Third, #3 derives less utility from her own proposal, since the adversary's constraint is tighter. Fourth, she derives less utility from the adversary's proposal, because her own constraint is slacker. In spite of all these negative effects, #3's expected utility conditional on reaching round T-3 nonetheless increases from 97.4085 to 97.4090. The reason is that she gains so substantially when #4 and #5 make proposals, for the reason described above. In round T-5 of the second iteration, player #3's bargaining position is sufficiently enhanced relative to the adversary's that the latter's expected utility conditional on reaching this round actually declines. Proceeding backwards up the game tree, the gains to player #3 continue to cumulate, resulting ultimately in a northeasterly shift in the solution that benefits the entire alliance.

TABLE 12. Simulation #20, Experiment $\mathcal{P}$(U); $\bar{\beta} = 0.374$.

Pr sr	Co al	Offers: x_1	x_2	Utilities: u_1	u_2	u_3	u_4	u_5	u_0
Round T-1 of first iteration: upper bound on $x_1 = 0.1$.									
1	145	−0.1000	1.0000	99.0354	99.7460	99.9313	99.4413	98.4920	95.9560
2	245	−0.1000	1.0000	99.0354	99.7460	99.9313	99.4413	98.4920	95.9560
3	345	0.1000	1.0000	98.4920	99.4413	99.9996	99.7460	99.0354	95.9560
4	145	0.1000	1.0000	98.4920	99.4413	99.9996	99.7460	99.0354	95.9560
5	145	0.1000	1.0000	98.4920	99.4413	99.9996	99.7460	99.0354	95.9560
0	145	0.0000	0.0000	94.7838	95.5796	95.9362	95.5796	94.7838	100.0000
Expected utilities:				95.9019	96.7142	97.0857	96.7315	95.9328	98.8482
Round T-1 of second iteration: upper bound on $x_1 = 0.09$.									
1	145	−0.1000	1.0000	99.0354	99.7460	99.9313	99.4413	98.4920	95.9560
2	245	−0.1000	1.0000	99.0354	99.7460	99.9313	99.4413	98.4920	95.9560
3	345	0.0900	1.0000	98.5221	99.4594	99.9990	99.7336	99.0112	95.9643
4	145	0.0900	1.0000	98.5221	99.4594	99.9990	99.7336	99.0112	95.9643
5	145	0.0900	1.0000	98.5221	99.4594	99.9990	99.7336	99.0112	95.9643
0	145	0.0000	0.0000	94.7838	95.5796	95.9362	95.5796	94.7838	100.0000
Expected utilities:				95.9070	96.7173	97.0856	96.7294	95.9287	98.8496
Round T-3 of first iteration: upper bound on $x_1 = 0.1$.									
1	145	−0.1000	0.5567	97.2916	97.9896	98.1717	97.6903	96.7577	98.8482*
2	245	−0.1000	0.5567	97.2916	97.9896	98.1717	97.6903	96.7577	98.8482*
3	345	0.0262	0.5683	97.0147	97.8607	98.2741	97.9395	97.1551	98.8482*
4	145	0.1000	0.5567	96.7577	97.6903	98.2387	97.9896	97.2916	98.8482*
5	145	0.1000	0.5567	96.7577	97.6903	98.2387	97.9896	97.2916	98.8482*
0	345	0.0124	0.2767	95.8825	96.7023	97.0857*	96.7392	95.9484	99.7383
Expected utilities:				96.2072	97.0275	97.4085	97.0584	96.2623	99.4848
Round T-3 of second iteration: upper bound on $x_1 = 0.09$.									
1	145	−0.1000	0.5564	97.2902	97.9882	98.1703	97.6889	96.7563	98.8496*
2	245	−0.1000	0.5564	97.2902	97.9882	98.1703	97.6889	96.7563	98.8496*
3	345	0.0262	0.5680	97.0134	97.8594	98.2728	97.9381	97.1538	98.8496*
4	145	0.0900	0.5588	96.7954	97.7163	98.2464	97.9857	97.2759	98.8496*
5	145	0.0900	0.5588	96.7954	97.7163	98.2464	97.9857	97.2759	98.8496*
0	345	0.0124	0.2767	95.8824	96.7022	97.0856*	96.7391	95.9482	99.7383
Expected utilities:				96.2112	97.0302	97.4090	97.0576	96.2602	99.4852
Round T-5 of first iteration: upper bound on $x_1 = 0.1$.									
1	123	−0.0958	0.3677	96.5230	97.2204	97.4085*	96.9355	96.0150	99.4848*
2	123	−0.0754	0.3750	96.5037	97.2248	97.4501	97.0006	96.1038	99.4848*
3	345	0.0174	0.3859	96.3097	97.1390	97.5332	97.1909	96.4021	99.4848*
4	345	0.0754	0.3750	96.1038	97.0006	97.5003	97.2248	96.5037	99.4848*
5	345	0.1000	0.3660	95.9961	96.9214	97.4655	97.2184	96.5258	99.4848*
0	345	0.0160	0.3554	96.1907	97.0173	97.4085*	97.0649	96.2756	99.5647
Expected utilities:				96.2182	97.0412	97.4264	97.0789	96.2854	99.5419
Round T-5 of second iteration: upper bound on $x_1 = 0.09$.									
1	123	−0.0953	0.3677	96.5219	97.2199	97.4090*	96.9367	96.0169	99.4852*
2	123	−0.0754	0.3748	96.5030	97.2242	97.4494	97.0001	96.1033	99.4852*
3	345	0.0174	0.3857	96.3090	97.1384	97.5325	97.1902	96.4015	99.4852*
4	345	0.0754	0.3748	96.1033	97.0001	97.4996	97.2242	96.5030	99.4852*
5	345	0.0900	0.3698	96.0409	96.9546	97.4806	97.2219	96.5177	99.4852*
0	345	0.0160	0.3555	96.1912	97.0179	97.4090*	97.0655	96.2762	99.5644
Expected utilities:				96.2210	97.0434	97.4276	97.0795	96.2854	99.5418

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