Burden Sharing and Public Good Investments in Policy Reform

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1. Introduction

Any attempt to reform existing public policies or to implement new policies faces an arduous negotiation process and the tyranny of the status quo. One of the basic premises of the Uruguay Round of the GATT is that the reform of border policies could not be sustained without dramatic modification of internal agricultural policies. In October of 1989, the United States tabled a proposal for reforming internal policies of the agricultural sector throughout GATT signatory countries. In essence, this tabled proposal specified policies in terms of three regimes: red light, green light, and yellow light policies. Red light policies were to be forbidden; green light policies were to be promoted; and yellow light policies were to be treated on a case by case basis. Quite obviously, green light policies include public good provisions that promote economic growth and do not involve coupled distortionary transfers.

Consistent with the red- and green-light proposal, the EC, long after the apparent death of the Uruguay Round is debating the elimination of targeted transfers to large producers. More specifically, the farm commissioner, Ireland's Ray MacSharry, has proposed that coupled income transfers be targeted only to smaller farmers. Grants would be offered to these smaller farmers as long as they enhance the rural landscape by using less chemical fertilizers and pesticides on their crops and managed their land in an environmentally friendly fashion. This proposal argues for enhancing the rural landscape, a quasi public good, as a substitute for coupled distortionary transfers.

Within any particular country, negotiation over the green, red, and yellow light policy space can lead to significant conflicts and obstacles. In this setting, what role does political power in all of its dimensions play? Does compensation to those who lose from policy reform make sense? How is the tradeoff between public and special interests resolved during the negotiation process? What nonneutral policies might be offered as compensation schemes, in contrast to lump-sum transfers, to counter the obstacles that exist from powerful interest groups?

Throughout many OECD countries, certain commodities within the agricultural sector have been heavily subsidized. Any attempts to reduce the aggregate value of subsidies paid out to the agriculture sector through reducing red-light policies or substituting green-light policies must face both political and economic forces. This paper examines reform of agricultural policies from the lense of a noncooperative multilateral bargaining game. Our approach is a customized specialization of the abstract theoretical model specified in Rausser and Simon (1991). Now the specifics. Any reduction in subsidies is presumed to be invested in some public good, a "green light" policy. Two possible investment projects are admitted. The first project increases the profitability of the nonagricultural sector. The second alternative increases the profitability of the agricultural sector with differential effects across various commodity groups, depending on the location of the public good; the closer the public good to the production of a particular commodity, the greater the increase in profits for that commodity. On average, however, the second investment opportunity is presumed to be less profitable than the first, even when located at a point that maximizes its productivity. From a social perspective, therefore, aggregate welfare is maximized when the entire proceeds of the subsidy reduction program are invested in the first public good.

The constructed model has seven basic players. Five "peripheral" players will represent the various special agricultural commodity groups that are currently being subsidized. Each special interest group seeks to maximize the profits of the industry it represents. The other two players are "central" players, representing different branches of the government: One is the OMB (Office of Management and Budget), the other represents the *politicians*. The OMB is the guardian of the *public interest* while the politicians are motivated entirely by political considerations. Specifically, the OMB aims to maximize aggregate tax revenues. Since all profits are taxed at the same rate, this is equivalent to aggregate profit maximization. The politicians' objective in bargaining is to minimize the *political costs* (or maximize the political benefits) of decision making. To model these costs and benefits, we assume that each peripheral player imposes costs or bestows benefits on the politicians according to an exogenously specified "reward/punishment schedule" mapping outcomes of the decision-making process into some form of "political currency." Punishments may be thought of as foregone campaign contributions and rewards as augmented campaign contributions.

The players bargain to determine the values of three sets of policy variables. First, they bargain over what fraction, π, of the revenue released by the subsidy reduction will be invested in the second investment project (i.e., in the agricultural sector). The remaining fraction $(1 - \pi)$ is invested in the first project (in the nonagricultural sector).

Obviously, the peripheral players all want π to be as large as possible. The politicians, whose only concern is to keep the special interest groups happy, also want π as large as possible. The OMB, on the other hand, is concerned exclusively with aggregate tax revenues. Since the first investment is more productive than the second, even when the second is located optimally, the OMB wants π to be as small as possible. Second, there is the location, $y = (y_1,y_2)$, of the agricultural investment. Each peripheral player seeks to steer y as close to her "bliss point" as possible. The OMB seeks the location that minimizes the *average* distance between the investment's location and the various players' bliss points. The politicians' preferred location is the one that minimizes aggregate bargaining costs. The third set of variables is the fraction of the aggregate subsidy reduction that is borne by each player. Each player wants to make her own share as small as possible. For the OMB, the distribution of the revenue reduction burden is a matter of indifference. The politicians, on the other hand, want shares to reflect the balance of influence among the participants—its goal is to minimize the share of the burden borne by the politically influential players and increase the share of those players who can punish the politicians less severely.

In the above model, the space of issues being negotiated is multidimensional and the relationship between individual and group objectives is quite complex. Along one of these dimensions, the interests of each commodity group coincide; each faction wants to increase the fraction of the bounty that is spent on their sector. Along other dimensions, i.e., the shares of the burden, the interests of any particular faction are diametrically opposed to the interest of any other. Along the remaining dimensions, some factions have a partial overlap of interests with other factions.

In our stylized representation of the reform process that unfolds when many agents negotiate with each other, political power is crucial. Accordingly, one of the main purposes of this paper is to investigate the components of political power. In other words, which variables in the model contribute to the government's power and which contribute to the agricultural sector's power? Since we wish to predict the effectiveness of an individual or group, we must search for an ex ante notion of power, for both individuals and groups. Equipped with such a notion, we should be able to identify the relative power of different entities from the basic parameters of the model.

It is relatively straightforward to conceptualize certain components of ex ante individual power. Since our stylized representation focuses on negotiations and policy reform, power sourced in democratic voting does not arise. Other components of political power, however, can be formalized. They include a particular agent's access, influence, degree of risk aversion, and strategic position. The agent's particular interest will be more powerful, the larger the access probability or the influence coefficient. The less risk averse a particular agent is, the less threatened she will feel by the prospect of disagreement. Accordingly, he can be expected to take a tougher bargaining stance. Another source of power depends critically upon the default utility. In a purely formal sense of comparative statics, it is expected that an infinitesimal increase in an agents default utility will infinitesimally increase his effectiveness. The final and most interesting component of individual political power is also the most difficult to conceptualize. In particular, an agent whose location coincides with the core has a distinct power advantage over others. This player, by virtue of his location, is an attractive candidate for every coalition; and this is clearly a source of power.

2. Basic Model

The game-theoretic underpinnings of the the formulation are reviewed in this section. The underlying model is a noncooperative multilateral bargaining game that we introduced in Rausser and Simon (1991). We will very briefly review the interpretation of this model, describe its formal structure, and state its main properties. The reader is referred to the original paper for extensive motivation, a formal presentation of the model.

The basic model is a noncooperative game in extensive form, with a finite number of players and a finite number of "rounds." It is a generalization of the famous alternating-offer, bilateral bargaining game known as the Stahl-Rubinstein model [Stahl (19) and Rubinstein (19)]. In the Stahl-Rubinstein model, players take turns to propose a division of a "pie." After one player has proposed a division, the other can accept or reject the proposal. If she accepts, the game ends and the division is adopted. If she rejects, she then makes a proposal herself, which the first player then accepts or rejects. The game continues for a finite, or possibly infinite, number of rounds. Our model differs from Stahl-Rubinstein in two major respects. In our game, the proposer is chosen randomly in each round of bargaining. Second, we generalize the bilateral framework to a multilateral bargaining formulation.

There is a finite set of players, called the player set, who meet together to select a policy vector, x, from some set, X, of *feasible vectors*. The set X is a compact subset of a finite-dimensional space. In addition to X, there is a distinguished vector, $\varnothing$, which is called the default policy vector. If players fail to reach agreement during the negotiation process, then the vector $\varnothing$ is selected by default. Each player has a continuous, quasi-concave von Neuman Morgenstern payoff function defined on $X \cup \{\varnothing\}$. Player i's payoff function will be denoted by u_i. For the purposes of the present paper, we will assume that each player receives a lower payoff from $\emptyset$ than from any vector in X.

As part of the specification of the game, there is a list of *admissible coalitions.* An admissible coalition is a subset of the player set that has the authority to choose a policy vector on behalf of the group. In most formal democratic structures, a coalition is admissible if and only if it contains a majority of the of players. As we have noted, however, our model is intended to represent less formal structures. In these structures, there will typically be criteria for admissibility in addition to majority rule. For example, if the White House is viewed as a multi-agent decision-making body, then it will surely be the case that a necessary condition for a coalition to be admissible is that it contains the President. More generally, in many informal, group decision-making situations, *leadership* of the group typically exits. It may be appropriate to insist that each admissible coalition must contain the leader(s) of the group.

A *T-round bargaining game* has T rounds of negotiations. Each round is divided into three stages. In the first stage, a player is chosen "by nature" to be the proposer. Nature makes her choice according to a prespecified probability distribution over the player set. This distribution is given as part of the description of the game. In the second stage, the proposer specifies a coalition (of which he must be a member) and a feasible policy vector. In the third, each member of the proposed coalition (except the proposer) chooses whether to accept or reject the policy vector announced by the proposer. If all accept it, the vector is *selected* and the game ends. If not, the next round begins. A proposer is again selected at random and the game proceeds as before. If agreement has not been reached after T rounds, then the game ends in disagreement and the policy vector $\emptyset$ is selected by default.

A *T-round strategy* for player i specifies that for each $1 \leq t \leq T$ the vector i will propose if he is chosen to be the proposer in round t and a set of vectors that i will accept if i is invited by some other player to join a coalition in round t. A *T-round strategy profile* is a list of strategies, one for each player. Each strategy profile defines an outcome for the game. An outcome is a finite support probability measure on the set of vectors, $X \cup \{\varnothing\}$. Stated less tersely, an outcome is a nonnegative function on $X \cup \{\phi\}$, which takes positive values at finitely many points in the domain, and these finite values sum to unity. A *subgame perfect equilibrium* for a T-round game is a T-round strategy profile with the property that at every point in the game, each player's choice is optimal *starting from that point*, given the strategies specified by the other players. A *proper* equilibrium is a subgame perfect equilibrium that is robust to a certain class of "perturbations."[1]

We will be concerned with negotiations in which there is an arbitrarily large number of rounds. Accordingly, we define our multilateral bargaining model to be a sequence of T-round bargaining games, with T growing to infinity. A *solution* to our model is a limit point of proper equilibrium outcomes of any sequence of T-round games, with T growing to infinity. More formally, a finite support probability measure, μ, is a solution to our model if the following property is satisfied: for any positive ε, there is a $\overline{T}$ sufficiently large that for any T greater than $\overline{T}$, there is some proper equilibrium of the T-round bargaining game which generates an outcome that is within ε of μ. The properties of our model and its solutions are developed in Rausser and Simon (1991). We summarize these properties below.

One preliminary result is that every T-round game has a proper equilibrium. Moreover, this equilibrium is generically unique. In the models we will consider, each game is completely defined by a finite number of parameters. Thus, the *universe* of games is a subset of a finite-dimensional space, which can be equipped with Lebesgue measure. Thus our usage of generic is completely standard: A property of a game is generically true if the set of games for which the property is false is a subset of the universe of games that has Lebesgue measure zero.

In general, the proper equilibrium outcomes of a sequence of T-round games will not converge. To guarantee existence of a solution to the bargaining model, therefore, we need to impose two further conditions on the model. The first is that there is some player who belongs to every admissible coalition. A player satisfying this condition will be called a *central player*. When there is only one of them, she will be sometimes called *the center*. The second condition is that the payoff function of the central player is strictly concave.

In the informal negotiating environments that we are attempting to model, the heuristic interpretation of the first assumption above is that the group of negotiators has a natural *leader*. Almost by definition of leadership, a necessary condition for a subset of the group to possess the authority to select a policy alternative on behalf of the group is that the leader is included in the group. Earlier in the section, we mentioned one example of an informal negotiating environment. This was "The White House." It is difficult to imagine that a coalition within this group could make a decision in the name of "The White House" unless the coalition included The President.

In fact, it is not difficult to imagine an organizational setting where a leader naturally emerges. In some instances, the leader is officially assigned; in other cases, the leadership role is only a temporary assignment. Regardless, a set of informal environments exist where there is a natural leader. This is particularly true in a democratically structured political system. Although the group-decision process may be informal, it is difficult to image a cabinet or executive decision being taken without the assent of a president or a prime minister. In many other cases, a leadership role is naturally played by whoever or whatever coalition is responsible for implementing any decisions that are made.

Few formal environments exist where majorities can make decisions without some leadership. Such formality often masks the informal leadership-driven decision making that lurks somewhere in the background. Leadership can and often does arise from loosely structured, ad hoc groupings. In some situations, the leader simply represents the final arbiter of any differences that might arise. Because so many influences exist, there is much uncertainty about whether this assigned leader will explicitly or implicitly approve whatever proposals may have emerged. In any event, she can be expected to be part of any admissible coalition.

A solution exists for every multilateral bargaining model satisfying the "leadership" assumptions stated above. Moreover, this solution is generically unique. Finally, any solution is *deterministic*. That is, the limit outcome assigns positive probability to exactly one policy vector. This last result is particularly important, since an a priori concern about our model might be that its solution depends so heavily on a random draw by nature. In fact, this dependence is minimal: When T is very large, the policy vector that is ultimately selected by the group differs only marginally as the identity of the proposer changes.

The final result for the abstract model relates its solution to the more familiar solution concept known as *the core*. We define the core of our game in the obvious way: A policy vector, $x \in X \cup \{\varnothing\}$, is an element of the core if there exists no admissible coalition C and alternative policy vector, $y \in X \cup \{\varnothing\}$, such that every member in C strictly prefers y to x. Whenever our model has a deterministic solution, then the policy vector that is selected with probability one is an element of the core.

3. Burden Sharing and Location of Public Good

In this section, specific content is given to the multilateral bargaining framework described in the preceding section. We first pose the problem in rather general terms and then suggest a specific interpretation in the context of agricultural economic policy and the GATT *negotiations*. Consider the following specification of a political system. It consists of an *alliance* of politically powerful members of society, the *general public*, and the *government*. The members of the alliance have similar but not identical economic interests. The interests of each member can be represented by a point in Euclidean space, called the *location* of the member. The closer the locations of two members, the more similar are their economic interests. The general public is politically unorganized and plays no active role in our model. We caricature the government by decomposing it into two wings. First, there is a *benevolent* wing, whose sole objective is to maximize the aggregate economic well-being of society.

Second, there is a *political* wing, whose sole objective is to maximize its own political support. This overall design allows us to investigate a number of important aspects of the political process.

As with agricultural policy, it will be presumed that some fraction of government tax revenue has been spent in a socially unproductive way, merely transferring resources from society at large to the alliance. The government now attempts to negotiate a reform package that will reduce these wasteful expenditures. The parties to the negotiation process are the members of the alliance and the two wings of the government. The benevolent wing will act as the guardian of the "public interest." Since the only politically significant entities are the members of the alliance, the political wing, acting in its own self-interest, will act as an advocate for these members of the alliance. More precisely, the political wing will negotiate for a policy vector that reflects in varying degrees the interests of the different members. The weight assigned to each member's interests will reflect the relative political power of that member.

The reform negotiations must address three issues. First, how will the burden of the expenditure cutback be distributed among the members of the alliance? We will refer to this as the problem of distributing the *policy burden*. To simplify matters, we assume that the aggregate size of the cutback is nonnegotiable.[2] Second, what alternative use will be made of the funds that were being wasted but are now available? We will refer to this as the problem of allocating the *policy bounty*. We will assume that these funds must be divided between two proposed investment projects. The projects are infinitely divisible, so that any division of the funds is feasible. One of these projects is called the *superior project*; the other is called the *inferior project*. We assume that there is a unique superior project and a continuum of potential alternative inferior projects.

Like the members of the alliance, each inferior project can be represented by some point in Euclidean space, called the *location* of the project. The superior project has a higher rate of return than any of the inferior projects. From a normative perspective then, a policy vector can be optimal only if the entire policy bounty is allocated to the superior project. We assume, however, that the benefits from the superior project accrue to the politically unorganized general public, so that this project receives no political support from any of the members of the alliance. The returns to the inferior project, on the other hand, accrue directly to the alliance, so that the members do support this project. Thus, the extent to which the government funds the superior project is a measure of the political autonomy of the benevolent wing of the government. Conversely, the extent to which the inferior project is funded is a measure of the political power wielded by the alliance, either directly through its participation in the negotiations, or indirectly through the influence it brings to bear on the political wing of the government. We will focus closely on these measures of autonomy and power in the analysis below.

The final issue which the negotiators must address is the *location* of the inferior project, assuming, of course, some fraction of the policy bounty is allocated to such projects. Each individual member within the alliance benefits more from the inferior project, the smaller the distance between that member's location and the location of the public good. From a normative perspective, if the inferior investment project is undertaken at all, its location should maximize the *aggregate* level of benefit to the alliance. The extent to which the negotiated location deviates from the optimal location is a measure of the relative direct or indirect political power of certain members within the alliance.

To investigate comparative statics properties the model, as posed above is too abstract; we will need to specify explicit functional forms for agents' utilities and impose some further structure on the negotiation process. To motivate these restrictions, we offer the following, more concrete version of the abstract problem. The alliance is a spatially differentiated *agricultural sector*. The members of the alliance are lobbyists representing different *commodity groups*. Each commodity group has a distinct geographic *location*. The benevolent wing of the government is represented by the OMB; the political wing, by the Congress (Senate and House). Until the present time, the commodity groups have been heavily subsidized. The GATT accord now mandates a reduction in the *aggregate* level of subsidies paid out to the sector. By an appropriate choice of units, we can assume that the required subsidy reduction is one unit. If subsidies are reduced, one additional unit of tax revenue will be available to the government. As before, this *policy bounty* must be divided between two proposed investment projects.[3] The superior project is an investment in the educational infrastructure that will increase the productivity of the public at large. The other investment is a hydroelectric development that will provide electric power to the agricultural sector. (We assume that these projects are infinitely divisible.) The location of the project is subject to negotiation. The commodity groups are responsible for the cost of transporting power from the hydroelectric site to their locations; transportation costs increase quadratically with distance. Thus, the location that minimizes aggregate transportation costs is the mean of the commodity group locations. Even at this location, however, the aggregate net return from the hydroelectric project is lower than the return from the educational project.

The government enters into negotiations with the lobbyists representing the commodity groups, to determine the following aspects of the policy reform package: By what amount should each group's subsidy level be reduced, in order to obtain a total subsidy reduction of one unit? What fraction of the proceeds of the subsidy reduction should be spent on education, and what fraction on the hydroelectric project? Where should the hydroelectric project be located? The commodity groups and the Congress all negotiate to have as large as possible a fraction the of the policy bounty spent on the hydroelectric project; the OMB negotiates to make this fraction as small as possible. Each commodity group negotiates to have the hydroelectric project located near its own location; the OMB negotiates to have it built near the mean location; the Congress' preferred location reflects the relative political power of the various groups. Each commodity group wants to minimize its own share of the burden; the OMB is indifferent between different allocations of the burden; the Congress wants to assign smaller shares of the burden to the more powerful groups, and larger shares to the less powerful ones.

We assume that there are five members of the alliance. The members will be indexed by the subscript, i. The benevolent wing of the government will be denoted by the subscript, b, and the political wing by subscript, p.

Endogenous variables. There are nine variables that will be determined endogenously, as part of the solution to the multilateral bargaining problem. The first is the fraction, π, of the policy bounty that will be allocated to the inferior project; π is an element of the unit interval. The second and third variables, denoted by $y = (y_1, y_2)$, denote the location of the inferior project; y is a vector in $\mathbf{R}^2$. The remaining five variables, $s = (s_1, \ldots, s_5)$, specify the shares of the policy burden borne by the five members of the alliance; s is an element of the four-dimensional unit simplex, i.e., $s_i \geq 0$ and $\sum_{i=1}^{5} s_i = 1$.

The main exogenous variables. The following variables will be specified exogenously. The *rate of return* on the superior investment project is denoted by r. That is, if one unit of the policy bounty is invested in this project, the "general public" will receive r dollars of revenue. The return on the inferior project depends on two system parameters, as well as the locations of the alliance members and of the investment. The system parameters are a *sectoral inefficiency factor*, θ, contained in the open unit interval, and a *spatial inefficiency factor*, $\beta_1 > 0$. Member i's location is denoted by $\alpha_i \in \mathbf{R}^2$. Finally, there is a *normalization constant*, β_0, which is determined by the other parameters in a manner described below.

If alliance member i is located at $\alpha_i \in \mathbf{R}^2$, and one unit of the policy bounty is invested in the inferior project located at $y \in \mathbf{R}^2$, then i will receive a net revenue of $\theta(\beta_0 - \beta_1 \|y - \alpha_i\|^2)$ dollars, where $\|v - w\|$ denotes the Euclidean distance between v and w and β_0 will be defined below. That is, the inferior investment's productivity for a particular member declines quadratically in the distance between the member and the project; β_1 determines the sensitivity of productivity to the location of the project. Observe that *aggregate* net revenue is maximized when the project is located at the mean of the alliance members' locations, i.e., at $\bar{\alpha} = \frac{1}{5}\sum_{i=1}^{5}\alpha_i$. The normalization constant, β_0, is chosen so that, if there were no spatial inefficiencies (i.e., $y = \bar{\alpha}$) and no sectoral inefficiencies (i.e., $\theta = 1$), then the two investments would be equally productive. That is, β_0 is determined implicitly by the condition $r = 5(\beta_0 - \beta_1\bar{d})$, where $\bar{d} = \frac{1}{5}\sum_{i=1}^{5}\beta_i\|\bar{\alpha} - \alpha_i\|^2$. Rearranging yields:

$$\beta_0 = \frac{r + \beta_1\bar{d}}{5}.$$

Our assumption that $\theta < 1$ guarantees that the inferior project is always less efficient than the superior project.

A central aspect of our scenario is that each member of the alliance prefers π to be as large as possible. To ensure that this is the case, we must restrict attention to the subset of the parameter space in which each alliance member earns a positive net revenue from the investment in equilibrium. The requirement for positive revenue is that for each i, and each possible location of the inferior project, y, $\beta_0 - \beta_1\|y - \alpha_i\|^2 > 0.$. Since β_0 is determined by other parameters and y is determined endogenously, this restriction is rather complicated. It is easy to check, however, that no player will ever propose a location for y that lies outside the convex hull of the α_i. Letting $\tilde{d}$ denote the maximum distance between α_i and α_j, for any i and j, a sufficient condition is that

$$r > \beta_1(5\tilde{d} - \bar{d}).$$

The payoff function for members of the alliance. Prior to the policy reform, alliance member i has an initial income of γ units. (The only role that γ plays in the model is to ensure that agents' payoffs are always positive. This is important only for computational purposes.) This amount is reduced by i's share of the policy burden, s_i, and increased by i's net revenue from the inferior investment project. This revenue is proportional to the fraction, π, of the policy bounty that is invested in the inferior project. Finally, player i is risk averse, with a coefficient of relative risk aversion of ($\rho_i \in [0, 1]$. Summarizing, member i's payoff from a policy vector (π, y, s) is

$$u_i(\pi, y, s) = \left\{ \gamma - s_i + \pi\theta\left[\beta_0 - \beta_1 \|y - \alpha_i\|^2\right]\right\}^{1-\rho_i}.$$

We will be interested in i's willingness to compromise on location choice, y, in order to negotiate a larger share of the policy bounty, π. The tradeoff between y and π is easy to analyze when we restrict the locations of the members of the alliance and the public good to lie in a one-dimensional subspace of $\mathbf{R}^2$. In particular, set $y_2 = \alpha_{j,2}$, for each j. In this case, the measure of the tradeoff is member i's marginal rate of substitution of y_1 for π, i.e.,

$$\mathrm{MRS}_i^{y_i\pi} = \frac{dy_i}{d\pi}\bigg|_{u_i \text{constant}} = abs\left(\frac{\partial u_i / \partial \pi}{\partial u_i / \partial y_i}\right) = \frac{1}{2\pi} abs\left[\frac{\beta_0}{\beta_1 (y_1 - \alpha_{i,1})} - (y_1 - \alpha_{i,1})\right].$$

Note that this tradeoff is independent of θ. Moreover, as β_1 increases, i's indifference curve becomes flatter, that is, i is less willing to compromise on location.

The payoff function for the benevolent wing of the government. The benevolent wing (player b) is concerned only with maximizing aggregate net revenue. It pays no attention to distributional issues. Its payoff is determined by the sum of the revenues earned from the two investment projects. Thus, player b)'s payoff from a policy vector (π, y, s) is:

$$u_b(\pi, y, s) = \left\{ r(1-\pi) + \pi\theta\sum_{j=1}^{S}\left[\beta_0 - \beta_1 \|y - \alpha_j\|^2\right]\right\}^{1-\rho_b}.$$

It is straightforward to check that for given π and s, $u_b(\pi, \cdot, s)$ is maximized when y is set to the mean location $\overline{\alpha}$. Note that by definition of β_0, u_b is strictly increasing in π whenever θ is less than one. Once again, we can measure player b's willingness to tradeoff location for π as

$$MRS_b^{y_1,\pi} = \frac{dy_1}{d\pi}\bigg|_{u_b \text{ constant}} = abs\left(\frac{\partial u_b / \partial \pi}{\partial u_b / \partial y_1}\right) = abs\left\{\frac{\sum_{i=1}^{5}\left[\beta_0 - \beta_1 (y_1 - \alpha_j)^2\right] - \frac{r}{\theta}}{2\pi\beta_1 \sum_{i=1}^{5}(y_1 - \alpha_j)}\right\}$$

$$= abs\left\{\frac{\beta_1^{-1}(5\beta_0 - r/\theta) - \sum_{i=1}^{5}(y_1 - \alpha_j)^2}{2\pi \sum_{i=1}^{5}(y_1 - \alpha_j)}\right\}.$$

Note that, by definition of β_0, *b*'s willingness to trade location for π approaches zero as y approaches the mean location and θ approaches unity.

The payoff function for the political wing of the government. The objective of the political wing is to maximize its political support. This support accumulates or dissipates, depending on whether the members of the alliance are satisfied or dissatisfied with the outcome of the negotiation process. Specifically, we assume that each member declares in advance an *influence schedule*, which assigns a reward or punishment to each policy vector. In the present model, member *i* rewards or punishes the government according to whether its payoff from the package exceeds or falls short of some *benchmark* payoff level, $\bar{u}_i$. The benchmark may be interpreted as the utility member *i* assigns to the status quo; that is, *i* rewards the government if it prefers the selected package to the status quo, otherwise the government is punished.

For concreteness, imagine that the currency of rewards and punishments is campaign contributions. Each member declares some base contribution level, and increases this level as a reward, or decreases it as a punishment. Clearly, the steeper a member's schedule, the more sensitive the political wing will be to the preferences of this member. Specifically, given a proposal $(\pi, \bar{\bar{y}}, s)$, member *i* transfers to the government the amount, $\Psi_i e^{u_i(\pi, y, s) - \bar{u}_i}$, where ψ_i is some positive number. Note that the larger ψ_i is, the more influential player *i* will be. For this reason, we refer to ψ_i as member *i*'s influence coefficient.

Summarizing, the payoff function for the political wing is just the sum of the influence schedules of the various members of the alliance:

$$u_p(\pi, y, s) = \sum_{j=1}^{5} \Psi_i e^{u_i(\pi, y, s) - \bar{u}_i}.$$

We conclude this section by introducing some concepts that will be used in the following section. We begin by defining what we mean by the *objectives* of either an individual participant or a group of participants in the negotiation process. By "individual objectives" we mean the "incremental goals" of a participant in the negotiation process, *relative to* some benchmark solution to the process. In the abstract, an individual's incremental goal is, simply, to shift the benchmark solution in the direction that the gradient of his payoff function points. By "objectives," we mean the directions in which this payoff function is increasing. For example, member i of the alliance has three objectives: to obtain a larger share, π, of the policy bounty; to bear a smaller portion, s_i, of the policy burden; and to shift the location for the inferior investment, y, toward player i's own location, α_i. We emphasize again that, in our usage, objectives are only defined *relative* to some benchmark vector of policy variables.

We will also refer to the objectives of a *group* of participants. In our model, the group that is of primary interest to us is the alliance. Of course, since groups do not actually participate *as groups* in the negotiation, these objectives are necessarily hypothetical. However, since utility in our model is transferable, the notion of a group payoff function is meaningful. For example, in our model, there is a well-defined payoff function for the alliance: It is increasing in π and decreasing in the distance between y and the mean of the α_i's. Thus, the objectives of this group are to to obtain a larger share, π, of the policy bounty and shift the location for the inferior investment, y, closer to the mean location, $\bar{\alpha}$.

We will be interested in the relationship between the objectives of a group and the objectives of the individuals who comprise the group. To study this relationship, it is useful to classify individual objectives into different components. We will distinguish between the *communal*, the *personal*, and the *factional* components of an individual's objectives. The communal component refers to objectives that are shared by all members of the alliance. Each individual's personal component will be different from other individuals' personal components, indeed, they will be diametrically opposed to each other. The factional component refers to objectives that are shared, at least partially, by some members and are opposed by others.

In our model, the members of the alliance form a group and members' objectives can be divided into the above components in a straightforward way. The communal objective is to increase the fraction, π, of the policy bounty that is invested in their sector. The personal component for player i is to reduce s_i, the share of the policy burden that must be borne by player i. Finally, the factional component relates to the location of the public good: Members located to the right of the "benchmark" location of the public good will be united against those located to the left.

Our classification can be applied, though in a less clear cut way, to a wide variety of negotiating situations. Consider, for example, the members of a university department. There may be a communal interest in increasing total departmental resources. Each member's personal component might involve minimizing his own teaching load, or maximizing his own share of departmental resources. The factional component might involve departmental issues such as the balance between theory versus applications, teaching versus research, junior versus senior faculty members. Alternatively, consider the privatization debate that is currently taking place in Eastern Europe. In the negotiations over privatizing a specific enterprise, the group might consist of all the potential equity holders. These all may share a communal interest in minimizing the extent of government regulation of the enterprise. Their personal objectives might relate to the magnitude and terms of their own equity holdings. The factional component of their objectives might relate to such tradeoffs as between the environmental quality of the workplace and the profitability of the enterprise; between labor-market practices that provide security and reward seniority versus those that provide incentives and reward effort.

For the analysis that follows, we will find it useful to rank individual members of a group as more or less *group oriented* depending on the extent to which their individual objectives are compatible with the objectives of the group. Like objectives, group orientation is defined only relative to some benchmark policy vector. Formally, the measure of individual i's group-orientation is simply the angle between the gradients of i's payoff function and the group's payoff function. If this angle is zero, then i is totally group oriented; an angle of 180 degrees means that i's objectives are diametrically opposed to those of the group's; an angle of 90 degrees means that i's objectives are orthogonal to those of the group.

Group orientation is relatively easy to evaluate in our model. A member of the alliance, i, will be more group oriented, the greater the emphasis he places on increasing π relative to decreasing s_i. Similarly, i will be more group oriented if his factional objective is to move y closer to, rather than away from, the mean location, $\overline{\alpha}$. This example emphasizes that group-orientation depends on context. If the benchmark location is to the left of the mean, then, other things being equal, players located to the right of the mean will be more group oriented than those located to the left; if the benchmark is located to the right of the mean, this ranking will be reversed.

We conclude this subsection with a brief discussion of *power*. In the following section, we will refer to power in many forms. For example, we will talk about the power of an individual negotiator and the the balance of power between different factions. It will be apparent from our description above that there are several distinct sources of power in our model. Three of these sources are readily understood. There is a fourth potential source of power, but we will exclude it from consideration in the present model. A fifth source of power is much more difficult to conceptualize.

The first source of player $\overline{\alpha}$ power is his access probability, w_i. (Recall that i is chosen to be the proposer in any round with probability w_i.) If w_i is increased, then i's expected utility will increase in every round of bargaining. In addition, he will take a tougher bargaining stance, since he will be less deterred by the prospect of disagreement. A second source of i's power is his *influence coefficient*, ψ_i. If ψ_i is higher, then the political wing will be more sensitive to i's objectives. In addition, other players will have a tendency to orient their proposals in directions favored by i, in order to secure the agreement of the political wing, which is an essential player. A third source of power is i's coefficient of relative risk aversion, ρi. The less risk averse player i is (i.e., the larger ρ_i), the less threatened he will feel by the prospect of disagreement; and so he will take a tougher bargaining stance.

The fourth component is more subtle in its effects. It is $u_i(\varnothing)$, the utility that i receives from the default policy vector. Since it is rather difficult to analyze the role of this value, we have chosen to assume it away in this paper by imposing the restriction that that agreement on any policy vector in X is preferable to disagreement. In a sequel to this paper, we will re-examine the role of this variable in some detail. The final source of individual political power is by far the most difficult to conceptualize. For want of a better name, we will call it *strategic power*. In our particular model, strategic power is the power conferred upon a player by virtue of his *location* relative to the others. We will discuss the role played by strategic power in later sections. At this point, there is little we can say about it in the abstract.

4 A Numerical Example.

In this section, we consider in considerable detail an explicit example that has been solved numerically. For simplicity, the political wing of the government (OMB) has been excluded from the negotiations and we have declared that burden shares are nonnegotiable. As a byproduct of this discussion, the reader will be introduced to our computer algorithm for solving the model. In the discussion below, we will refer frequently the computer output which is displayed as Table IV-1a. The first section of the output lists the parameters of the bargaining problem. There are 10 admissible coalitions, numbered from 1 to 10, and 6 players,

TABLE IV.1a

Number of rounds:	50						
Number of admissible coalitions:	10						
Number of peripheral players:	5						
Number of government players:	1						
Return on superior project (r):	20.000						
Sectoral inefficiency factor (theta):	0.500						
Spatial normalization factor (beta(0)):	4.500						
Spatial inefficiency factor (beta(1)):	1.000						
Members of coalition number 1:	OUT	IN	IN	IN	OUT	IN	
Members of coalition number 2:	OUT	IN	IN	OUT	IN	IN	
Members of coalition number 3:	OUT	IN	OUT	IN	IN	IN	
Members of coalition number 4:	OUT	OUT	IN	IN	IN	IN	
Members of coalition number 5:	IN	IN	IN	OUT	OUT	IN	
Members of coalition number 6:	IN	IN	OUT	IN	OUT	IN	
Members of coalition number 7:	IN	IN	OUT	OUT	IN	IN	
Members of coalition number 8:	IN	OUT	IN	IN	OUT	IN	
Members of coalition number 9:	IN	OUT	IN	OUT	IN	IN	
Members of coalition number 10:	IN	OUT	OUT	IN	IN	IN	
Location of player number 1: (alpha)	-1.000	0.000					
Location of player number 2: (alpha)	-0.500	0.000					
Location of player number 3: (alpha)	0.000	0.000					
Location of player number 4: (alpha)	0.500	0.000					
Location of player number 5: (alpha)	1.000	0.000					
Vector of access weights (w):	1.000	1.000	1.000	1.000	1.000	5.000	
Vector of risk aversion coefficients (rho):	0.500	0.500	0.500	0.500	0.500	0.500	
Vector of influence coefficients (psi)	0.000	1.000	1.000	1.000	1.000	1.000	0.000
Constant in payoff functions (gamma):	20.000						
Convergence tolerance level:	0.000000010						

Round #50

#10	1.000000	-1.000000	0.000000	4.75395	4.74342	4.71169	4.65833	4.58258	4.63601
#7	1.000000	-0.500000	0.000000	4.74342	4.75395	4.74342	4.71169	4.65833	4.67707
#8	1.000000	0.000000	0.000000	4.71169	4.74342	4.75395	4.74342	4.71169	4.69042
#10	1.000000	0.500000	0.000000	4.65833	4.71169	4.74342	4.75395	4.74342	4.67707
#10	1.000000	1.000000	0.000000	4.58258	4.65833	4.71169	4.74342	4.75395	4.63601
#10	0.000100	0.000000	0.000000	4.56072	4.56072	4.56072	4.56072	4.56072	4.89896
Expected payoffs:				4.62535	4.64144	4.64670	4.64144	4.62535	4.78130

Round #49

#8	0.536092	-0.500000	0.000000	4.65554	4.66529	4.65954	4.64225	4.61329	4.78130*
#7	0.561581	-0.238963	0.000000	4.65626	4.66857	4.66883	4.65706	4.63314	4.78130*
#8	0.569598	0.000000	0.000000	4.64730	4.66565	4.67175	4.66565	4.64730	4.78130*
#10	0.561581	0.238963	0.000000	4.63314	4.65706	4.66883	4.66857	4.65626	4.78130*
#4	0.536092	0.500000	0.000000	4.61329	4.64225	4.65954	4.66529	4.65954	4.78130*
#10	0.433440	0.336569	0.000000	4.62535*	4.64007	4.64542	4.64146*	4.62010	4.80966
Expected payoffs:				4.63363	4.64932	4.65554	4.65060	4.63500	4.79540

Round #48

#5	0.493228	-0.262093	0.000000	4.64547	4.65582	4.65556*	4.64470	4.62316	4.79540*
#5	0.494631	-0.238963	0.000000	4.64497	4.65584	4.65608	4.64567	4.62457	4.79540*
#9	0.531692	0.000000	0.000000	4.63706	4.65327	4.65865	4.65327	4.63706	4.79540*
#4	0.494631	0.238963	0.000000	4.62457	4.64567	4.65608	4.65584	4.64497	4.79540*
#4	0.493228	0.262093	0.000000	4.62316	4.64470	4.65556*	4.65582	4.64547	4.79540*
#7	0.481755	0.011911	0.000000	4.63401	4.64992*	4.65538	4.65042	4.63500*	4.79901
Expected payoffs:				4.63453	4.65049	4.65548	4.65074	4.63502	4.79724

Round #47

#5	0.493113	-0.153440	0.000000	4.64152	4.65397	4.65588*	4.64725	4.62803	4.79724*
#5	0.493113	-0.153441	0.000000	4.64152	4.65397	4.65588*	4.64725	4.62803	4.79724*
#9	0.488234	0.000000	0.000000	4.63579	4.65172	4.65702	4.65172	4.63579	4.79724*
#4	0.493119	0.153441	0.000000	4.62803	4.64725	4.65588*	4.65397	4.64152	4.79724*
#4	0.493116	0.153440	0.000000	4.62803	4.64725	4.65588*	4.65397	4.64152	4.79724*
#7	0.486992	0.001265	0.000000	4.63467	4.65012*	4.65541	4.65067	4.63502*	4.79856
Expected payoffs:				4.63442	4.65066	4.65536	4.65075	4.63500	4.79785

Round #46

#5	0.488867	-0.101020	0.000000	4.63817	4.65283	4.65596*	4.64858	4.63065	4.79789*
#5	0.488867	-0.101020	0.000000	4.63817	4.65283	4.65596*	4.64858	4.63065	4.79789*
#9	0.488114	0.000000	0.000000	4.63332	4.65115	4.65642	4.65115	4.63332	4.79789*
#4	0.488867	0.101020	0.000000	4.63065	4.64858	4.65596*	4.65283	4.63817	4.79789*
#4	0.488867	0.101020	0.000000	4.63065	4.64858	4.65596*	4.65283	4.63817	4.79789*
#7	0.487613	0.001464	0.000000	4.63488	4.65066*	4.65593	4.65072	4.63500*	4.79841
Expected payoffs:				4.63493	4.65073	4.65598	4.65076	4.63500	4.79815

Round #45

#5	0.488366	-0.063934	0.000000	4.63766	4.65208	4.65599*	4.64940	4.63227	4.79815*
#5	0.488366	-0.063934	0.000000	4.63766	4.65208	4.65599*	4.64940	4.63227	4.79815*
#9	0.488865	0.000000	0.000000	4.63513	4.65092	4.65617	4.65092	4.63513	4.79815*
#4	0.488366	0.063934	0.000000	4.63227	4.64940	4.65599*	4.65209	4.63766	4.79815*
#4	0.488366	0.063934	0.000000	4.63227	4.64940	4.65598*	4.65209	4.63766	4.79815*
#7	0.487864	0.000466	0.000000	4.63496	4.65073*	4.65598	4.65075	4.63500*	4.79834
Expected payoffs:				4.63498	4.65075	4.65600	4.65076	4.63500	4.79826

Round #44

#5	0.488165	-0.040446	0.000000	4.63669	4.65161	4.65600*	4.64991	4.63328	4.79826*
#5	0.488165	-0.040446	0.000000	4.63669	4.65161	4.65600*	4.64991	4.63328	4.79826*
#8	0.488364	0.000000	0.000000	4.63505	4.65083	4.65608	4.65083	4.63505	4.79826*
#4	0.488165	0.040446	0.000000	4.63328	4.64991	4.65600*	4.65161	4.63669	4.79826*
#4	0.488165	0.040446	0.000000	4.63328	4.64991	4.65600*	4.65161	4.63669	4.79826*
#10	0.487964	0.000338	0.000000	4.63498*	4.65075	4.65600	4.65076*	4.63501	4.79834
Expected payoffs:				4.63499	4.65076	4.65601	4.65077	4.63500	4.79830

Round #43

#5	0.488084	-0.025584	0.000000	4.63607	4.65130	4.65601*	4.65023	4.63392	4.79830*
#5	0.488084	-0.025584	0.000000	4.63607	4.65130	4.65601*	4.65023	4.63392	4.79830*
#9	0.488164	0.000000	0.000000	4.63502	4.65078	4.65604	4.65078	4.63502	4.79830*
#4	0.488084	0.025584	0.000000	4.63392	4.65023	4.65601*	4.65130	4.63607	4.79830*
#4	0.488084	0.025584	0.000000	4.63392	4.65023	4.65601*	4.65130	4.63607	4.79830*
#7	0.488004	0.000127	0.000000	4.63499	4.65076*	4.65601	4.65077	4.63500*	4.79833
Expected payoffs:				4.63500	4.65077	4.65601	4.65077	4.63500	4.79832

Round #42

#5	0.488052	-0.016182	0.000000	4.63568	4.65111	4.65601*	4.65043	4.63432	4.79832*
#5	0.488052	-0.016182	0.000000	4.63568	4.65111	4.65601*	4.65043	4.63432	4.79832*
#9	0.488084	0.000000	0.000000	4.63501	4.65078	4.65602	4.65078	4.63501	4.79832*
#4	0.488052	0.016182	0.000000	4.63432	4.65043	4.65601*	4.65111	4.63568	4.79832*
#4	0.488052	0.016182	0.000000	4.63432	4.65043	4.65601*	4.65111	4.63568	4.79832*
#10	0.488020	0.000081	0.000000	4.63500*	4.65077	4.65601	4.65077*	4.63500	4.79833
Expected payoffs:				4.63500	4.65077	4.65601	4.65077	4.63500	4.79832

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Round #3

#5	0.488031	-0.000593	0.000000	4.63503	4.65078	4.65601*	4.65076	4.63498	4.79833*
#5	0.488031	-0.000595	0.000000	4.63503	4.65078	4.65601*	4.65076	4.63498	4.79833*
#9	0.488031	0.000000	0.000000	4.63500	4.65077	4.65601	4.65077	4.63500*	4.79833*
#4	0.488031	0.000595	0.000000	4.63498	4.65076	4.65601*	4.65078	4.63503	4.79833*
#4	0.488031	0.000593	0.000000	4.63498	4.65076	4.65601*	4.65078	4.63503	4.79833*
#10	0.488031	0.000000	0.000000	4.63500*	4.65077	4.65601	4.65077*	4.63500*	4.79833
Expected payoffs:				4.63500	4.65077	4.65601	4.65077	4.63500	4.79833

Round #2

#5	0.488031	-0.000593	0.000000	4.63503	4.65078	4.65601*	4.65076	4.63498	4.79833*
#5	0.488031	-0.000595	0.000000	4.63503	4.65078	4.65601*	4.65076	4.63498	4.79833*
#9	0.488031	0.000000	0.000000	4.63500	4.65077	4.65601	4.65077	4.63500*	4.79833*
#4	0.488031	0.000595	0.000000	4.63498	4.65076	4.65601*	4.65078	4.63503	4.79833*
#4	0.488031	0.000593	0.000000	4.63498	4.65076	4.65601*	4.65078	4.63503	4.79833*
#10	0.488031	0.000000	0.000000	4.63500*	4.65077	4.65601	4.65077*	4.63500*	4.79833
Expected payoffs:				4.63500	4.65077	4.65601	4.65077	4.63500	4.79833

Round #1

#5	0.488031	-0.000593	0.000000	4.63503	4.65078	4.65601*	4.65076	4.63498	4.79833*
#5	0.488031	-0.000595	0.000000	4.63503	4.65078	4.65601*	4.65076	4.63498	4.79833*
#9	0.488031	0.000000	0.000000	4.63500	4.65077	4.65601	4.65077	4.63500*	4.79833*
#4	0.488031	0.000595	0.000000	4.63498	4.65076	4.65601*	4.65078	4.63503	4.79833*
#4	0.488031	0.000593	0.000000	4.63498	4.65076	4.65601*	4.65078	4.63503	4.79833*
#10	0.488031	0.000000	0.000000	4.63500*	4.65077	4.65601	4.65077*	4.63500*	4.79833
Expected payoffs:				4.63500	4.65077	4.65601	4.65077	4.63500	4.79833

numbered from 1 to 6. Each line beginning "Members of coalition number ..." is followed by six columns, specifying which players are included in this coalition. For example, coalition #1 consists of players #2, #3, #4, and #6. The next lines indicate the locations and utility parameters of the privileged sector members. The locations are distributed symmetrically along the horizontal axis. To calculate player i's access probability, divide his access weight by the sum all of the access weights. The utility parameters are identical for all members of the alliance. Note especially, that player #6 is chosen to the proposer with probability one-half. The remaining players are chosen with equal probability.

The remainder of the output summarizes the outcome of negotiations in each round of the bargaining. Consider, for example, the seven rows of numbers below the statement "Round #50." The first six rows contain ten columns. For $1 \leq i \leq 6$, the first column of row i is the coalition selected by player i in the last period. The second through fourth columns list the policy vector proposed by i: The second column is the value of π; the third and fourth are, respectively, the horizontal and vertical components of the proposed location of y. The fifth through tenth columns specify the payoff that each player will earn if the corresponding policy vector is accepted. The seventh row lists the expected payoff for each player conditional on reaching the final round of negotiations.

We solve the model by standard dynamic programming techniques, starting from the last round. Our maintained hypothesis is that, if no agreement is reached in the final round, then each player earns an arbitrarily large negative payoff. Consequently, the optimal response for any proposer in this round is to propose his globally optimal policy vector. In particular, each member of the privileged sector proposes a π-value of unity and a location for y that coincides with the member's own location. Since any player will accept any proposal rather than incur the low disagreement payoff, the proposer can choose any one of the coalitions of which he is member. When the proposer is indifferent between coalitions, our computer algorithm chooses the one indexed by the larger number.

Now consider the penultimate round of negotiations. A member, *j*, of a coalition will accept a policy vector proposed by *i* in this round if, and only if, the payoff received by *j* from the proposal is at least as great as *j*'s *expected* payoff conditional on reaching the next round. Thus, to determine his optimal proposal, player *i* must solve a separate nonlinear programming problem for each coalition to which he belongs. In the example we consider, the policy space has only two dimensions, since we have restricted attention to a one dimensional subspace of location space. Since each coalition has four members, there are three "participation constraints." Generically, then, at most two will be binding. In the computer output, a binding constraint is indicated by an asterisk following the corresponding payoff number. In round #49, for example, player #6's participation is the only binding constraint for each of players #1 through #5.

Having solved each of the nonlinear programming problems, player *i* then picks the coalition that yields him the highest payoff. If the payoff exceeds *i*'s expected payoff conditional on reaching the next round, then *i* will propose this coalition and the corresponding policy vector. Note that there may be rounds in which *i* makes a proposal that is *not* accepted. This can happen for one of two reasons. First, *i* 's best feasible alternative may yield him a lower payoff than his expected payoff conditional on passing to the next round. Second, there may be no proposal available to *i* that satisfies the necessary participation constraints.

We now consider in detail players' proposals in Round #49. First note that, unlike in round #50, players #1 through #5 cannot persuade player #6 to accept a π-value of unity. Similarly, #6 cannot persuade any of the other players to accept a π-value of zero. Next, observe that for $1 \leq i \leq 5$, the distance between *i*'s location and the origin is inversely related to the magnitude of the π-value proposed by *i*. The reason is simple. Each player *i* is constrained by the need to have player #6 accept his proposal. Player #6's optimal location is the origin. Since players #1 and #5 have a greater conflict than the other players over location, they must compromise more over π in order to secure #6's agreement. Similarly, #2 and #4 must compromise over π more than #3. This point illustrates our earlier discussion about the factional versus the communal components of objectives. In the language of the preceding section, we say that #3 is more communally oriented than #2 and #4, and that these players are, in turn, more communally oriented than #1 and #5. Our final comment about this round concerns player #6's choice of coalition. He chooses coalition #10, consisting of players #1, #4, and #5. By symmetry, he could have received the same payoff had he chosen coalition #7, which contains the same members as #10, except that #2 replaces #4. The computer chose coalition #10 because ten is larger than seven. Note that #6 specifies a positive location to satisfy player #4, whose location is positive. Had the computer chosen coalition #7, #6 would have proposed a negative location, and the signs of all his subsequent offers would be reversed.

We now turn to round #48. Our first observation is that the distance between the different players' proposals is smaller than in Round #49. The reason is that, on the one hand, player #6's participation constraint is tighter for players #1 through #5, while on the other hand, players #2 and #4's participation constraints are tighter for player #6. Next, observe that player #6 switches from coalition #10 to coalition #7; that is, he replaces player #4 with player #2. The explanation for this switch is instructive. Recall that in the following round (#49), the proposals that players plan to make are symmetric about the origin, *except* that #6 plans to propose a positive location for y. Therefore, player #2's expected payoff conditional on reaching the following period is lower than player #4's; and so #2's agreement is easier to obtain in the current period. Note also that #6 again proposes a *positive* location for y, even though the new member #2 prefers a negative location. This reflects the fact that player #5's participation constraint in the current period is tighter than #1's, because #6 plans to propose a positive location in the following period.

As we proceed backward from Round #47 to Round #44, the gap between the proposed values of π continues to narrow, and the proposed locations for y converge toward the origin. Players #1 through #5 are forced to offer smaller and smaller y-values, because #6's participation continues to tighten. For player #6, the reason is more subtle: as the proposed locations become less skewed to the right, player #2's participation constraint becomes tighter, while #5's becomes looser, and #6's proposed location for y reflects this shift in the relative bargaining strength of #2 and #5. Finally, note that, throughout this period of the negotiations, #6 continues to choose coalition #7 over #10. The reason is that #2's participation constraint remains lower than #4's because the distribution of y-locations remains skewed to the right.

This concludes our detailed discussion of the output. Note that in the first round of the game, each player specifies a π-value of approximately 0.488, and a location for y of approximately zero. This, then, is the approximate solution to the game. It has several intuitively appealing properties. The game is almost symmetric, with player #6 on the on hand, and the remaining players on the other. A slight asymmetry arises because players #1 and #5 are not as cohesive as a single agent. If all of the players were as communally oriented as #3, then the outcome would have been exactly symmetric—π would have been equal to 0.5. The bargaining strength of the alliance was diluted, however, for two reasons. Because they were concerned with the factional components of their objectives, some of the alliance members were less aggressive than player #3 in negotiating for a higher value of π. A second, but related asymmetry in the model is that #6 is an essential player but #3 is not. Player #3 is #6's toughest opponent, but is excluded from #6's coalition except in the earliest rounds of the game. If we modify the example by making player #3 an essential player, the the solution value for π increases to approximately 0.492. We display the output for this modified game in Table IV-1b. This suggests that roughly one-third of the asymmetry arose because the toughest member of the alliance was not essential, while two-thirds arise because of the diffusion of objectives within the alliance.

TABLE IV.1b
Player #3 is central

Number of rounds:	50					
Number of admissible coalitions:	10					
Number of peripheral players:	5					
Number of government players:	1					
Members of coalition number 1:	OUT	IN	IN	IN	OUT	IN
Members of coalition number 2:	OUT	IN	IN	OUT	IN	IN
Members of coalition number 3:	OUT	IN	IN	IN	IN	IN
Members of coalition number 4:	OUT	OUT	IN	IN	IN	IN
Members of coalition number 5:	IN	IN	IN	OUT	OUT	IN
Members of coalition number 6:	IN	IN	IN	IN	OUT	IN
Members of coalition number 7:	IN	IN	IN	OUT	IN	IN
Members of coalition number 8:	IN	OUT	IN	IN	OUT	IN
Members of coalition number 9:	IN	OUT	IN	OUT	IN	IN
Members of coalition number 10:	IN	OUT	IN	IN	IN	IN
Location of player number 1: (alpha)	-1.000	0.000				
Location of player number 2: (alpha)	-0.500	0.000				
Location of player number 3: (alpha)	0.000	0.000				
Location of player number 4: (alpha)	0.500	0.000				
Location of player number 5: (alpha)	1.000	0.000				
Vector of access weights (w):	1.000	1.000	1.000	1.000	1.000	5.000
Vector of risk aversion coefficients (rho):	0.500	0.500	0.500	0.500	0.500	0.500
Constant in payoff functions (gamma):	20.000					
Return on superior project (r):	20.000					
Sectoral inefficiency factor (theta):	0.500					
Spatial normalization factor (beta(0)):	4.500					
Spatial inefficiency factor (beta(1)):	1.000					
Influence coefficient for player 1: (psi)	1.000					
Influence coefficient for player 2: (psi)	1.000					
Influence coefficient for player 3: (psi)	1.000					
Influence coefficient for player 4: (psi)	1.000					
Influence coefficient for player 5: (psi)	1.000					
Convergence tolerance level:	0.000000010					

Round #50

#10	1.000000	-1.000000	0.000000	4.75395	4.74342	4.71169	4.65833	4.58250	4.63681
#7	1.000000	-0.500000	0.000000	4.74342	4.75395	4.74342	4.71169	4.65833	4.67707
#10	1.000000	0.000000	0.000000	4.71169	4.74342	4.75395	4.74342	4.71169	4.69042
#10	1.000000	0.500000	0.000000	4.65833	4.71169	4.74342	4.75395	4.74342	4.67707
#10	1.000000	1.000000	0.000000	4.58250	4.65833	4.71169	4.74342	4.75395	4.63681
#10	0.000000	0.000000	0.000000	4.56072	4.56072	4.56072	4.56072	4.56072	4.89896
Expected payoffs:				4.62535	4.64144	4.64678	4.64144	4.62535	4.78130

Round #49

#8	0.536092	-0.500000	0.000000	4.65354	4.66529	4.65854	4.64225	4.61129	4.78130*
#7	0.561581	-0.230963	0.000000	4.65626	4.66857	4.66083	4.65706	4.63314	4.78130*
#10	0.569598	0.000000	0.000000	4.64730	4.66565	4.67175	4.66565	4.64730	4.78130*
#10	0.561581	0.230963	0.000000	4.63314	4.65706	4.66083	4.66857	4.65626	4.78130*
#4	0.534092	0.500000	0.000000	4.61129	4.64225	4.65854	4.66528	4.65354	4.78130*
#5	0.440293	0.000000	0.000000	4.62779	4.64204	4.64678*	4.64204	4.62779	4.80027
Expected payoffs:				4.63485	4.65060	4.65624	4.65090	4.63485	4.79470

Round #48

#5	0.496654	-0.259437	0.000000	4.64534	4.65645	4.65624*	4.64535	4.62371	4.79478*
#5	0.497928	-0.230963	0.000000	4.64553	4.65647	4.65670	4.64624	4.62499	4.79478*
#10	0.505037	0.000000	0.000000	4.63757	4.65388	4.65930	4.65388	4.63757	4.79478*
#4	0.497928	0.230963	0.000000	4.62499	4.64624	4.65670	4.65647	4.64553	4.79478*
#4	0.496654	0.259437	0.000000	4.62371	4.64535	4.65624*	4.65645	4.64598	4.79478*
#9	0.489202	0.000000	0.000000	4.63518	4.65098	4.65624*	4.65098	4.63518	4.79808
Expected payoffs:				4.63537	4.65133	4.65664	4.65133	4.63537	4.79643

Round #47

#5	0.494022	-0.154410	0.000000	4.64212	4.65468	4.65664*	4.64796	4.62861	4.79643*
#5	0.494022	-0.154411	0.000000	4.64212	4.65468	4.65664*	4.64796	4.62861	4.79643*
#10	0.497121	0.000000	0.000000	4.63637	4.65243	4.65777	4.65243	4.63637	4.79643*
#4	0.494022	0.154411	0.000000	4.62861	4.64796	4.65664*	4.65468	4.64212	4.79643*
#4	0.494022	0.154410	0.000000	4.62861	4.64796	4.65664*	4.65468	4.64212	4.79643*
#4	0.491267	0.000000	0.000000	4.63549	4.65136	4.65664*	4.65136	4.63549	4.79765
Expected payoffs:				4.63553	4.65146	4.65675	4.65146	4.63553	4.79704

Round #46

#5	0.492954	-0.100303	0.000000	4.63980	4.65358	4.65675*	4.64833	4.63126	4.79704*
#5	0.492954	-0.100303	0.000000	4.63980	4.65358	4.65675*	4.64833	4.63126	4.79704*
#10	0.494104	0.000000	0.000000	4.63593	4.65190	4.65720	4.65190	4.63593	4.79704*
#4	0.492954	0.100303	0.000000	4.63126	4.64833	4.65675*	4.65358	4.63980	4.79704*
#4	0.492954	0.100303	0.000000	4.63126	4.64833	4.65675*	4.65358	4.63980	4.79704*
#9	0.491852	0.000000	0.000000	4.63558	4.65147	4.65675*	4.65147	4.63558	4.79753
Expected payoffs:				4.63558	4.65151	4.65680	4.65151	4.63559	4.79729

Round #45

#5	0.492527	-0.063467	0.000000	4.63829	4.65285	4.65680*	4.65016	4.63290	4.79729*
#5	0.492527	-0.063467	0.000000	4.63829	4.65285	4.65680*	4.65016	4.63290	4.79729*
#10	0.493023	0.000000	0.000000	4.63576	4.65168	4.65698	4.65168	4.63576	4.79729*
#4	0.492527	0.063467	0.000000	4.63290	4.65016	4.65680*	4.65285	4.63829	4.79729*
#4	0.492527	0.063467	0.000000	4.63290	4.65016	4.65680*	4.65285	4.63829	4.79729*
#9	0.492086	0.000000	0.000000	4.63561	4.65151	4.65680*	4.65151	4.63561	4.79748
Expected payoffs:				4.63562	4.65153	4.65681	4.65153	4.63562	4.79738

Round #44

#5	0.492356	-0.040148	0.000000	4.63733	4.65238	4.65681*	4.65068	4.63391	4.79738*
#5	0.492356	-0.040148	0.000000	4.63733	4.65238	4.65681*	4.65068	4.63391	4.79738*
#10	0.492558	0.000000	0.000000	4.63568	4.65160	4.65688	4.65160	4.63568	4.79738*
#4	0.492356	0.040148	0.000000	4.63391	4.65068	4.65681*	4.65238	4.63733	4.79738*
#4	0.492356	0.040148	0.000000	4.63391	4.65068	4.65681*	4.65238	4.63733	4.79738*
#9	0.492180	0.000000	0.000000	4.63563	4.65153	4.65681*	4.65153	4.63563	4.79746
Expected payoffs:				4.63563	4.65153	4.65682	4.65153	4.63563	4.79742

Round #43

#5	0.492288	-0.025384	0.000000	4.63671	4.65207	4.65682*	4.65100	4.63455	4.79742*
#5	0.492288	-0.025384	0.000000	4.63671	4.65207	4.65682*	4.65100	4.63455	4.79742*
#10	0.492367	0.000000	0.000000	4.63566	4.65156	4.65685	4.65156	4.63566	4.79742*
#4	0.492288	0.025384	0.000000	4.63455	4.65100	4.65682*	4.65207	4.63671	4.79742*
#4	0.492288	0.025384	0.000000	4.63455	4.65100	4.65682*	4.65207	4.63671	4.79742*
#9	0.492217	0.000000	0.000000	4.63563	4.65153	4.65682*	4.65153	4.63563	4.79745
Expected payoffs:				4.63564	4.65154	4.65682	4.65154	4.63564	4.79744

Round #42

#5	0.492261	-0.016061	0.000000	4.63632	4.65188	4.65682*	4.65120	4.63495	4.79744*
#5	0.492261	-0.016061	0.000000	4.63632	4.65188	4.65682*	4.65120	4.63495	4.79744*
#10	0.492292	0.000000	0.000000	4.63565	4.65155	4.65684	4.65155	4.63565	4.79744*
#4	0.492261	0.016061	0.000000	4.63495	4.65120	4.65682*	4.65188	4.63632	4.79744*
#4	0.492261	0.016061	0.000000	4.63495	4.65120	4.65682*	4.65188	4.63632	4.79744*
#10	0.492232	0.000000	0.000000	4.63564	4.65154	4.65682*	4.65154	4.63564	4.79745
Expected payoffs:				4.63564	4.65154	4.65683	4.65154	4.63564	4.79744

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Round #3

#5	0.492242	-0.000589	0.000000	4.63566	4.65155	4.65683*	4.65153	4.63561	4.79745*
#5	0.492242	-0.000591	0.000000	4.63566	4.65155	4.65683*	4.65153	4.63561	4.79745*
#10	0.492242	0.000000	0.000000	4.63564	4.65154	4.65683	4.65154*	4.63564*	4.79745*
#4	0.492242	0.000591	0.000000	4.63561	4.65153	4.65683*	4.65155	4.63566	4.79745*
#4	0.492242	0.000589	0.000000	4.63561	4.65153	4.65683*	4.65155	4.63566	4.79745*
#10	0.492242	0.000000	0.000000	4.63564*	4.65154	4.65683*	4.65154*	4.63564*	4.79745
Expected payoffs:				4.63564	4.65154	4.65683	4.65154	4.63564	4.79745

Round #2

#5	0.492242	-0.000589	0.000000	4.63566	4.65155	4.65683*	4.65153	4.63561	4.79745*
#5	0.492242	-0.000591	0.000000	4.63566	4.65155	4.65683*	4.65153	4.63561	4.79745*
#10	0.492242	0.000000	0.000000	4.63564	4.65154	4.65683	4.65154*	4.63564*	4.79745*
#4	0.492242	0.000591	0.000000	4.63561	4.65153	4.65683*	4.65155	4.63566	4.79745*
#4	0.492242	0.000589	0.000000	4.63561	4.65153	4.65683*	4.65155	4.63566	4.79745*
#10	0.492242	0.000000	0.000000	4.63564*	4.65154	4.65683*	4.65154*	4.63564*	4.79745
Expected payoffs:				4.63564	4.65154	4.65683	4.65154	4.63564	4.79745

Round #1

#5	0.492242	-0.000589	0.000000	4.63566	4.65155	4.65683*	4.65153	4.63561	4.79745*
#5	0.492242	-0.000591	0.000000	4.63566	4.65155	4.65683*	4.65153	4.63561	4.79745*
#10	0.492242	0.000000	0.000000	4.63564	4.65154	4.65683	4.65154*	4.63564*	4.79745*
#4	0.492242	0.000591	0.000000	4.63561	4.65153	4.65683*	4.65155	4.63566	4.79745*
#4	0.492242	0.000589	0.000000	4.63561	4.65153	4.65683*	4.65155	4.63566	4.79745*
#10	0.492242	0.000000	0.000000	4.63564*	4.65154	4.65683*	4.65154*	4.63564*	4.79745
Expected payoffs:				4.63564	4.65154	4.65683	4.65154	4.63564	4.79745

5. Alliance Structure and Performance.

Our model has been designed to focus sharply on some questions that are, we believe, important but less clear cut in a general class of negotiating situations. Most of these questions concern the relationship between the *structure* of the alliance and its *performance*—in other words, the extent to which the objectives of the alliance are accomplished. The questions can conveniently be formulated in the language introduced in the previous section. Specifically, will the alliance perform better if its members all become more "communally oriented?" Will a transfer in power from less to more communally-oriented members result in improved performance by the alliance? Finally, suppose there are two opposing factions, neither of which are highly communally oriented. Will the alliance perform better when power is equally distributed between the two factions, or heavily weighted in favor of one faction?

Since the alliance as a unit is not represented at the negotiating table, its objectives will be accomplished only incidentally, as a byproduct of the negotiating efforts of individual members, who are acting in pursuit of their own *private* interests. To answer the questions raised above, therefore, we need to understand the relationship between the negotiation positions taken by individual members at various stages of the process and the ultimate solution to the bargaining problem. This issue will be addressed in the next subsection.

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Heuristics and Examples.

The discussion in this subsection is very informal. Our objective is to provide the reader with some intuition for the inner workings of the model and illustrate the extremely complex nature of the the interactions between alliance members. The discussion is organized around the three questions raised above. We will not provide any definitive answers. Rather, we will discuss some suggestive examples. In each case, we will attempt to juxtapose elements of the "conventional wisdom" about multilateral bargaining against the formalism of the model. To simplify matters, in all of the examples we consider, we will exclude the political wing of the government from the negotiations, and assume that the distribution of the policy burden is nonnegotiable.

The first of the questions above is the easiest to answer. Will the alliance perform better if its members all become "more communally oriented?" By "more communally oriented" we mean that the communal components of members' objectives become more important relative to the personal or factional components. This would could happen for several reasons. For example, the locations of all members could shrink closer to the origin. Intuitively, this seems to correspond to an increase in the "cohesiveness" of the alliance; intuitively, it certainly seems natural that this should lead to an improvement in alliance performance. It turns out that that this informal notion of cohesiveness has a very close formal counterpart in our model, and that its qualitative effect is just as our intuition would predict. A numerical example is provided in Table V.1a and Table V.1b. We begin with alliance members located along the horizontal axis, at locations -1.0, 0.5, 0, 0.5, and 1.0 . We then shrink this location vector to -0.95, 0.45, 0, 0.45, and 0.95. The solution value of π increases from 0.4970 to 0.4972, and the aggregate expected payoff to the alliance increases from approximately 24.888 to 24.889

How is "cohesiveness" captured within the formalism of our model? We will attempt to explain below, in a very nonrigorous way, the effects in our model of a shift toward the origin in all alliance members' locations. In the final round of negotiations, there will be a reduction in the variance of the y-locations proposed by different alliance members. This will increase expected utility of each alliance member conditional on reaching the final round. In other words, there will be a reduction in the cost to each alliance member of failing to reach an agreement in the penultimate round. This means that whichever coalition the center chooses in the penultimate round, her opportunity set will be strictly smaller than before: The policy vector that is agreed upon in this round will be strictly more favorable than before to each of the members of the coalition that agrees upon it. Moreover, it can be shown—with some

TABLE V.1a

Start with a symmetric location configuration

Then shrink locations towards the center

Number of rounds:	200
Number of admissible coalitions:	10
Number of peripheral players:	5
Number of government players:	1

Return on superior project (r):	100.000
Sectoral inefficiency factor (theta):	0.500
Spatial normalization factor (beta(0)):	20.500
Spatial inefficiency factor (beta(1)):	1.000

Members of coalition number 1:	OUT	IN	IN	IN	OUT	IN
Members of coalition number 2:	OUT	IN	IN	OUT	IN	IN
Members of coalition number 3:	OUT	IN	OUT	IN	IN	IN
Members of coalition number 4:	OUT	OUT	IN	IN	IN	IN
Members of coalition number 5:	IN	IN	IN	OUT	OUT	IN
Members of coalition number 6:	IN	IN	OUT	IN	OUT	IN
Members of coalition number 7:	IN	IN	OUT	OUT	IN	IN
Members of coalition number 8:	IN	OUT	IN	IN	OUT	IN
Members of coalition number 9:	IN	OUT	IN	OUT	IN	IN
Members of coalition number 10:	IN	OUT	OUT	IN	IN	IN

Location of player number 1: (alpha)	-1.000	0.000
Location of player number 2: (alpha)	-0.500	0.000
Location of player number 3: (alpha)	0.000	0.000
Location of player number 4: (alpha)	0.500	0.000
Location of player number 5: (alpha)	1.000	0.000

Vector of access weights (v):	1.000	1.000	1.000	1.000	1.000	5.000
Vector of risk aversion coefficients (rho):	0.500	0.500	0.500	0.500	0.500	0.500
Vector of influence coefficients (psi)	1.000	1.000	1.000	1.000	1.000	
Constant in payoff functions (gamma):	20.000					

Convergence tolerance level: 0.000001000

Simulation # 1 inner loop # 1

Round #200

#10	1.000000	-1.000000	0.000000	5.30516	5.37547	5.34780	5.30094	5.23450	5.43139
#7	1.000000	-0.500000	0.000000	5.37587	5.34516	5.37587	5.34780	5.30094	5.46580
#9	1.000000	0.000000	0.000000	5.34780	5.37587	5.38516	5.37587	5.34780	5.47723
#10	1.000000	0.500000	0.000000	5.30094	5.34780	5.37587	5.38516	5.37587	5.46580
#10	1.000000	1.000000	0.000000	5.23450	5.30094	5.34780	5.37587	5.38516	5.43139
#14	0.000000	0.000000	0.000000	4.56070	4.56070	4.56070	4.56070	4.56070	6.32456
Expected payoffs:				4.94479	4.95493	4.96362	4.95893	4.94478	5.88944

Round #199

#10	0.524890	-0.500000	0.000000	5.00516	5.01040	5.00516	4.98940	4.96303	5.88944*
#7	0.529026	-0.247685	0.000000	5.00246	5.01309	5.01314	5.00261	4.98143	5.88944*
#9	0.531453	0.000000	0.000000	4.98453	5.01446	5.01576	5.01046	4.98453	5.88944*
#10	0.529026	0.247685	0.000000	4.98143	5.00261	5.01314	5.01309	5.00246	5.88944*
#10	0.524890	0.500000	0.000000	4.96303	4.98940	5.00516	5.01040	5.00516	5.88944*
#5	0.667982	-0.001595	0.000000	4.94479*	4.95493	4.96362*	4.95887	4.94467	5.94307
Expected payoffs:				4.96736	4.94204	4.98705	4.98203	4.96700	5.91625

Round #198

#5	0.498085	-0.261096	0.000000	4.97753	4.96720	4.98705*	4.97601	4.95652	5.91625*
#5	0.498265	-0.247685	0.000000	4.97725	4.96729	4.98734	4.97738	4.95737	5.91625*
#9	0.498783	0.000000	0.000000	4.96875	4.98481	4.98882	4.98481	4.96875	5.91625*
#4	0.498265	0.247685	0.000000	4.95737	4.97738	4.98734	4.98729	4.97725	5.91625*
#4	0.498085	0.261096	0.000000	4.95652	4.97601	4.98705*	4.98728	4.97753	5.91625*
#10	0.496374	-0.000181	0.000000	4.96736*	4.98235	4.98701	4.98203*	4.96707	5.91914
Expected payoffs:				4.96737	4.98237	4.98736	4.98238	4.96738	5.91770

Round #197

#5	0.497436	-0.161344	0.000000	4.97363	4.96556	4.98736*	4.97915	4.96091	5.91770*
#5	0.497436	-0.161345	0.000000	4.97363	4.96559	4.98736*	4.97915	4.96091	5.91770*
#9	0.498084	0.000000	0.000000	4.96841	4.98342	4.98842	4.98342	4.96841	5.91770*
#4	0.497436	0.161345	0.000000	4.96391	4.97915	4.98736*	4.98559	4.97383	5.91770*
#4	0.497436	0.161344	0.000000	4.96391	4.97915	4.98736*	4.98559	4.97383	5.91770*
#7	0.496764	-0.000289	0.000000	4.96740	4.98237*	4.98735	4.98236	4.96738*	5.91880
Expected payoffs:				4.96749	4.98244	4.98746	4.98247	4.96740	5.91825

Round #196

#5	0.497176	-0.102076	0.000000	4.97157	4.98451	4.98746*	4.98044	4.96340	5.91825*
#5	0.497176	-0.102076	0.000000	4.97157	4.98451	4.98746*	4.98044	4.96340	5.91825*
#9	0.497435	0.000000	0.000000	4.96790	4.98289	4.98788	4.98283	4.96790	5.91825*
#4	0.497176	0.102076	0.000000	4.96340	4.98044	4.98746*	4.98451	4.97157	5.91825*
#4	0.497176	0.102076	0.000000	4.96340	4.98044	4.98746*	4.98451	4.97157	5.91825*
#10	0.496816	0.000007	0.000000	4.96749*	4.98247	4.98746	4.98247*	4.96749	5.91849
Expected payoffs:				4.96753	4.98251	4.98750	4.98251	4.96753	5.91847

Round #195

#5	0.497072	-0.064567	0.000000	4.97011	4.98380	4.98750*	4.98123	4.96494	5.91847*
#5	0.497072	-0.064567	0.000000	4.97011	4.98380	4.98750*	4.98123	4.96494	5.91847*
#9	0.497175	0.000000	0.000000	4.96768	4.98268	4.98767	4.98268	4.96768	5.91847*
#4	0.497072	0.064567	0.000000	4.96494	4.98123	4.98750*	4.98380	4.97011	5.91847*
#4	0.497072	0.064567	0.000000	4.96494	4.98123	4.98750*	4.98380	4.97011	5.91847*
#7	0.496968	-0.000057	0.000000	4.96753	4.98251*	4.98750	4.98251	4.96753*	5.91844
Expected payoffs:				4.96755	4.98253	4.98752	4.98253	4.96754	5.91855

Round #194

#5	0.497030	-0.040838	0.000000	4.96918	4.98335	4.98752*	4.98172	4.96591	5.91855*
#5	0.497030	-0.040838	0.000000	4.96918	4.98335	4.98752*	4.98172	4.96591	5.91855*
#9	0.497072	0.000000	0.000000	4.96761	4.98260	4.98759	4.98260	4.96761	5.91855*
#4	0.497030	0.040838	0.000000	4.96591	4.98172	4.98752*	4.98335	4.96918	5.91855*
#4	0.497030	0.040838	0.000000	4.96591	4.98172	4.98752*	4.98335	4.96918	5.91855*
#10	0.496888	-0.000004	0.000000	4.96755*	4.98253	4.98752	4.98253*	4.96755	5.91862
Expected payoffs:				4.96755	4.98254	4.98752	4.98254	4.96755	5.91859

Round #193

#5	0.497014	-0.025829	0.000000	4.96859	4.98305	4.98752*	4.98202	4.96652	5.91859*
#5	0.497014	-0.025829	0.000000	4.96859	4.98305	4.98752*	4.98202	4.96652	5.91859*
#9	0.497030	0.000000	0.000000	4.96758	4.98256	4.98755	4.98256	4.96758	5.91858*
#4	0.497014	0.025829	0.000000	4.96652	4.98202	4.98752*	4.98305	4.96859	5.91859*
#4	0.497014	0.025829	0.000000	4.96652	4.98202	4.98752*	4.98305	4.96859	5.91859*
#7	0.496987	-0.000012	0.000000	4.96755	4.98254*	4.98752	4.98254	4.96755*	5.91862
Expected payoffs:				4.96755	4.98254	4.98752	4.98254	4.96755	5.91860

Round #192

#5	0.497007	-0.016336	0.000000	4.96821	4.98287	4.98752*	4.98221	4.96690	5.91860*
#5	0.497007	-0.016336	0.000000	4.96821	4.98287	4.98752*	4.98221	4.96690	5.91860*
#9	0.497014	0.000000	0.000000	4.96757	4.98255	4.98754	4.98255	4.96757	5.91860*
#4	0.497007	0.016336	0.000000	4.96690	4.98221	4.98751*	4.98287	4.96821	5.91860*
#4	0.497007	0.016336	0.000000	4.96690	4.98221	4.98752*	4.98287	4.96821	5.91860*
#10	0.497000	-0.000002	0.000000	4.96755*	4.98254	4.98752	4.98254*	4.96755	5.91861
Expected payoffs:				4.96756	4.98254	4.98753	4.98254	4.96756	5.91861

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Round #3

#5	0.497003	-0.004172	0.000000	4.96772	4.98262	4.98753*	4.98246	4.96739	5.91861*
#5	0.497003	-0.004168	0.000000	4.96772	4.98262	4.98753*	4.98246	4.96739	5.91861*
#9	0.497003	0.000000	0.000000	4.96756	4.98254	4.98753	4.98254	4.96756	5.91861*
#4	0.497003	0.004168	0.000000	4.96739	4.98246	4.98753*	4.98262	4.96772	5.91861*
#4	0.497003	0.004172	0.000000	4.96739	4.98246	4.98753*	4.98262	4.96772	5.91861*
#7	0.497002	-0.000001	0.000000	4.96756	4.98254*	4.98753	4.98254	4.96756*	5.91861
Expected payoffs:				4.96756	4.98254	4.98753	4.98254	4.96756	5.91861

Round #2

#5	0.497003	-0.002648	0.000000	4.96766	4.98259	4.98753*	4.98249	4.96745	5.91861*
#5	0.497003	-0.002648	0.000000	4.96766	4.98258	4.98753*	4.98249	4.96745	5.91861*
#9	0.497003	0.000000	0.000000	4.96756	4.98254	4.98753	4.98254	4.96756	5.91861*
#4	0.497003	0.002648	0.000000	4.96745	4.98249	4.98753*	4.98259	4.96766	5.91861*
#4	0.497003	0.002649	0.000000	4.96745	4.98249	4.98753*	4.98259	4.96766	5.91861*
#10	0.497002	0.000000	0.000000	4.96756*	4.98254	4.98753	4.98254*	4.96756	5.91861
Expected payoffs:				4.96756	4.98254	4.98753	4.98254	4.96756	5.91861

Round #1

#5	0.497002	-0.001847	0.000000	4.96763	4.98258	4.98753*	4.98250	4.96748	5.91861*
#5	0.497002	-0.001840	0.000000	4.96763	4.98258	4.98753*	4.98250	4.96748	5.91861*
#8	0.497003	0.000000	0.000000	4.96756	4.98254	4.98753	4.98254	4.96756	5.91861*
#4	0.497002	0.001840	0.000000	4.96748	4.98250	4.98753*	4.98258	4.96763	5.91861*
#4	0.497002	0.001847	0.000000	4.96748	4.98250	4.98753*	4.98258	4.96763	5.91861*
#7	0.497002	0.000000	0.000000	4.96756	4.98254*	4.98753	4.98254	4.96756*	5.91861
Expected payoffs:				4.96756	4.98254	4.98753	4.98254	4.96756	5.91861

TABLE V.1b

Start with a symmetric location configuration

Then shrink locations towards the center

Number of rounds:	200					
Number of admissible coalitions:	10					
Number of peripheral players:	5					
Number of government players:	1					
Return on superior project (r):	100.000					
Sectoral inefficiency factor (theta):	0.500					
Spatial normalization factor (beta(0)):	20.442					
Spatial inefficiency factor (beta(1)):	1.000					
Members of coalition number 1:	OUT	IN	IN	IN	OUT	IN
Members of coalition number 2:	OUT	IN	IN	OUT	IN	IN
Members of coalition number 3:	OUT	IN	OUT	IN	IN	IN
Members of coalition number 4:	OUT	OUT	IN	IN	IN	IN
Members of coalition number 5:	IN	IN	IN	OUT	OUT	IN
Members of coalition number 6:	IN	IN	OUT	IN	OUT	IN
Members of coalition number 7:	IN	IN	OUT	OUT	IN	IN
Members of coalition number 8:	IN	OUT	IN	IN	OUT	IN
Members of coalition number 9:	IN	OUT	IN	OUT	IN	IN
Members of coalition number 10:	IN	OUT	OUT	IN	IN	IN
Location of player number 1: (alpha)	-0.950	0.000				
Location of player number 2: (alpha)	-0.450	0.000				
Location of player number 3: (alpha)	0.000	0.000				
Location of player number 4: (alpha)	0.450	0.000				
Location of player number 5: (alpha)	0.950	0.000				
Vector of access weights (w):	1.000	1.000	1.000	1.000	1.000	5.000
Vector of risk aversion coefficients (rho):	0.500	0.500	0.500	0.500	0.500	0.500
Vector of influence coefficients (psi)	1.000	1.000	1.000	1.000	1.000	
Constant in payoff functions (gamma):	20.000					
Convergence tolerance level:	0.000001000					

Simulation # 1 Inner loop # 2

Round #200

#10	1.000000	-0.950000	0.000000	5.38301	5.37371	5.34937	5.30969	5.24717	5.43588
#1	1.000000	-0.450000	0.000000	5.37371	5.38301	5.37540	5.35283	5.30969	5.46797
#5	1.000000	0.000000	0.000000	5.34937	5.37540	5.38301	5.37540	5.34937	5.47723
#10	1.000000	0.450000	0.000000	5.30969	5.35283	5.37540	5.38301	5.37371	5.46797
#10	1.000000	0.950000	0.000000	5.24717	5.30969	5.34937	5.37371	5.38301	5.43588
#10	0.000000	0.000000	0.000000	4.56070	4.56070	4.56070	4.56070	4.56070	6.32456
Expected payoffs:				4.94665	4.95942	4.96262	4.95892	4.94665	5.89077

Round #199

#10	0.523969	-0.475109	0.000000	5.00371	5.00842	5.00371	4.99049	4.96576	5.89077*
#7	0.520567	-0.223104	0.000000	5.00103	5.01110	5.01113	5.00262	4.98307	5.89077*
#9	0.529082	0.000000	0.000000	4.99414	5.00897	5.01326	5.00897	4.99414	5.89077*
#10	0.520567	0.223104	0.000000	4.98307	5.00262	5.01113	5.01110	5.00103	5.89077*
#10	0.523969	0.475109	0.000000	4.96576	4.99049	5.00371	5.00842	5.00371	5.89077*
#5	0.469322	-0.003325	0.000000	4.94665*	4.95985	4.96362*	4.95974	4.94641	5.84183
Expected payoffs:				4.96809	4.94208	4.98611	4.98203	4.96787	5.91636

Round #198

#5	0.490157	-0.246286	0.000000	4.97741	4.98649	4.98611*	4.97762	4.95865	5.91636*
#5	0.490427	-0.223104	0.000000	4.97457	4.98651	4.98654	4.97847	4.95996	5.91636*
#8	0.489668	0.000000	0.000000	4.97044	4.98450	4.98856	4.98450	4.97044	5.91636*
#4	0.490427	0.223104	0.000000	4.95996	4.97847	4.98654	4.98651	4.97697	5.91636*
#4	0.490157	0.246286	0.000000	4.95865	4.97762	4.98611*	4.98649	4.97741	5.91636*
#10	0.456645	-0.000753	0.000000	4.96603*	4.98205	4.98608	4.98203*	4.96804	5.91801
Expected payoffs:				4.96837	4.98233	4.98642	4.98237	4.96836	5.91764

Round #197

#5	0.497636	-0.144732	0.000000	4.97404	4.98505	4.98642*	4.97871	4.96271	5.91764*
#5	0.497636	-0.144733	0.000000	4.97404	4.98505	4.98642*	4.97871	4.96271	5.91764*
#8	0.498157	0.000000	0.000000	4.96925	4.98327	4.98732	4.98327	4.96925	5.91764*
#4	0.497636	0.144733	0.000000	4.96271	4.97871	4.98642*	4.98505	4.97404	5.91764*
#4	0.497636	0.144732	0.000000	4.96271	4.97871	4.98642*	4.98505	4.97404	5.91764*
#10	0.481358	-0.000354	0.000000	4.96839*	4.98234	4.98641	4.98237*	4.96838	5.91857
Expected payoffs:				4.96847	4.98247	4.98651	4.98247	4.96847	5.91810

Round #196

#5	0.497385	-0.094092	0.000000	4.97205	4.98416	4.98651*	4.98070	4.96409	5.91810*
#5	0.497385	-0.094092	0.000000	4.97205	4.98416	4.98651*	4.98070	4.96409	5.91810*
#9	0.497605	0.000000	0.000000	4.96882	4.98282	4.98686	4.98282	4.96882	5.91810*
#4	0.497385	0.094092	0.000000	4.96409	4.98070	4.98651*	4.98416	4.97205	5.91810*
#4	0.497385	0.094092	0.000000	4.96409	4.98070	4.98651*	4.98416	4.97205	5.91810*
#7	0.497144	-0.000156	0.000000	4.96848	4.98247*	4.98650	4.98246	4.96847*	5.91848
Expected payoffs:				4.96851	4.98250	4.98654	4.98250	4.96850	5.91828

Round #195

#5	0.497297	-0.059516	0.000000	4.97077	4.98357	4.98654*	4.98143	4.96624	5.91829*
#5	0.497297	-0.059516	0.000000	4.97077	4.98357	4.98654*	4.98143	4.96624	5.91829*
#9	0.497305	0.000000	0.000000	4.96865	4.98264	4.98668	4.98264	4.96865	5.91829*
#4	0.497297	0.059516	0.000000	4.96624	4.98143	4.98654*	4.98357	4.97077	5.91829*
#4	0.497297	0.059516	0.000000	4.96624	4.98143	4.98654*	4.98357	4.97077	5.91829*
#10	0.497209	-0.000026	0.000000	4.96851*	4.98250	4.98654	4.98250*	4.96851	5.91844
Expected payoffs:				4.96852	4.98251	4.98655	4.98251	4.96852	5.91836

Round #194

#5	0.497262	-0.037643	0.000000	4.96995	4.98319	4.98655*	4.98184	4.96709	5.91836*
#5	0.497262	-0.037643	0.000000	4.96995	4.98319	4.98655*	4.98184	4.96709	5.91836*
#9	0.497297	0.000000	0.000000	4.96858	4.98257	4.98661	4.98257	4.96858	5.91836*
#4	0.497262	0.037643	0.000000	4.96709	4.98184	4.98655*	4.98319	4.96995	5.91836*
#4	0.497262	0.037643	0.000000	4.96709	4.98184	4.98655*	4.98319	4.96995	5.91836*
#7	0.497226	-0.000034	0.000000	4.96852	4.98251*	4.98655	4.98251	4.96852*	5.91842
Expected payoffs:				4.96853	4.98252	4.98656	4.98252	4.96853	5.91839

Round #193

#5	0.497247	-0.023808	0.000000	4.96943	4.98295	4.98656*	4.98209	4.96762	5.91839*
#5	0.497247	-0.023808	0.000000	4.96943	4.98295	4.98656*	4.98209	4.96762	5.91839*
#9	0.497261	0.000000	0.000000	4.96855	4.98254	4.98658	4.98254	4.96855	5.91839*
#4	0.497247	0.023808	0.000000	4.96762	4.98209	4.98656*	4.98295	4.96943	5.91839*
#4	0.497247	0.023808	0.000000	4.96762	4.98209	4.98656*	4.98295	4.96943	5.91839*
#10	0.497233	-0.000009	0.000000	4.96853*	4.98252	4.98656	4.98252*	4.96853	5.91842
Expected payoffs:				4.96853	4.98252	4.98656	4.98252	4.96853	5.91841

Round #192

#5	0.497242	-0.015058	0.000000	4.96910	4.98279	4.98656*	4.98225	4.96796	5.91841*
#5	0.497242	-0.015058	0.000000	4.96910	4.98279	4.98656*	4.98225	4.96796	5.91841*
#9	0.497247	0.000000	0.000000	4.96854	4.98253	4.98657	4.98253	4.96854	5.91841*
#4	0.497242	0.015058	0.000000	4.96796	4.98225	4.98656*	4.98279	4.96910	5.91841*
#4	0.497242	0.015058	0.000000	4.96796	4.98225	4.98656*	4.98279	4.96910	5.91841*
#7	0.497236	-0.000000	0.000000	4.96853	4.98252*	4.98656	4.98252	4.96853*	5.91842
Expected payoffs:				4.96853	4.98252	4.98656	4.98252	4.96853	5.91841

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Round #3

#5	0.497230	-0.003846	0.000000	4.96868	4.98259	4.98656*	4.98245	4.96839	5.91841*
#5	0.497230	-0.003842	0.000000	4.96868	4.98259	4.98656*	4.98245	4.96839	5.91841*
#9	0.497239	0.000000	0.000000	4.96853	4.98252	4.98656	4.98252	4.96853	5.91841*
#4	0.497230	0.003842	0.000000	4.96839	4.98245	4.98656*	4.98259	4.96868	5.91841*
#4	0.497230	0.003846	0.000000	4.96839	4.98245	4.98656*	4.98259	4.96868	5.91841*
#10	0.497230	-0.000001	0.000000	4.96853*	4.98252	4.98656	4.98252*	4.96853	5.91841
Expected payoffs:				4.96853	4.98252	4.98656	4.98252	4.96853	5.91841

Round #2

#5	0.497230	-0.002442	0.000000	4.96863	4.98257	4.98656*	4.98248	4.96844	5.91841*
#5	0.497230	-0.002441	0.000000	4.96862	4.98257	4.98656*	4.98248	4.96844	5.91841*
#9	0.497230	0.000000	0.000000	4.96853	4.98252	4.98656	4.98252	4.96853	5.91841*
#4	0.497230	0.002441	0.000000	4.96844	4.98248	4.98656*	4.98257	4.96862	5.91841*
#4	0.497230	0.002442	0.000000	4.96844	4.98248	4.98656*	4.98257	4.96863	5.91841*
#7	0.497230	0.000000	0.000000	4.96853	4.98252*	4.98656	4.98252	4.96853*	5.91841
Expected payoffs:				4.96853	4.98252	4.98656	4.98252	4.96853	5.91841

Round #1

#5	0.497230	-0.001703	0.000000	4.96860	4.98255	4.98656*	4.98249	4.96847	5.91841*
#5	0.497230	-0.001695	0.000000	4.96860	4.98255	4.98656*	4.98249	4.96847	5.91841*
#9	0.497230	0.000000	0.000000	4.96853	4.98252	4.98656	4.98252	4.96853	5.91841*
#4	0.497230	0.001695	0.000000	4.96847	4.98249	4.98656*	4.98255	4.96860	5.91841*
#4	0.497230	0.001703	0.000000	4.96847	4.98249	4.98656*	4.98255	4.96860	5.91841*
#9	0.497230	0.000000	0.000000	4.96853*	4.98252	4.98656	4.98252	4.96853*	5.91841
Expected payoffs:				4.96853	4.98252	4.98656	4.98252	4.96853	5.91841

effort—that the proposed policy vector is more favorable to all members of the alliance, not just the members of the coalition that accepts it. It follows from this that, in the penultimate round, there are two effects that reinforce each other: Both increase the expected utility of each alliance member conditional on reaching the final round. We can repeat the above argument as many times as necessary, working backward until we reach the first period of the game. This establishes—informally—that the effect of shrinking alliance members' locations toward the origin indeed leads to an improvement in the performance of the alliance.

The second question we raised above is less easy to dispose of. Will a transfer in power from less to more communally-oriented members improve the performance of the alliance? The results surprisingly reveal that the degree of "aggregate communal orientation" is not a reliable predictor of alliance performance. To see the problem, assume that there is a "right wing" and a "left wing" faction of the alliance, but that if it acted as a single decision-making unit, the alliance would choose a location of zero. Assume also that initially, the right-wing faction is more powerful than the left-wing, so that in the solution to the model, the location of y is positive. Taking this solution as a benchmark, the left-wing faction is the more communally oriented of the two factions because its objective is to shift the location of y closer to zero. Now, the participation constraint of some right-wing alliance member must necessarily be binding on the center. Otherwise, she would be able to obtain agreement for a location closer to the origin, which she would prefer. If power is transferred from the right wing to the left wing, then the right-wing participation constraints will slacken as the right wing loses ground. The center will now be able to negotiate a y-location closer to the origin. This effect alone will increase the aggregate alliance payoff. However, because the main opposition to the center is now weaker, she will also be able negotiate a lower π-value and, this effect, will hurt the alliance. If the latter effect dominates, the shift in power will result in a net deterioration in the performance of the alliance.

A numerical example is provided in Tables V.2a and V.2b. Players #1 and #2 form the left-wing faction, and players #3 through #5 form the right-wing faction. Initially, all players

TABLE V.2a
Asymmetric Spatial Configuration
Transfer power from #3 to #2

Number of rounds:	200
Number of admissible coalitions:	10
Number of peripheral players:	5
Number of government players:	1

Return on superior project (r):	100.000
Sectoral inefficiency factor (theta):	0.500
Spatial normalization factor (beta(0)):	21.508
Spatial inefficiency factor (beta(1)):	1.000

Members of coalition number 1:	OUT	IN	IN	IN	OUT	IN
Members of coalition number 2:	OUT	IN	IN	OUT	IN	IN
Members of coalition number 3:	OUT	IN	OUT	IN	IN	IN
Members of coalition number 4:	OUT	OUT	IN	IN	IN	IN
Members of coalition number 5:	IN	IN	IN	OUT	OUT	IN
Members of coalition number 6:	IN	IN	OUT	IN	OUT	IN
Members of coalition number 7:	IN	IN	OUT	OUT	IN	IN
Members of coalition number 8:	IN	OUT	IN	IN	OUT	IN
Members of coalition number 9:	IN	OUT	IN	OUT	IN	IN
Members of coalition number 10:	IN	OUT	OUT	IN	IN	IN

Location of player number 1: (alpha)	-2.200	0.000
Location of player number 2: (alpha)	-0.500	0.000
Location of player number 3: (alpha)	0.800	0.000
Location of player number 4: (alpha)	0.800	0.000
Location of player number 5: (alpha)	1.000	0.000

Vector of access weights (w):	1.000	1.000	1.000	1.000	1.000	5.000
Vector of risk aversion coefficients (rho):	0.500	0.500	0.500	0.500	0.500	0.500
Vector of influence coefficients (psi)	1.000	1.000	1.000	1.000	1.000	
Constant in payoff functions (gamma):	20.000					

Convergence tolerance level: 0.000001000

Round #200

#10	1.000000	-2.000000	0.000000	5.42100	5.33844	5.12515	5.10206	5.07960	5.20150
#7	1.000000	-0.500000	0.000000	5.31181	5.42247	5.35970	5.34969	5.33984	5.46580
#8	1.000000	0.800000	0.000000	5.07965	5.35378	5.42247	5.42210	5.42100	5.44794
#10	1.000000	0.900000	0.000000	5.05561	5.34969	5.42210	5.42247	5.42210	5.44013
#10	1.000000	1.000000	0.000000	5.03063	5.33844	5.42100	5.42210	5.42247	5.43138
#10	0.000000	0.000000	0.000000	4.56070	4.56070	4.56070	4.56070	4.56070	6.32456
Expected payoffs:				4.87952	4.96131	4.95540	4.95227	4.94076	5.86985

Round #199

#5	0.523362	-1.088466	0.000000	5.00433	5.02296	4.95540*	4.94720	4.93857	5.86985*
#7	0.552750	-0.241669	0.000000	4.97066	5.05370	5.03145	5.02665	5.02141	5.86985*
#9	0.550311	0.388549	0.000000	4.90499	5.03585	5.04838	5.04730	5.04493	5.86985*
#10	0.549096	0.438039	0.000000	4.89052	5.03296	5.04928	5.04749	5.04526	5.86985*
#6	0.547845	0.487854	0.000000	4.88183	5.02945	5.04895	5.04738	5.04537	5.86985*
#4	0.440085	0.388549	0.000000	4.83891	4.94437	4.95540*	4.95376	4.95177	5.86375
Expected payoffs:				4.88645	4.96973	4.99115	4.98849	4.98544	5.91685

Round #198

#5	0.498560	-0.144045	0.000000	4.92405	5.00640	4.99115*	4.98717	4.98280	5.91685*
#5	0.498560	-0.144045	0.000000	4.92405	5.00640	4.99115*	4.98717	4.98280	5.91685*
#4	0.495346	0.388549	0.000000	4.87175	4.99350	5.00280	5.00097	4.99875	5.91685*
#4	0.494343	0.438039	0.000000	4.86544	4.98788	5.00270	5.00107	4.99905	5.91685*
#4	0.493216	0.487854	0.000000	4.85583	4.98505	5.00240	5.00087	4.99915	5.91685*
#4	0.481301	0.388549	0.000000	4.86345	4.97916	4.99115*	4.98937	4.98720	5.92046
Expected payoffs:				4.87624	4.98720	4.99459	4.99242	4.98985	5.92266

Round #197

#5	0.491692	0.145454	0.000000	4.89365	4.99481	4.99459*	4.99182	4.98865	5.92266*
#5	0.491692	0.145454	0.000000	4.89365	4.99481	4.99459*	4.99182	4.98865	5.92266*
#4	0.488527	0.388549	0.000000	4.86760	4.98484	4.99698	4.99518	4.99298	5.92266*
#4	0.487537	0.438039	0.000000	4.86181	4.98225	4.99688	4.99527	4.99327	5.92266*
#4	0.486426	0.487854	0.000000	4.85584	4.97945	4.99659	4.99517	4.99337	5.92266*
#4	0.485733	0.388549	0.000000	4.86593	4.98252	4.99459*	4.99280	4.99061	5.92503
Expected payoffs:				4.87929	4.98447	4.99526	4.99333	4.99100	5.92384

Round #196

#5	0.488960	0.274188	0.000000	4.87840	4.98893	4.99526*	4.99301	4.99036	5.92384*
#5	0.488960	0.274188	0.000000	4.87840	4.98893	4.99526*	4.99301	4.99036	5.92384*
#4	0.487130	0.388525	0.000000	4.86675	4.98360	4.99579	4.99389	4.99180	5.92384*
#4	0.486144	0.438012	0.000000	4.86098	4.98108	4.99568	4.99409	4.99209	5.92384*
#4	0.485036	0.487824	0.000000	4.85502	4.97831	4.99539	4.99389	4.99219	5.92384*
#4	0.486513	0.388563	0.000000	4.86637	4.98316	4.99526*	4.99346	4.99127	5.92437
Expected payoffs:				4.86736	4.98360	4.99537	4.99354	4.99132	5.92411

Round #195

#5	0.487895	0.326543	0.000000	4.87357	4.98639	4.99537*	4.99332	4.99089	5.92411*
#5	0.487895	0.326543	0.000000	4.87357	4.98639	4.99537*	4.99332	4.99089	5.92411*
#4	0.486822	0.388523	0.000000	4.86657	4.98342	4.99552	4.99372	4.99153	5.92411*
#4	0.485836	0.438010	0.000000	4.86080	4.98084	4.99543	4.99382	4.99183	5.92411*
#4	0.485365	0.450705	0.000000	4.85928	4.98015	4.99537*	4.99382	4.99187	5.92411*
#4	0.486640	0.388563	0.000000	4.86645	4.98327	4.99537*	4.99357	4.99138	5.92426
Expected payoffs:				4.86660	4.98335	4.99539	4.99359	4.99139	5.92418

Round #194

#5	0.487400	0.351152	0.000000	4.87076	4.98517	4.99539*	4.99344	4.99110	5.92418*
#5	0.487400	0.351152	0.000000	4.87076	4.98517	4.99539*	4.99344	4.99110	5.92418*
#4	0.486731	0.388526	0.000000	4.86651	4.98335	4.99545	4.99365	4.99146	5.92418*
#4	0.485995	0.426000	0.000000	4.86216	4.98141	4.99539*	4.99374	4.99170	5.92418*
#4	0.485995	0.426001	0.000000	4.86216	4.98141	4.99539*	4.99374	4.99170	5.92418*
#10	0.486687	0.387348	0.000000	4.86660*	4.98335	4.99539	4.99359*	4.99139	5.92424
Expected payoffs:				4.86654	4.98333	4.99540	4.99359	4.99140	5.92421

Round #193

#5	0.487128	0.364875	0.000000	4.86918	4.98449	4.99540*	4.99350	4.99122	5.92421*
#5	0.487128	0.364875	0.000000	4.86918	4.98449	4.99540*	4.99350	4.99122	5.92421*
#4	0.486698	0.388528	0.000000	4.86649	4.98332	4.99542	4.99362	4.99143	5.92421*
#4	0.486240	0.412245	0.000000	4.86374	4.98210	4.99540*	4.99369	4.99160	5.92421*
#4	0.486240	0.412245	0.000000	4.86374	4.98210	4.99540*	4.99369	4.99160	5.92421*
#10	0.486682	0.387971	0.000000	4.86654*	4.98332	4.99540	4.99359*	4.99140	5.92423
Expected payoffs:				4.86650	4.98331	4.99540	4.99360	4.99141	5.92422

Round #192

#5	0.486961	0.373568	0.000000	4.86819	4.98405	4.99540*	4.99354	4.99129	5.92422*
#5	0.486961	0.373568	0.000000	4.86819	4.98405	4.99540*	4.99354	4.99129	5.92422*
#4	0.486685	0.388532	0.000000	4.86646	4.98331	4.99541	4.99361	4.99142	5.92422*
#4	0.486398	0.403539	0.000000	4.86475	4.98254	4.99540*	4.99366	4.99153	5.92422*
#4	0.486398	0.403539	0.000000	4.86475	4.98254	4.99540*	4.99366	4.99153	5.92422*
#10	0.486678	0.388268	0.000000	4.86650*	4.98331	4.99540	4.99360*	4.99141	5.92423
Expected payoffs:				4.86649	4.98331	4.99540	4.99360	4.99141	5.92423

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Round #3

#5	0.486708	0.386640	0.000000	4.86667	4.98338	4.99540*	4.99359	4.99140	5.92423*
#5	0.486708	0.386651	0.000000	4.86667	4.98338	4.99540*	4.99359	4.99140	5.92423*
#2	0.486676	0.388539	0.000000	4.86647	4.98330*	4.99540	4.99360	4.99141	5.92423*
#4	0.486645	0.390180	0.000000	4.86628	4.98322	4.99540*	4.99361	4.99142	5.92423*
#4	0.486644	0.390220	0.000000	4.86628	4.98322	4.99540*	4.99361	4.99142	5.92423*
#10	0.486674	0.388537	0.000000	4.86647*	4.98330	4.99540	4.99360	4.99141*	5.92423
Expected payoffs:				4.86648	4.98330	4.99540	4.99360	4.99141	5.92423

Round #2

#5	0.486690	0.387369	0.000000	4.86661	4.98334	4.99540*	4.99360	4.99140	5.92423*
#5	0.486698	0.387371	0.000000	4.86661	4.98334	4.99540*	4.99360	4.99140	5.92423*
#4	0.486676	0.388539	0.000000	4.86647	4.98330	4.99540	4.99360	4.99141	5.92423*
#4	0.486654	0.389686	0.000000	4.86634	4.98326	4.99540*	4.99361	4.99142	5.92423*
#4	0.486654	0.389700	0.000000	4.86634	4.98326	4.99540*	4.99361	4.99142	5.92423*
#10	0.486676	0.388533	0.000000	4.86648*	4.98330	4.99540	4.99360	4.99141*	5.92423
Expected payoffs:				4.86648	4.98330	4.99540	4.99360	4.99141	5.92423

Round #1

#5	0.486691	0.387730	0.000000	4.86657	4.98334	4.99540*	4.99360	4.99140	5.92423*
#5	0.486691	0.387731	0.000000	4.86657	4.98334	4.99540*	4.99360	4.99140	5.92423*
#4	0.486676	0.388540	0.000000	4.86647	4.98330	4.99540	4.99360	4.99141	5.92423*
#4	0.486661	0.389344	0.000000	4.86638	4.98326	4.99540*	4.99360	4.99142	5.92423*
#4	0.486661	0.389356	0.000000	4.86638	4.98326	4.99540*	4.99360	4.99142	5.92423*
#10	0.486676	0.388534	0.000000	4.86648*	4.98330	4.99540	4.99360	4.99141*	5.92423
Expected payoffs:				4.86647	4.98330	4.99540	4.99360	4.99141	5.92423

TABLE V.2b
Asymmetric Spatial Configuration
Transfer power from #3 to #2

Number of rounds:	200					
Number of admissible coalitions:	10					
Number of peripheral players:	5					
Number of government players:	1					
Return on superior project (r):	100.000					
Sectoral inefficiency factor (theta):	0.500					
Spatial normalization factor (beta(0)):	21.500					
Spatial inefficiency factor (beta(1)):	1.000					
Members of coalition number 1:	OUT	IN	IN	IN	OUT	IN
Members of coalition number 2:	OUT	IN	IN	OUT	IN	IN
Members of coalition number 3:	OUT	IN	OUT	IN	IN	IN
Members of coalition number 4:	OUT	OUT	IN	IN	IN	IN
Members of coalition number 5:	IN	IN	IN	OUT	OUT	IN
Members of coalition number 6:	IN	IN	OUT	IN	OUT	IN
Members of coalition number 7:	IN	IN	OUT	OUT	IN	IN
Members of coalition number 8:	IN	OUT	IN	IN	OUT	IN
Members of coalition number 9:	IN	OUT	IN	OUT	IN	IN
Members of coalition number 10:	IN	OUT	OUT	IN	IN	IN
Location of player number 1: (alpha)	-2.200	0.000				
Location of player number 2: (alpha)	-0.500	0.000				
Location of player number 3: (alpha)	0.800	0.000				
Location of player number 4: (alpha)	0.800	0.000				
Location of player number 5: (alpha)	1.000	0.000				
Vector of access weights (w):	1.000	1.050	0.950	1.000	1.000	5.000
Vector of exponents on utilities (rho):	0.500	0.500	0.500	0.500	0.500	0.500
Vector of risk aversion coefficients (rho):	1.000	1.000	1.000	1.000	1.000	
Constant in payoff functions (gamma):	20.000					
Convergence tolerance level:	0.000001000					

Simulation # 1 inner loop # 2

Round #200

#10	1.000000	-2.000000	0.000000	5.42100	5.33884	5.12515	5.10286	5.07860	5.28150
#7	1.000000	-0.500000	0.000000	5.31441	5.42247	5.35870	5.34960	5.33884	5.46580
#3	1.000000	0.800000	0.000000	5.07569	5.35870	5.42247	5.42210	5.42100	5.44794
#10	1.000000	0.900000	0.000000	5.05561	5.34969	5.42210	5.42247	5.42210	5.44013
#10	1.000000	1.000000	0.000000	5.03363	5.33884	5.42100	5.42210	5.42247	5.43138
#10	0.000000	0.000000	0.000000	4.56070	4.56070	4.56070	4.56070	4.56070	6.32456
Expected payoffs:				4.87170	4.36143	4.95509	4.95191	4.94835	5.87004

Round #199

#5	0.523153	-1.090502	0.000000	5.00432	5.02273	4.95509*	4.94608	4.93823	5.87004*
#7	0.552646	-0.241469	0.000000	4.97359	5.05360	5.03137	5.02657	5.02133	5.87004*
#9	0.550107	0.388549	0.000000	4.90492	5.03577	5.04830	5.04728	5.04484	5.87004*
#10	0.548983	0.438039	0.000000	4.89846	5.03288	5.04818	5.04740	5.04517	5.87004*
#4	0.547741	0.487054	0.000000	4.89177	5.02976	5.04886	5.04729	5.04528	5.87004*
#4	0.438681	0.388549	0.000000	4.83779	4.94407	4.85509*	4.95349	4.95146	5.96406
Expected payoffs:				4.84623	4.34861	4.99083	4.98816	4.98810	5.91705

Round #198

#5	0.498314	-0.146763	0.000000	4.92410	5.00622	4.99083*	4.98685	4.98247	5.91705*
#5	0.498314	-0.146763	0.000000	4.92410	5.00622	4.99083*	4.98685	4.98247	5.91705*
#4	0.485113	0.388548	0.000000	4.47141	4.39031	5.00260	5.00078	4.99855	5.91705*
#4	0.494110	0.438038	0.000000	4.46575	4.38768	5.00250	5.00088	4.99885	5.91705*
#4	0.492984	0.487054	0.000000	4.85363	4.38486	5.00220	5.00077	4.99895	5.91705*
#4	0.481335	0.388549	0.000000	4.46322	4.37886	4.99083*	4.98905	4.98689	5.92877
Expected payoffs:				4.87440	4.38794	4.99426	4.99207	4.98949	5.92291

Round #197

#5	0.481420	0.141670	0.000000	4.89346	4.39468	4.99426*	4.99147	4.98828	5.92291*
#5	0.481420	0.141670	0.000000	4.89346	4.39468	4.99426*	4.99147	4.98828	5.92291*
#6	0.488220	0.388549	0.000000	4.86742	4.88459	4.99472	4.99492	4.99273	5.92291*
#4	0.487238	0.438039	0.000000	4.86143	4.34200	4.99653	4.99502	4.99302	5.92291*
#6	0.486124	0.487454	0.000000	4.85566	4.37921	4.99633	4.99492	4.99312	5.92291*
#6	0.485334	0.388543	1.000000	4.86566	4.38219	4.99426*	4.99246	4.99020	5.92537
Expected payoffs:				4.87021	4.94466	4.99494	4.99298	4.99044	5.92414

Round #196

#5	0.488462	0.271095	0.000000	4.87960	4.98877	4.99494*	4.99267	4.99001	5.92414*
#5	0.488462	0.271095	0.000000	4.87960	4.98877	4.99494*	4.99267	4.99001	5.92414*
#4	0.486303	0.388524	0.000000	4.86656	4.98338	4.99548	4.99360	4.99150	5.92414*
#4	0.485797	0.438011	0.000000	4.86077	4.98081	4.99538	4.99370	4.99180	5.92414*
#4	0.484698	0.487823	0.000000	4.85482	4.97802	4.99510	4.99360	4.99190	5.92414*
#4	0.486132	0.388563	0.000000	4.86614	4.98285	4.99494*	4.99314	4.99095	5.92468
Expected payoffs:				4.86721	4.98343	4.99505	4.99322	4.99098	5.92442

Round #195

#5	0.487557	0.324045	0.000000	4.87353	4.98617	4.99505*	4.99300	4.99056	5.92442*
#5	0.487557	0.324045	0.000000	4.87353	4.98617	4.99505*	4.99300	4.99056	5.92442*
#4	0.486458	0.388522	0.000000	4.86634	4.98312	4.99521	4.99341	4.99123	5.92442*
#4	0.485473	0.438009	0.000000	4.86058	4.98056	4.99512	4.99351	4.99152	5.92442*
#4	0.485165	0.452411	0.000000	4.85887	4.97978	4.99505*	4.99350	4.99157	5.92442*
#4	0.486267	0.388563	0.000000	4.86622	4.98296	4.99505*	4.99325	4.99107	5.92458
Expected payoffs:				4.86643	4.98307	4.99507	4.99327	4.99107	5.92456

Round #194

#5	0.487050	0.350040	0.000000	4.87066	4.98492	4.99507*	4.99312	4.99078	5.92450*
#5	0.487050	0.350039	0.000000	4.87066	4.98492	4.99507*	4.99312	4.99078	5.92450*
#4	0.486363	0.388525	0.000000	4.86628	4.98304	4.99513	4.99333	4.99115	5.92450*
#4	0.485604	0.427115	0.000000	4.86180	4.98104	4.99507*	4.99343	4.99138	5.92450*
#4	0.485604	0.427116	0.000000	4.86180	4.98104	4.99507*	4.99343	4.99138	5.92450*
#10	0.486324	0.388863	0.000000	4.86643*	4.98307	4.99507	4.99327*	4.99107	5.92456
Expected payoffs:				4.86636	4.98304	4.99508	4.99328	4.99108	5.92453

Round #193

#5	0.486773	0.364006	0.000000	4.86906	4.98422	4.99508*	4.99318	4.99090	5.92453*
#5	0.486773	0.364006	0.000000	4.86906	4.98422	4.99508*	4.99318	4.99090	5.92453*
#4	0.486328	0.388528	0.000000	4.86626	4.98301	4.99510	4.99330	4.99112	5.92453*
#4	0.485852	0.413116	0.000000	4.86342	4.98178	4.99508*	4.99338	4.99128	5.92453*
#4	0.485852	0.413116	0.000000	4.86342	4.98178	4.99508*	4.99338	4.99128	5.92453*
#10	0.486318	0.387537	0.000000	4.86636*	4.98304	4.99508	4.99328*	4.99108	5.92455
Expected payoffs:				4.86632	4.98302	4.99508	4.99328	4.99109	5.92454

Round #192

#5	0.486601	0.372811	0.000000	4.86804	4.98377	4.99508*	4.99322	4.99097	5.92454*
#5	0.486601	0.372811	0.000000	4.86804	4.98377	4.99508*	4.99322	4.99097	5.92454*
#4	0.486313	0.388531	0.000000	4.86625	4.98300	4.99509	4.99329	4.99110	5.92454*
#4	0.486014	0.404187	0.000000	4.86445	4.98220	4.99508*	4.99334	4.99122	5.92454*
#4	0.486014	0.404187	0.000000	4.86445	4.98220	4.99508*	4.99334	4.99122	5.92454*
#10	0.486313	0.387828	0.000000	4.86632*	4.98302	4.99508	4.99328*	4.99109	5.92455
Expected payoffs:				4.86629	4.98301	4.99508	4.99328	4.99108	5.92454

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Round #3

#5	0.486318	0.387828	0.000000	4.86632	4.98302	4.99508*	4.99328	4.99109	5.92455*
#5	0.486318	0.387834	0.000000	4.86632	4.98302	4.99508*	4.99328	4.99109	5.92455*
#4	0.486303	0.388541	0.000000	4.86625	4.98298	4.99508	4.99328	4.99110	5.92455*
#4	0.486287	0.388410	0.000000	4.86615	4.98295	4.99508*	4.99329	4.99110	5.92455*
#4	0.486287	0.388424	0.000000	4.86615	4.98295	4.99508*	4.99329	4.99110	5.92455*
#10	0.486304	0.388325	0.000000	4.86625*	4.98299	4.99508	4.99328	4.99110*	5.92455
Expected payoffs:				4.86624	4.98298	4.99508	4.99328	4.99110	5.92455

Round #2

#5	0.486315	0.387828	0.000000	4.86632	4.98302	4.99508*	4.99328	4.99108	5.92455*
#5	0.486315	0.387830	0.000000	4.86632	4.98302	4.99508*	4.99328	4.99108	5.92455*
#8	0.486303	0.388584	0.000000	4.86624	4.98299	4.99508	4.99328*	4.99110	5.92455*
#4	0.486293	0.388102	0.000000	4.86618	4.98296	4.99508*	4.99329	4.99110	5.92455*
#4	0.486283	0.388112	0.000000	4.86618	4.98296	4.99508*	4.99328	4.99110	5.92455*
#10	0.486303	0.388583	0.000000	4.86624*	4.98298	4.99508	4.99328	4.99110*	5.92455
Expected payoffs:				4.86625	4.98299	4.99508	4.99328	4.99110	5.92455

Round #1

#5	0.486315	0.387820	0.000000	4.86632	4.98302	4.99508*	4.99328	4.99108	5.92455*
#5	0.486315	0.387830	0.000000	4.86632	4.98302	4.99508*	4.99328	4.99109	5.92455*
#9	0.486303	0.388554	0.000000	4.86625	4.98298	4.99508	4.99328	4.99110*	5.92455*
#4	0.486293	0.388102	0.000000	4.86618	4.98296	4.99508*	4.99329	4.99110	5.92455*
#4	0.486283	0.389112	0.000000	4.86618	4.98296	4.99508*	4.99329	4.99110	5.92455*
#10	0.486303	0.388553	0.000000	4.86625*	4.98299	4.99508	4.99328	4.99110*	5.92455
Expected payoffs:				4.86625	4.98298	4.99508	4.99328	4.99110	5.92455

have the same basic power attributes (though, clearly, player #3 has a strategic power advantage due to his location). We transfer power from the right wing to the left wing by slightly decreasing player #3's access probability and slightly increasing player #2's. In the final round of the game, the increased weight on player 2's negative y-location lowers the expected payoffs of the right-wing players. Since it is the right-wing that offers the main resistance to the center (player #6), this slackening of their participation constraints in the penultimate period increases the set of opportunities available in this period. Consequently, she negotiates a lower π-value. It follows once again that, in the penultimate round, there are two mutually reinforcing effects that reduce the expected utility of the right-wing faction—the higher weight on #2's unfavorable location and the lower π-value. Again, these effects trace back to the initial round of negotiations; and the performance of the alliance deteriorates. The solution-value of π decreases from approximately 0.4867 to 0.4863, and the aggregate expected payoff to the alliance decreases from approximately 24.830 to 24.828.

There is a easily-articulated, intuitive counterpart to the quasi-formal reasoning we have just presented. It may be perfectly rational for me to abdicate some of my personal power in favor of a more powerful "secondary adversary," in order to further strengthen his negotiating position against a common "primary adversary." To the extent that we share communal objectives, an improvement in his performance in the primary negotiations will also benefit me, even though my weakened position will cost me something in the secondary negotiations.

We now turn to the third question raised above. Does the alliance perform better when power is equally distributed between opposing factions, or when it is unequally distributed? To address this question, we revisit the symmetric example that was considered in detail in the preceding section. We will successively perturb the power structure in this example by transferring more and more power from the right wing to the left wing. Specifically, we reduce player #4's access probability and increase player #2's. The conventional wisdom on the effect of this transfer seems to be that it should improve the performance of the alliance, since concentrated power is more effective than diffuse power. Our example demonstrates that, at least in the context of our model, the issue is much more delicate than this wisdom would suggest. We find that a very small transfer of power results in a deterioration in alliance performance; but when more power is transferred, this trend is reversed. Table V.3a tracks the relevant variables. The source of this reversal is buried within the fine structure of the model, and we will not pursue it in great detail. It will suffice to observe that there are two offsetting effects. As power shifts from the right wing to the left, player #4's participation constraints slackens while #1's tightens. First one effect dominates, then the other. Notice also that, with each increase in the transfer of power, there is a change in the sequence of coalitions chosen by the center. Since these are discrete changes, they introduce discontinuities into the model which complicate the analysis considerably. In particular, calculus techniques cannot be used to predict the effect on alliance performance of changes in coalition choice.

6. Concluding Remarks

This paper has heuristically examined the reform of agricultural policies from the lens of a noncooperative, multilateral bargaining game. The framework developed is a customized specialization of the abstract theoretical model specified in Rausser and Simon (1991). The levels of negotiation include the distribution of burden, the amount of a public good, and its location. The dimensions of the model were formalized, paying particular attention to various components of political power. Components of political power included access, influence, risk aversion, default utility, and strategic positioning.

One of the distinct features of the formalized model is the specification of two wings of government—one benevolent, and another purely political. Different commodity groups were specified and thus an opportunity exists for examining conflict and cooperation among members of commodity groups, as well as with the two wings of government. A number of hypotheses were offered. These hypotheses cannot be examined in the context of comparative statics because of the complexity of the formalized model. However, a computer model has been constructed and simulation experiments will be conducted. Once these simulation experiments are completed, the natural next step is to test the hypotheses that emerge. We propose to test these hypotheses by conducting a number of multilateral bargaining negotiations with human subjects. It is also hoped that the simulation experiments of a computer model will lead to conjectures and point the way to analytical solutions.

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Footnotes

[1]We will be concerned with the proper equilibria of our game. However, the distinction between a subgame-perfect and a proper equilibrium is somewhat technical and tangential to the main point of this applied paper. Nontechnical readers can safely ignore the distinction; others are referred to Rausser and Simon (1991) for the technicalities.

[2]We did consider the more complicated model in which this variable is endogenized, and found the additional results relatively uninteresting. Accordingly, we chose the simpler model.

[3]In the case of the United States, additional tax revenue could be used to reduce the government deficit. To the extent that lower public-sector deficits lead to reduced real rates of interest, the policy bounty may come in the form of increased investment and economic growth. In this event, public-sector investment of one type or another would be replaced by private-sector investment. The consequences of the latter investment are similar to those results from public-sector investments in the "superior project."

References

Fiorina, Morris, and Charles Plott, "Committee Decisions under Majority Rule: An Experimental Study," *American Political Science Review*, , v. 82, 1978, pp. 575-598.

Rausser, Gordon, and Leo Simon, "A Noncooperative Model of Multilateral Bargaining." Department of Agricultural and Resource Economics, University of California at Berkeley, mimeo, 1991.

Rubinstein, Ariel, "Perfect Equilibrium in a Bargaining Model," *Econometrica*, v. 50, January 1982, pp. 97-109.

Stahl, I., *Bargaining Theory*, Stockholm: Stockholm School of Economics, 1972.

Stahl, I., "An N-Person Bargaining Game in the Extensive Form." In *Mathematical Economics and Game Theory*, ed. by R. Henn and O. Moeschlin. Lecture Notes in Economics and Mathematical Systems No. 141. Berlin: Springer-Verlag, 1977.