Costly Voting:
Theoretical and Experimental Results on Commons Dilemmas in Spatial Committee Games

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Abstract

Our focus in this paper is with the transaction costs inherent in most decision making settings. We specifically investigate an "institution free" collective choice mechanism that includes costs to calling votes. A set of models show that under low costs (i.e., where no cost-induced equilibrium exists), actors have dominant strategies to continue to call votes. When those costs are collectively borne, a commons problem arises in which everyone is left worse off. A series of experimental manipulations are implemented to test various aspects of this model. These experiments use five-person committees with a forward moving agenda. Our results show that subject behavior is consistent with our theoretical predictions. We speculate about how differing instituitional mechanism may be developed and retained precisely to offset these kinds of collective costs.

The Problem

Democracy is a costly proposition. While most scholars normatively value open participation in making collective choices, a handful of political scientists have warned of the drag on collective choice generated by decision making costs (Buchanan and Tullock, 1962; Dahl, 1970; Elster, 1989). Even something as mundane as balloting within a legislature can represent a cost for the collective choice. This point was implicitly recognized by the Russian Parliament at the outset of its December 1992 meeting. Legislators were cautioned by their Chairman "against needless roll-call votes, noting that each cost 700 rubles -- about $2 at the going exchange rate." *(New York Times,* Dec. 2, 1992; A: 18) Heeding the call for fiscal austerity, legislators even moved to reduce costly television coverage of their proceedings. Our point is that fully open participation is costly and that it plays out in a counterintuitive way. Any single individual has powerful incentives to bear the short-run costs to decision making. So, any Russian legislator had incentives to call a recorded vote. However, everyone is left worse off when there is no cloture to the decision process. This is the hidden aspect of decision costs that was recognized by the Russian Parliamentary Chair and that he cautioned against

Even though the costs of decision making are well known, few scholars have paid them much attention. Almost all models of collective choice assume that the costs to decision making are zero (see in particular McKelvey, 1979; 1986; Schofield, 1978). As a consequence actors only need to be concerned with the policy implications of their choices and not with whether their differences are major or minor or whether the energy devoted to resolving those differences is worthwhile. These models, and others like them, allow very long agendas, assuming an almost Sisyphean ardor on the part of decision makers. In settings with no preference induced equilibrium (and that encompasses the bulk of all complex decision settings), any proposal under consideration can be defeated by some other proposal. With sufficient time, energy and political acumen, an agenda can be built that cycles back to its starting point ~ or to any other point. Because the collective choice can only be characterized by disequilibrium, such results have disheartened many (Riker, 1980).

Of course, many scholars have turned to a variety of institutional remedies to explain why we observe a good deal more consistency to collective choices than our theories would lead us to expect. Shepsle (1979) and more recently Dion (1992) point out that committees, with well defined jurisdictions, provide a means by which equilibria may arise. Special rules designed to protect committee bills on the floor also can lead to equilibrium outcomes (Krehbiel, 1984). Even procedures dictating how amendments are ordered and voted upon can result in stable choices (Shepsle and Weingast, 1984; Ordeshook and Schwartz, 1987). Finally, Schofield et al. (1988) point out that rules requiring extraordinary majorities overcomes inconsistency in collective choices. However, in the search for stability and the discovery of institutions, the rationale for those institutions has been lost.

Riker (1980), in a seminal work reviewing the collective choice literature, implies that the stability uncovered by theorists who focus on institutions, may be illusory. Institutions, he notes, are little more than the congealed preferences of decision makers. As rational actors seeking to maximize policy gains, decision makers need to be little bound to the institutions they create. While certain configurations of rules result in equilibrium outcomes, those rules themselves are subject to negotiation and change. Like the collective choice over outcomes, the rules themselves are open to voting cycles and disequilibrium. As easily as new amendments can be offered to displace a status quo, so too can new institutional configurations be proposed to alter an existing institution. If institutions are perfectly malleable, then focusing on particular institutional arrangements simply because they yield consistency in the social choice is misguided.

Riker's conjecture on the malleable nature of institutions is difficult to challenge. On the one hand, institutions may be "sticky" with change thwarted by natural social processes. This is a problematic claim, however, because we do not know the causal mechanisms underlying those social processes. On the other hand, actors within an institution may be loathe to change the rules of the game. After all the rules they have learned and understand may be better than changes they may have to learn and do not understand. Yet we constantly observe political institutions being tinkered with and changed. Legislative scholars know that Congress is constantly bombarded with prescriptions for change (and each of us has our own favorite reforms). By far the most interesting turn on Riker's conjecture comes indirectly from Krehbiel's (1991) study of congressional committees. He quite rightly wonders why rational agents would yield substantial power to a committee, thereby conferring a tremendous informational advantage, and yet be content with such an arrangement. He goes beyond concerns with structure induced equilibrium and points to the savings gained by those agents. By encouraging the development of expertise in committees (while also maintaining a powerful grip on appointments), agents save on the costs for establishing their own expertise. In a sense, then, institutions are put into place to minimize the costs of decision making.

Here we put the claim much more strongly than Krehbiel. We contend that most institutional rules are put into place, and generally stay put, in order to minimize the costs to decision making. While there are an infinite number of ways to restructure institutions, most rules endure for a simple reason — they offset potentially destructive decision costs. Certainly the Chair of the Russian Parliament was not concerned with the cost of a single vote ~ especially when the stakes involved the very character of decision making within the body. What was recognized, however, was the underlying commons dilemma facing the Parliament With no single vote costing very much, no actor had any reason to refrain from calling yet another vote. But the cumulative effect of many votes was potentially erosive. It is this aspect of decision costs that stands out. Even though those costs are usually trivial, if every actor believes this to be the case and no one has an incentive to withhold imposing those costs, then gains from making a collective choice can quickly dissipate.

Most decision makers implicitly understand the transaction costs for decision making in collective choice settings. Like their counterparts in the Russian Parliament, legislators are attuned to the costs of decision making. It is generally the case that specific institutional mechanisms are adopted in order to lessen those costs. For instance, legislatures often grant specialized agenda powers to committees and then protect those powers through special rules, largely in an effort to minimize floor activity. As well, formal rules of procedure often are adopted to limit the number of amendments made and votes taken. Even informal constraints typically are imposed as legislators reach agreements off the floor. In short, most institutions incorporate mechanisms that limit the transaction costs to decision making. However, are decision costs sufficiently high so as to degrade the collective choice or do institutional rules designed to thwart those costs have their own pernicious effect?

In this paper we focus on the costs of voting within a spatial committee setting. Of course, we know that decision makers in any collective choice arena face many different decision costs. Some involve the search for information, others involve building an agenda. We pick up on the commonplace activity of voting. The voting costs on which we focus have two interesting effects. On the one hand, those costs are privately borne. So, when a vote is called, each individual absorbs those costs. Their size may differ from person to person and even across issues. Nonetheless, those costs are present and should affect an individual's decision calculus. On the other hand, those costs also have a collective impact. Once a vote is called, no one is exempt. If anyone can call a vote and if everyone bears the collective cost for voting this sets the stage for a commons problem in which the product of uncoordinated individual action is the destruction of collective gains (Ostrom, 1990). In this sense voting not only has a private cost, but in a collective choice setting it has an accompanying collective cost Across any single vote, those costs may be trivial. However, with many votes, those costs increasingly mount.

In the next section of this paper we explore some of the formal characteristics of costly voting. In the subsequent section we turn to laboratory experimental methods to test a number of our theoretical conjectures. We conclude, rather pessimistically, that open agenda processes are destructive when voting is costly. In the absence of institutional mechanisms to mediate the costs of voting, this drag on the decision process quickly dissipates gains actors might obtain from a collective choice setting.

A Theoretical Framework for Decision Costs.

In the following discussion we elaborate two very distinct types of models. We do so in order to capture very different aspects of decision costs. The first model focuses exclusively on a spatial committee setting. It does so in order to provide a set of boundaries on the size of costs and in order to note the existence of equilibrium accompanying rather heavy voting costs. This model concludes that cost-based equilibrium should be rare, but tells us little about the strategic considerations of committee members. The second model, which is a game theoretic simplification of the collective choice process detailed under spatial theory, provides us insight into how actors might strategically approach the voting costs we introduce. Using a simplified sequential model of calling a vote we are able to sketch out the underlying dynamic leading to a commons dilemma ~ even with relatively trivial voting costs.

Our decision setting relies on standard assumptions tied to spatial models of collective choice. In order to motivate the study, we adopt some rather simple notation. Let $N = \{1,2,...,n\}$ be the n-membered (odd) set of decision makers charged with selecting a single alternative, x, from a compact, convex policy space $X \subseteq R^m$. Each member $i \in N$ has a strictly quasi-concave binary preference relation (Type One preferences). Utility declines as a function of distance away from i's ideal point, x^i, so that *the set of alternatives preferred to x by player i* is defined as

$P_i(x) = \left\{x^* \in X \middle| \|x^i - x^*\| < \|x^i - x\|\right\}$.

For simple majority rule games we define the *set of winning coalitions* in N as $S = \{S_1, S_2, \ldots, S_k\}$ where $S_j \in S$ if and only if $|S_j| > \frac{n}{2}$. An alternative, x*, is *socially preferred* if it is preferred by all members of any $S_j \in S$ or $x^* \in P_j(x)$ where $\mathbf{P}_j(x) = \bigcap_{i \in S_j} \mathbf{P}_i(x)$. The set of all socially preferred alternatives is defined as the win set of x or $W(x) = \bigcup_{S_j \in S} \mathbf{P}_j(x)$. Since we will usually reference an agenda process, we define the existing policy, or the status quo, as x^o. An open access agenda procedure is defined as one allowing *any* individual to call a vote on a particular alternative, x, and requires each member to choose either x^o or x. In this setting no member abstains.[1]

We assume that taking a vote imposes costs on all members of the collectivity and define these voting costs as $d^i(x)$. For simplicity, we assume that $d^i(x) = d^j(x), \forall i, j \in N$ and that $d(x) = d(x^o), \forall x, x^o \in X$ and thus, consider a constant cost of **d** for any vote.

The Logic of Open Agendas

When selecting an outcome under an open agenda, each individual must evaluate whether a winning alternative represents an improvement sufficient to compensate for the cost of voting. If so, an individual has an incentive to call a vote. Specifically individual i will propose an alternative to the status quo x^o as long as there exists an $x \in W(x^o)$ such that $u^i(x) - \mathbf{d} > u^i(x^o)$. To more generally capture this notion, we define i's cost-induced preferred set as $P_i^c(x^o)$. Every point in $P_i^c(x^o)$ results in a gain for i greater than the cost of proposing that vote. This set contains those amendments to x^o that a rational actor would bring to a vote in the face of voting costs. This brings up two crucial points. First note that member i is only concerned with her own costs when contemplating an amendment to the status quo. Member i need not be concerned with the effect of calling a vote on the others. Second, once a vote is called, then the cost of voting is absorbed by all actors. At that point, an actor's only concern is with the difference between the amendment and the status quo. The cost of voting is now a sunk cost and irrelevant to the voting decision. Thus, this model only focuses on ways in which voting costs affect the calculus of calling a vote.

Consider, then, the circumstances under which no vote will be called. First, we define a set of equilibrium outcomes as $E(x) = \left\{ x \in X \middle| \bigcup_{i \in N} P_i^c(x^o) \bigcap W(x^o) = \varnothing \right\}$. We only consider those alternatives within the win set of x^o since a losing proposal results in a payoff of $u(x^o) - \mathbf{d}$ which is strictly less than $u(x^o)$, the utility of no vote, for any $\mathbf{d} > 0$. Thus, an actor will not rationally propose a losing alternative. When the status quo is located within a radius of **d** from x^i no change will produce a better outcome for i since the costs of the vote exceed any potential gain from continued movement (i.e.- $P_i^c(x^o) = \varnothing$). The only way to predict with certainty that the decision process ends at x^o is if the costs of calling a vote are sufficiently high so that $\bigcup_{i \in N} P_i^c(x^o) \bigcap W(x^o) = \varnothing$ as shown in the following result.

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[1] In the event that an individual is indifferent between the status quo and an amendment, we assume that actor will vote for the status quo.

Theorem 1: For d ≥ 0, $x^o \in E(x)$ if and only if $\bigcup_{i \in N} P_i^c(x^o) \bigcap W(x^o) = \varnothing$ (See the discussion in the appendix.)

What is the practical interpretation to this? An equilibrium will exist when a particular distribution of preferences is satisified or when a specific threshhold of costs is met. However, the conditions that must hold in either case are extreme. On the one hand, either a Core must exist or actors must all have practically the same set of preferences. Both are rather extreme constraints on the structure of preferences. On the other hand, the costs must be so high so that it is not worthwhile for *any* individual to call a vote. However, this too is an extreme constraint on the process. More typically, the transaction costs for voting are relatively trivial compared with the issues and gains at stake. By and large we should not expect to find an equilibrium that is a function of the cost of voting.

If there is no preference-induced equilibrium, as McKelvey (1976; 1979) and others have shown, an agenda may wander anywhere. That is, any point can be reached via some agenda as actors try to perfect the outcome. If there is no cost-induced equilibrium no endogenous stopping rule exists. If there is no stopping rule then an agenda can be very lengthy. In this setting, a lengthy agenda translates to high costs. If those costs are absorbed at each step (and are nothing more than sunk costs), then the overall gains from decision making steadily erode with each vote.

Game Theoretic Intuition.

This social choice characterization only points out that an equilibrium will be rare. However, we think that it misses a fundamental dynamic at work: the incentives actors have for continuing to vote. That model ignores the strategic nature of calling a vote. When actors weigh the accumulating costs and consider the array of proposals before them, do they choose to stop the process in order to avoid voting costs? We conclude they do not. Instead, they have powerful incentives to continue calling votes, while collectively bearing the costs of voting. This in turn erodes what any actor gains from the collective choice. In order to capture the strategic behavior of those decision makers we shift to a game theoretic analysis that mimics a forward moving agenda process.

Consider the following voting game. Three actors (A,B,C) begin the game with the status quo x^o. Three alternatives are on the floor and the actors have the following ordered preferences over the alternatives:

A: $\{x, y, z, x^o\}$
B: $\{y, z, x, x^o\}$
C: $\{z, x, y, x^o\}$

In each case actors prefer any alternative to the status quo (although this is not a necessary condition for the model). As well, this particular ordering generates a voting cycle across alternatives x, y, and z. Now, suppose those actors are sequentially (and publicly) polled as to whether they wish to bring a proposal up for a vote. That is, actor A annouces whether she will call a vote, in turn B does the same, and finally C makes her announcement Once all announcements are made Nature chooses from among those wishing to call a vote. Let this constitute a single stage of the game. If no one chooses to call a vote, then the game ends with the current status quo. If only a single person chooses to call a vote, then that individual is selected by Nature with certainty. If two or more actors announce they will call a vote, then Nature chooses randomly between them. For the sake of simplicity we assume that actors are risk neutral in expectations and that Nature chooses with equivalent probabilities from the actors announcing their intention to call a vote.[2] Following Nature's move, the actor chosen to call the vote proposes an alternative to be voted on. Once a proposal is made the vote is taken. When a vote is called all actors, regardless of their announcement, are charged a cost represented as *"d."*

The Single Stage Game.

What happens if actors are confronted with this game and play it for only one period? Each actor has a two choices — either to announce that she will or will not call a vote. Let this setting be represented by the game in extensive form displayed on Figure 1. Nature's move at the conclusion of announcements is simply folded into the player's expectations for that particular branch of the game. On the figure, player i's utility for an alternative is given as $u_i(x) \equiv x$. Simplifying in this manner allows us to generically represent outcomes, keeping in mind that each actor has different orderings across alternatives and unique utility functions. In the simplest case (where no one calls a vote) the outcome vector for actors A, B, and C would be: $\{u_A(x^\circ), u_B(x^\circ), u_C(x^\circ)\}$. For simplicity, we normalize players utility by setting their payoff (in terms of utility) for the status quo to zero.

<Figure 1 About Here>

It is easy to show that if voting costs are trivial (and we will turn to what this means below) then each actor has an incentive to call a vote. This is demonstrated under backward induction. Beginning with the left-most branches (boxes 1 and 2), player C prefers the outcome z to x^0 given trivial costs and so will call a vote. Moving to the right,

2 Actors could just as well be differentially weighted to reflect power asymmetries within the institution. This reflects the fact that the power of recognition might be crucial when proposals are made. For now we acknowledge, but ignore, this complication.

when considering boxes 3 and 4 player C will once again call a vote, taking a $\frac{1}{2}$ chance of getting z, her most preferred outcome, rather than a certain chance of getting y. Likewise, across all other branches C will choose a strategy of calling a vote. Knowing this, Player B, for the left branch, has a choice between the outcome in box 2 or 4. She will call a vote, since a chance of getting y or z is better than z alone (even though it is her second ranked alternative). Likewise B, knowing what C will do at the last stage on the right branch has a choice between the outcome in box 6 or 8. The expected value for calling a vote (with a payoff of $\frac{u_B(x)+u_B(y)+u_B(z)}{3}-d$ exceeds that of not calling a vote. Finally, knowing what the other actors will do, player A's choices reduce to outcomes from box 4 and box 8. Again, based on expectations, A will choose to call a vote.[3] Consequently the subgame perfect equilibrium for this one stage game (with trivial costs) is for each actor to call a vote.

Calling a vote is, of course, contingent on trivial costs. There are two conditions where voting costs are non-trivial.

Condition 1: Suppose $d > \max_{\forall i \in N}\{u_i(x), u_i(y), u_i(z)\}$.

Condition 1 is the least interesting case. Here the cost for calling a vote exceeds each actor's most preferred alternative. While the costs to voting may often be high we expect this case is unlikely. However it sets an upper bound and clearly each actor would defer bringing a vote to the floor. The second condition is more interesting.

Condition 2:

$$d > u_C(z);$$
$$d > \frac{u_B(y)+u_B(z)}{2}\text{; and}$$
$$d > \frac{u_A(x)+u_A(y)+u_A(z)}{3}.$$

Condition 2 requires that actor C's cost of voting exceeds that of her best payoff. It requires that actor B's cost of voting exceeds the average of her first and second best alternatives. Finally it requires that actor A's cost of voting exceeds her average payoff across all three alternatives. Here, with the exception of actor C, the cost of voting drops across the actors . If Condition 2 is met, then the strategy choice is for all three actors to not call a vote. However, even under this condition these costs are extreme.

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[3] In expectations it is the case that so long as $u_A(x) > \frac{u_A(y)+u_A(z)}{2}$ then A will choose to call a vote. By assumption of A's preferences, this holds.

A Two-Stage Game.

Consistent with a forward moving agenda in the social choice setting, what happens if actors bear the cost of voting for each stage, the game continues to the second stage, and actors receive a payoff only for the outcome in the second stage? In this setting actors first consider an amendment to the status quo. If a vote is called, then the amendment is voted on. Actors then decide whether to call a second vote, which is an amendment to the amendment As in the forward moving spatial theory version of this game, the new amendment is simply paired against the first stage winner. Here we assume myopic voters, who, if chosen by nature, propose their most preferred outcome. Actors are also assumed to vote sincerely and outcomes are represented on this basis.[4] Depending on which alternative is selected in the first stage, each node on Figure 1 leads to several different paths. For instance, in the rightmost node each alternative has a one-third chance of being chosen by nature in the first stage. If y is chosen, then each actor faces a new decision about whether to (sequentially) call another vote. In this instance there is a subgame equilibrium in which Player C has no incentive to call a vote while both A and B will call a vote given that they know their successor's action. Each of these subgames are discussed in the Appendix. Figure 2 represents the second stage outcomes, in expectation, given that a member is looking ahead from the beginning of the game. These expectations are based on results from the first stage represented on Figure 1 and solving each of the subgames in the second stage. For example, if A and B choose not to call a vote, then according to Figure 1, z would be the outcome with a cost attached to the vote. Figure 2 illustrates that if that node were reached, then the outcome, if actors chose their best response in the second stage, is a flip of a coin between y and z. Moreover, since a vote will be called in the second stage, all players now bear double the costs of the first stage.

<Figure 2 About Here>

Given Figure 2 we can calculate whether a subgame perfect equilibrium exists. Under trivial costs, all actors will choose to call a vote, provided that for C, $[u_C(z) - u_C(x)] > [u_C(x) - u_C(y)]$. Keeping this innocuous restriction on preferences, then all players will choose to call a vote in the face of trivial costs. Their expectation remains a one-third chance of each alternative minus the costs attached to two stages of voting.

Costs are no longer trivial when Condition 1 does not hold, but Condition 3 *does* hold:

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[4] For this limited two-stage game we could calculate the sophisticated voting strategy for players (see McKelvey and Niemi, 1978). This is only possible given the finite structure of the agenda. However, we expand our disussion to an unknown end point which leaves it impossible to calculate a sophisticated voting strategy.

Condition 3:

$$d > \frac{u_A(x) - u_A(y)}{2};$$
$$d > \frac{u_B(y) - u_B(z)}{2}; \text{ and}$$
$$d > u_C(z) - u_C(x)$$

Compared with Condition 2 these costs are considerably smaller. In each instance costs have to be greater than some ratio of the difference in utility between an actor's first and second ranked alternatives. It is also worth noting that because C goes last, C can absorb greater costs before not calling a vote. When Condition 3 holds, all actors will choose to call a vote in the first stage and will not call a vote in the second stage. The resulting expectation, for any actor, is $\frac{u_i(x)+u_i(y)+u_i(z)}{3} - d$, with voting costs only assessed in the first stage.

The n-Stage Game.

Finally, how does the game unfold if the agenda has n stages? Again, at each stage costs are imposed on all actors and payoffs are a function of the final majority preferred alternative. In this setting, costs steadily accumulate while payoffs for the final alternative do not. Again assuming trivial costs, actors have a dominant strategy (via subgame perfection) to always begin by calling a vote. Proposition 1 shows that the expectation for this strategy is $\frac{u_i(x)+u_i(y)+u_i(z)}{3} - nd$.

Proposition 1: For the n-stage game, the expectation for always calling a vote is $\frac{u_i(x)+u_i(y)+u_i(z)}{3} - nd$. (see Appendix).

Clearly actors anticipate that *any* outcome can arise at the n<u>th</u> stage. At the same time the costs faced by subjects continue to increase as a function of the number of stages.

As the number of stages grows very large, if *any* actor calls a vote *at each stage*, then expectations for each final node converges on $\frac{u_i(x)+u_i(y)+u_i(z)}{3} - nd$. This point is shown in Proposition 2.

Proposition 2: For any alternative selected in the first stage, as the number of stages grows very large, the expected outcome converges on an equal probability of all alternatives. (see Appendix).

What Proposition 2 implies is that if anyone calls a vote at each stage, with a sufficiently large number of stages, the result in expectations is no different than if everyone called a vote. Given this convergence then actors must consider whether to ever call a vote. With many voting stages, the choice reduces to sticking with x^o, the initial status quo, or a chance of getting one's most preferred alternative. All of this, of course, is predicated on trivial costs.

Suppose costs are non-trivial. Under what conditions will voting halt? Again, if Condition 1 holds, no one will ever call a vote and the initial status quo is the predicted outcome for the game. However, this assumes enormous costs to voting. It is also the case that if Condition 3 holds, voting comes to a halt. In fact only a single vote would be taken and the game would end at the second stage. From the discussion of each of the subgames in the Appendix, it is the case that no matter which stage of the game players are at, actors will refuse to call a vote if the cost for voting exceeds a ratio of the difference between their first and second preferred alternative. Since this is independent of the stage, if the condition is met, the game will halt at the second stage. The winning alternative will be the amendment to the initial status quo.

Finally, costs will be non-trivial whenever Condition 4 holds.

$$\textit{Condition 4.} \quad d > \max_{i \in N}\left(\frac{u_i(x)+u_i(y)+u_i(z)}{3n}\right)$$

Condition 4 holds, since with a sufficiently large number of votes, actors are simply comparing their return from the initial status quo with their expectations for some subset of actors calling votes across n voting stages.[5] Generally these costs will be less than those under Condition 1 or Condition 3. There is, however, a fundamental problem for assessing this condition. Actors ordinarily will not know how many votes will be taken. If neither Condition 1 nor Condition 3 holds, then actors have a dominant strategy to call votes and to continue calling votes. Assessing at the outset how many votes will be called is almost impossible. It is possible that if actors know the size of the voting costs, then they could infer the maximal number of votes that should be called (i.e., call no more than $n = \max_{i \in N}\left(\frac{u_i(x)+u_i(y)+u_i(z)}{3d}\right)$ votes). Moreover if actors expect that more than that number of votes will be called, then calling no vote is a dominant strategy for each player. Again, the sticky problem is knowing how many votes can be called. In the setting examined here, there is no mechanism for deciding any upper bound. In almost all decision making bodies there are well defined institutional constraints on the number of votes taken on any single matter. Those boundaries obviously provide some assurance about the extent of decision costs.

It is important to note several points from this discussion. First, the game theoretic intuition does not tell us *which* outcome will be selected. Only if Condition 1 or some

[5] Note that earlier we assumed that all actor's utility for x^0 is normalized to zero. Condition 4 is calculated by setting each member's expectation to zero and then solving for the size of the costs.

variant of Condition 4 holds can we predict that x°, the status quo, will be the outcome. In other words, in the face of enormous costs, no vote will be taken. This is not a terribly insightful finding. Second, this model shows more clearly than the social choice model that actors will have powerful incentives to call many votes with costs continually eating away at any gains.

General Observations.

The spatial and game theoretic models point to the same thing. When voting is collectively assessed, not everyone has an incentive to refrain from calling a vote. The setting described here offers a simple prediction: when costs are trivial, voting will continue. Even though the accumulated costs may grow quite large, at least one actor will choose to call yet another vote. Absent any institutional constraint to limit the number of votes, actors will invariably continue to impose voting costs in such a way so as to dissipate any gains that might be captured from decision making.

It is difficult to test this prediction in a natural setting. Assessing individuals' payoffs and costs are notoriously difficult in those settings. However, to get around these problems, we turn to an empirical test using laboratory experiments. The aim behind these experiments is to test our theoretical insights and not to replicate any natural setting. If the theory has any bite, it should show up in our highly controlled settings — if not, then we should focus out attention elsewhere.

Experimental Design

The design of this experiment closely resembles the spatial model elaborated in the preceding section. It is based on 5-person committee experiments conducted by Fiorina and Plott (1978), McKelvey, Ordeshook and Winer (1978) and Herzberg and Wilson (1991).[6] While the design closely mimics the spatial model detailed in the first part of the theory section, our game theoretic model has alerted us to the dynamics of subject behavior. In this sense, then, we depart from the usual focus of spatial experiments on the outcomes selected by the committee. Instead we zero in on the actions of our subjects, comparing their behavior with those strategies suggested by game theory. Rather than viewing each experimental trial as yielding a single outcome, we are interested in the supergame properties of many subjects building very long (costly) voting agendas.

[6]Unlike the committee experiments by Fiorina and Plott (1978) and McKelvey, Ordeshook and Winer (1978) which were conducted in face-to-face settings, these experiments used computer controlled settings to mediate all player interaction. The experiments were conducted on Macintosh computers connected over a local area network. Source code for these computer programs is available from the first author.

Subjects in this experiment were recruited through advertisements posted around the campus at Indiana University. Subjects volunteered to participate on a particular time and date, and experiments were filled on a first-call basis. All participation in these experiments took place at computer terminals which were physically separated. Players could not see one another's terminals and their identities were randomized and kept anonymous during the experiments.

Prior to beginning the experiment, individuals participated in a computer exercise for which they earned an endowment. Subjects were told the exercise was unrelated to the experiment and was designed to help familiarize them with the computer. In the exercise an individual picked a point from a line numbered from 0 to 100. The computer then picked a point from the line and the subject was paid an amount based on the closeness of their guess to that of the computer. The computer's selection was based on a random draw from a normal distribution. Subjects were given, for each point, the likelihood the computer would select that point Subjects continued guessing until they had earned at least $3.00. This exercise was included for two reasons. First it was designed to help familiarize the subjects with using the "mouse" which was their sole interface with the computer. Second, in some of the experimental manipulations subjects could lose money. Consequently, this exercise served as a means for earning an endowment. Others show that having a subject earn, rather than be granted, an endowment has an impact on their subsequent behavior in experimental settings (Hoffman and Spitzer, 1985).

Following this exercise, participants were given instructions designed to familiarize them with the experiment and test their comprehension.[7] Upon completing these instructions, individuals participated in a practice period for which they were not paid During practice, participants were urged to try all the options until they were familiar with the experiment. Participants were cautioned that once they completed the practice session their earnings solely depended on the collective choice that was reached

In the experiment, participants were to collectively choose an alternative from a 300x300 point two-dimensional policy space. Alternatives were represented as Cartesian coordinates from orthogonal dimensions labeled X and Y. All experiments used a forward moving agenda procedure in which proposing alternatives, voting, and adjourning was governed under a modified version *of Robert's Rules of Order.* At the outset of the experiment a fixed status quo was introduced by the experimenter. Any subject could place a proposal on the floor and once proposed it remained there throughout the decision period. A vote to amend the status quo was not considered unless a proposal was "seconded" by

[7] These instructions are available from the authors upon request

another member. Once a proposal was seconded, a vote was called between the amendment and the status quo. All amendments were treated as an amendment in the nature of a substitute. If a simple majority of the committee (three out of five) voted in favor of retaining the status quo, the experiment continued, with the floor open to new amendments. If a majority voted for the amendment it became the (amended) status quo, and the floor was opened to amendments to this new status quo. The experiment continued in this fashion until a subject made a motion to adjourn the committee meeting. If a simple majority voted to adjourn, then that decision period came to an end and subjects were paid their value for the current status quo. If a majority voted against adjournment, the experiment continued, with the floor open to further amendments to the status quo. It was up to a majority of the committee to decide when to end the decision period.

Each individual was assigned an ideal point in this two-dimensional space and was given a payoff function. In these experiments, member preferences are represented as circles, with payoffs decreasing with distance from the member's ideal point. The payoff functions across experimental designs are summarized in Table 1. By using an abstract policy space (made up of X and Y axes) and by inducing player's valuation for points in the space, we sought to avoid problems associated with participants adopting different subjective valuations for the policy space. All calculations for a subject were handled by the micro-computer. The computer terminal displayed the alternative space, the member's ideal point, representative indifference curves, and the ideal points of all other members (but not their payoff functions). The current status quo, as well as all proposals currently on the floor were also represented on this alternative space. Finally, members had a set of menus from which they could select a number of actions.

<Table 1 About Hero

In these experiments, subjects participated in three distinct periods, with each period constituting a distinct decision. All subjects were told the number of periods in which they would participate. The first was always a "practice" period, in which subjects were not paid. Instead, they were urged to use this period to learn the underlying institution and to ask questions of the experimenter if they were unclear about how to use the equipment The first period was always without costs and subjects were placed in a preference configuration they would not see in the remaining two periods. In both the second and third periods, subjects were paid for the final choice by the committee. Their money was tallied (including the amount earned in the initial exercise) and they were paid at the conclusion of the experiment.[8] Between each period subjects were given new

[8] Under some experimental manipulations subjects ended the experiment by owing the experimenter money. Such subjects were paid $2.00. It was not announced beforehand that subjects would be paid a minimal

instructions, by the computer, detailing the design and manipulation for the subsequent period.

Experimental Manipulations.

In these experiments two different preference configurations were used and within each configuration up to three different treatments were imposed. The first, the *Star* preference configuration, has individuals arrayed nearly symmetrically around the center of the alternative space. This configuration is identical to that used in Herzberg and Wilson (1991) and has the property that under this forward moving, simple majority rule voting mechanism, there is no preference-induced equilibrium. The second configuration, a *Core* preference configuration, has a preference-induced equilibrium located at player A's ideal point. The ideal points for both configurations were rotated around the center of the alternative space for different trials. This was done to eliminate any focal points that inadvertently might have been introduced. All of the results have been oriented to the configurations discussed in this text Table 1 lists normalized the ideal points and payoff functions of all players in all experimental designs. By using two distinct preference configurations we provide a comparative basis with which to assess the effects of voting costs. Under the *Core* we have an explicit prediction as to *where* outcomes should fall, regardless of voting costs. We have no such prediction for outcomes under the *Start* configuration.

Our focus is with the cost to voting and we imposed two treatments. The control group experienced no costs for calling a vote. One treatment charged subjects $.15 and the second charged subjects $.30 for each vote that was taken. Neither treatment imposed sufficiently high costs to yield a cost-induced equilibrium. To have insured such an equilibrium the voting cost in the *Star* configuration would have had to have been $1.12. In the experiment subjects were told what their costs would be for calling a vote prior to beginning the period. It was made clear to them that, no matter who called a vote, everyone was charged for voting. Moreover, before calling a vote, subjects were reminded of the cost attached to calling a vote (this was omitted for the control). No distinction was

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amount for participating. Instead, the instructions clearly stated that the sole amount subjects would earn was what they earned in the experiment. When a subject's earnings are negative, several crucial assumptions about induced valuation are violated, including dominance and saliency (Smith, 1982). However, in several cases, the initial endowment for subjects would have had to have been in excess of $15.00 for those subjects to have broken even. From observing the experiments and listening to comments from subjects afterward, even when subjects had large losses (particularly in the second period), they still thought they could make money in the last period. There is every indication that subjects continued to take their task seriously even when they were facing negative payoffs.

made in these experiments between votes on an amendment and votes on adjournment. The same cost was applied to both types of votes.

Under the *Core* configuration subjects faced either a $.00 cost or a $.30 cost per vote. Under the *Star* configuration subjects faced either a $.00 cost, a $.15 cost or a $.30 cost per vote. We chose not to test all cost treatments under the *Core* because we felt the collective choice problem was simplified in the presence of a spatial equilibrium and we wished to stretch our limited research dollars. In all trials, the cost for voting was subtracted immediately after the vote was taken. It was represented as a decrease in a member's overall payoff. For example, under the high cost treatment, if a member's ideal point was initially worth $25.00, after a vote was called, that ideal point was worth $24.70 and represented as such. Thus, subjects felt the effects of these voting costs after each vote.

Predictions.

Our main focus is with the costs to voting. Intuitively it seems that as the cost to voting increases, fewer votes will be called. However, our theoretical models point in the opposite direction. So long as voting costs are trivial, at least one individual has an incentive to call a vote. This is especially true under the *Star* configuration, since there exists no preference-induced equilibrium that introduces a natural stopping point. Instead there always exists a majority rule agenda path leading elsewhere in the alternative space. Under the *Core* configuration, some individual has an incentive, even in the face of trivial costs, to continue calling a vote until reaching the equilibrium.

In the experiment our predictions are twofold. First, controlling for the preference configuration, there will be no difference across the control and cost treatment groups as to the number of votes taken. Even though subjects face a game with the characteristics of a commons dilemma, not all actors have an incentive to withhold calling a vote. Because the *Core* configuration has a natural stopping point (member A's ideal point), we expect subjects under this manipulation to take fewer votes than under the *Star* configuration. Second, where subjects are assessed costs for each vote called, they will dissipate all rents from the committee setting. This is the spatial voting equivalent to the non-replenishable commons problem, where the product of uncoordinated individual action is to destroy whatever gains might exist.

Analysis

The outcomes for this experiment are listed on Table 2. Outcomes for the *Core* configuration are plotted on Figure 3, while outcomes for the *Star* configuration are plotted on Figure 4. Turning first to Figure 3, we find that outcomes under both cost treatments converged on the preference-induced equilibrium, member A's ideal point. Although no outcome is located at the equilibrium, in 5 of 13 trials the final outcome was in equilibrium. That is, it could have defeated any proposal on the floor. Statistically, we find that there is no difference in the dispersion of outcomes between the control and cost conditions. Taking the Euclidean distance of each outcome from x^A, we find no difference between the $.00 and $.30 cost treatments (a simple t-test of distance yields: t=.22, p=.83). We conclude that there are no obvious differences in the *outcomes* selected across treatments. However, our theoretical model says nothing about the distribution of outcomes and we turn to further analysis below.

<Table 2, Figure 3 About Here>

Turning to Figure 4, we reach similar conclusions about outcomes under the *Star* configuration. Given this array of preferences and our institutional mechanism, there exists no equilibrium. As expected, those outcomes are scattered across the alternative space. Although many of the outcomes converge on the central portion of the alternative space, this is a common finding (see Herzberg and Wilson, 1991; Grofman et al., 1987). Other than centrality, we find no pattern to the dispersion of outcomes attributable to our control group and two cost treatments. To show this we calculated the Euclidean distance of all outcomes from the dimension by dimension grand mean for those outcomes. We estimated a simple ANOVA and found no difference across treatments (F(2,20)=l.25, p=.31). Again we conclude there are no obvious differences in *outcomes* across the cost manipulations.

<Figure 4 About Hero

Across all manipulations it is apparent that subjects took their task seriously. While subjects often choose a variety of novel strategies in laboratory experiments, in this experiment they behaved like sincere voters. Of the 2,589 votes on amendments only 56 (2.16%) were cast in unexpected ways ~ either for the status quo even though the amendment was worth more or vice versa.[9] This is powerful evidence supporting the saliency of our rewards. Notably, two-thirds of the insincere votes came from trials where the cost to voting was the highest

With these preliminaries out of the way we can turn to our main question: Did the cost of voting lead subjects to decrease the number of votes they called? Results under GLM are reported on Table 3. The dependent variable is the number of votes taken. Since many subjects might have developed expectations about the experiment in their second,

9 Another eleven votes were cast when a player was indifferent. Six were for the status quo and the remaining five for the amendment. Many models assume that indifferent voters flip a coin in their decision. This is a meager piece of evidence backing such an assumption.

paid, period of play, we control for the trial's period. Since there exists an endogenous stopping rule in trials with a Core, we also control for the type of preference configuration. Finally, we focus on the size of costs as our primary treatment variable. We only report the main effects in Table 3, since there were no theoretically justified interactions.

<Table 3 About Hero

Our results are straightforward. There are no significant main effects with the number of votes taken. Neither the period nor the preference configuration has an effect on the number of votes taken. Even costs have no statistically significant effect. The upshot of this finding is that our theoretical conjecture is supported. Subjects do not respond to the cost of voting. As those costs vary, subjects continue to have an incentive to call a vote, and they do so. On average subjects called just over 21 votes in each trial. This meant that in trials with costs to voting subjects paid a premium. In the no-cost trials subjects earned $5.52 per trial, on average. In trials with high costs, on average, subjects paid $6.30 — a sum that often exceeded their earnings.

The key decision facing subjects was when to adjourn. As the costs mounted, the decision rules subjects used for ending the trial became increasingly erratic. In large part this was due to the steady erosion of any gains from decision making. To illustrate this we estimated a PROBIT of subjects' votes on adjournment as a function of their payoff for the status quo. This was done for both successful and unsuccessful motions to adjourn. The estimated probabilities for different dollar payoffs for the *Star* configuration under each of the cost treatments are given on Figure 5. A plot for the *Core* configuration treatments is quite similar, but not displayed here. The S-shaped curve for the no-cost trials is indicative of a very strong fit. Our estimate shows that subjects were "indifferent" between voting for or against adjournment when the status quo was worth $5.64. A similar story is true for those subjects under the $.15 cost treatment. Those subjects were indifferent as to whether to adjourn at $5.28. Yet the displayed probability function has a less pronounced S-shape (although the fit is still quite good for our estimated parameters). Part of this is explained by the fact that subjects faced real losses in these trials. Their payoffs could end up negative (in 17 percent of the cases, they did, losing on average $2.44) and subjects exhibited greater uncertainty in deciding when to halt the trial. Even so, subjects in these trials did not call fewer votes. When the costs for voting were doubled, voting became very erratic. Subjects were indifferent between staying or ending the trial at $7.90, a value considerably higher than under the other two cost manipulations. By inspection, the fit for this high cost trial is quite poor. Over 48 percent of the subjects lost money in these trials (on average losing $11.93). Paradoxically, even though subjects knew they were losing money with each vote, they continued to call votes, anticipating future gains.

<Figure 5 About Hero

Trial CV20 is representative of the how subjects proceeded in these trials. In this trial subjects were under a *Star* configuration and faced $.15 costs per vote taken. A total of 23 votes were taken in this trial ~ 20 of which were to amend the status quo and 3 of which were to end the trial. Figure 6 plots successful changes to the status quo. Subjects were not terribly sophisticated in the amendments they brought forward, since only 25 percent were successful In four of the first five votes subjects succeeded in amending the status quo. On votes 6 and 7 player A brought the amendment from vote 3 forward for reconsideration. It failed and player C brought forward a motion to adjourn, which failed on a 4-1 vote. On the eleventh vote player D seconded alternative (160,124), which would be the final outcome for the trial. It passed by a 3-2 vote with the coalition {A,D,E}. In five of the next ten amendment votes player A again forced subjects to reconsider the amendment which had won at vote 3. Each time it failed, but A's persistence cost him (and the other players) $.75. Overall, subjects cast 23 votes, which cost them $3.45. If they had halted the trial at votes 3 or 11 they would have come out well ahead. However, if subjects had halted after vote 3 players C and D would have jointly earned *negative* $4.31. Given that they would have jointly earned $25.78 for the status quo at vote 2, they were unlikely to want to halt the trial with a loss. Meanwhile, if subjects had halted the experiment following vote 11, only player B would have borne a loss, and this was less than $.10. By the time subjects quit the trial, players A and B absorbed losses, jointly earning -$3.26. The fact that each player had a proposal that made them better off meant that no player had an incentive to stop the experiment. Instead each player had an incentive to call a vote and invariably they did so.

<Figure 6 About Hero

The erosion of profits noted above is quite common in these experiments. In a surprisingly large percentage of these costly voting trials (75 percent) subjects were better off if they had stopped sooner. However, subjects had strong incentives to call yet another amendment vote. This was true even in settings with a Core, although subjects were unlikely to uncover an alternative that could defeat the current status quo. Getting subjects to vote to stop the trial was difficult As Figure 5 illustrates, those facing the greatest costs also voted the most erratically. Increasing costs left subjects more uncertain as to how to vote. But, increasing costs did not change their likelihood of calling a vote. Even facing steadily decreasing earnings, subjects ordinarily chose to continue the trial and bring another vote forward.

What we find is counterintuitive, yet theoretically expected. When faced with increasing costs for voting, subjects do not change their behavior. They have an incentive to call a vote (anticipating that they can be made better off) and they call votes. The collective action problem we have introduced operates much as we expected. Players do not hold back in calling new votes with the consequence that payoffs erode. The example detailed above for trial CV20 is quite common. Although subjects settled on the final outcome reasonably early in the trial, attempts at amending continued The net effect was that everyone's payoffs were decreased.

Conclusion

The costs to decision making are rarely absent in collective choice setting, yet almost all theoretical models assume decision making is frictionless. What we have done here is to explicitly link voting costs to the collective choice process. The good news is that the problem of decision costs ordinarily does not displace the problem of the disequilibrium of majority rule. That is, actors in a majority rule collective choice process will continue to face problems associated with voting cycles, wandering agendas and inconsistencies in collective choices. In this context only if the costs to voting are sufficiently large do we find an equilibrium to majority rule processes. The bad news is that these decision costs can seriously undermine the gains from the collective choice process. We find that actors have no incentive to limit their own behavior even though the combination of those actions leads to a collective dilemma. Each actor's choice to call a vote introduces a severe drag on the decision process. These voting costs can markedly transform actor's expectations for collective choices. Quite simply our findings point out that where the costs to voting are trivial, there is no impact as to *which* outcome is selected. However, those costs have an enormous impact on the *process* of collective choice, especially by eroding the gains from decision making.

It is apparent that decision costs can be costly indeed for the collective choice. We contend that, in large part, institutional rules are stable precisely because they limit the costs that decision makers bear. Many rules are adopted in order to minimize decision costs, even though it is widely recognized that such rules confer special advantages. This is not to say that all rules are designed to minimize decision costs, since they do not In the U.S. Senate, Rule 22 is specifically retained so as to *impose* decision costs on that body. By providing the right to a filibuster, it is expected that minority rights will be heard over the cacophony pushing to simply clear the workload. Yet such rules are rare. Ordinarily institutional mechanisms are put into place with an eye toward reducing decision costs and retained for the same reason.

The institutional context for reducing decision costs is doubly important The seemingly simple concerns for the costs of voting voiced by members of the Russian

Parliament are echoed more broadly in other newly evolving democracies. When building new political institutions there are powerful voices crying for fully open participatory settings. The rationale for openness, especially in previously closed societies, is seductive. Afterall, free discussion, open agendas and minimal rules hobbling legislators will ensure that many voices are heard and many interests represented. However, there are penalties attached to completely open institutional settings. Few actors will choose to give up their special interests and few will choose to negotiate compromise. The result is that decisions either will not be made or the process will continue for so long that everyone is left worse off. In settings where interests are sharply divided (e.g., where there are powerful ethnic or religious splits) completely open institutions can be disastrous.

The task for decision makers is to design institutions that not only allow diversity in exercising voice, but also enable compromises to be struck and decisions to be made. The cost to decision making is not something unique to emerging Eastern European political institutions. As Jillson and Wilson (1993) detail, Americans learned these lessons the hard way in the design of the failed Continental Congress.

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Table 1

Parameters Used in Experiments

Star Preferences.

Member	*Ideal Points*	*Max. Value*	*Loss Rate (y)*
A	(22,214)	$25.00	-.013
B	(171,290)	$25.00	-.013
C	(279,180)	$25.00	-.013
D	(225,43)	$25.00	-.013
E	(43,75)	$25.00	-.013

Status Quo == (280,280)

Core Preferences

Member	*Ideal Points*	*Max. Value*	*Loss Rate (y)*
A	(120,125)	$15.00	-.018
B	(34,168)	$19.00	-.013
C	(242,247)	$25.00	-.011
D	(222,74)	$19.00	-.013
E	(30,35)	$19.00	-.013

Status Quo = (175,265)

Utility for any X and for the ith's member's ideal point, Xi, is given by:

Non-linear Payoff: Ui = (Max. Value) * exp(*y* * (IIX - Xill))

Linear Payoff: Ui = [(Max. Value) - (IIX - Xill * $. 14)]

Table 2

Experiment Outcomes By Manipulation

Star Configuration

No Costs

Experiment	Period	Outcome	Total Votes
cv22	2	(176,191)	27
cv22	3	(225,43)	2
cv23	2	(204,180)	33
cv24	2	(172,210)	21
cv25	2	(190,167)	73
cv26	2	(34,173)	12
cv26	3	(146,133)	64
cv27	3	(173,198)	50
cv28	3	(280,280)	1

$.15 Costs

Experiment	Period	Outcome	Total Votes
cv2	2	(157,124)	23
cv9	2	(89,209)	5
cvl4	3	(135,133)	16
cvl6	3	(119,165)	2
cvl7	3	(153,160)	3
cvl9	3	(168,149)	14
cv20	2	(160,124)	23

$.30 Costs

Experiment	Period	Outcome	Total Votes
cv2	3	(155,147)	12
cvlO	3	(171,282)	5
cvl5	2	(207,216)	13
cvl5	3	(154,122)	2
cvl4	2	(55,175)	35
cvl7	2	(167,118)	56
cvl8	3	(172,291)	42

Table 2 Continued

Core Configuration

No Costs

Experiment	Period	Outcome	Total Votes
cv29	3	(125,124)	26
cv30	3	(123,75)	6
cv31	2	(156,135)	16
cv32	3	(138,147)	3
cv33	2	(124,150)	6
cv34	3	(100,127)	87
cv35	2	(120,129)	13

$30 Costs

Experiment	Period	Outcome	Total Votes
cvl	3	(122,111)	17
cv7	2	(106,89)	3
cv9	3	(133,130)	18
cv11	2	(120,124)	26
cvl2	2	(112,106)	2
cv21	3	(46,130)	7

Table 3

GLM Estimates for Experiment Treatments

Source	Sum of Squares	DF	MS	F	P
Period	34.59	1	34.59	.076	.785
Configuration	718.69	1	718.69	1.572	.219
COST	1738.94	2	869.50	1.902	.166
Error	14171.45	31	457.14		

Figure 1

Single Period Voting Game With Generic Outcomes to Players

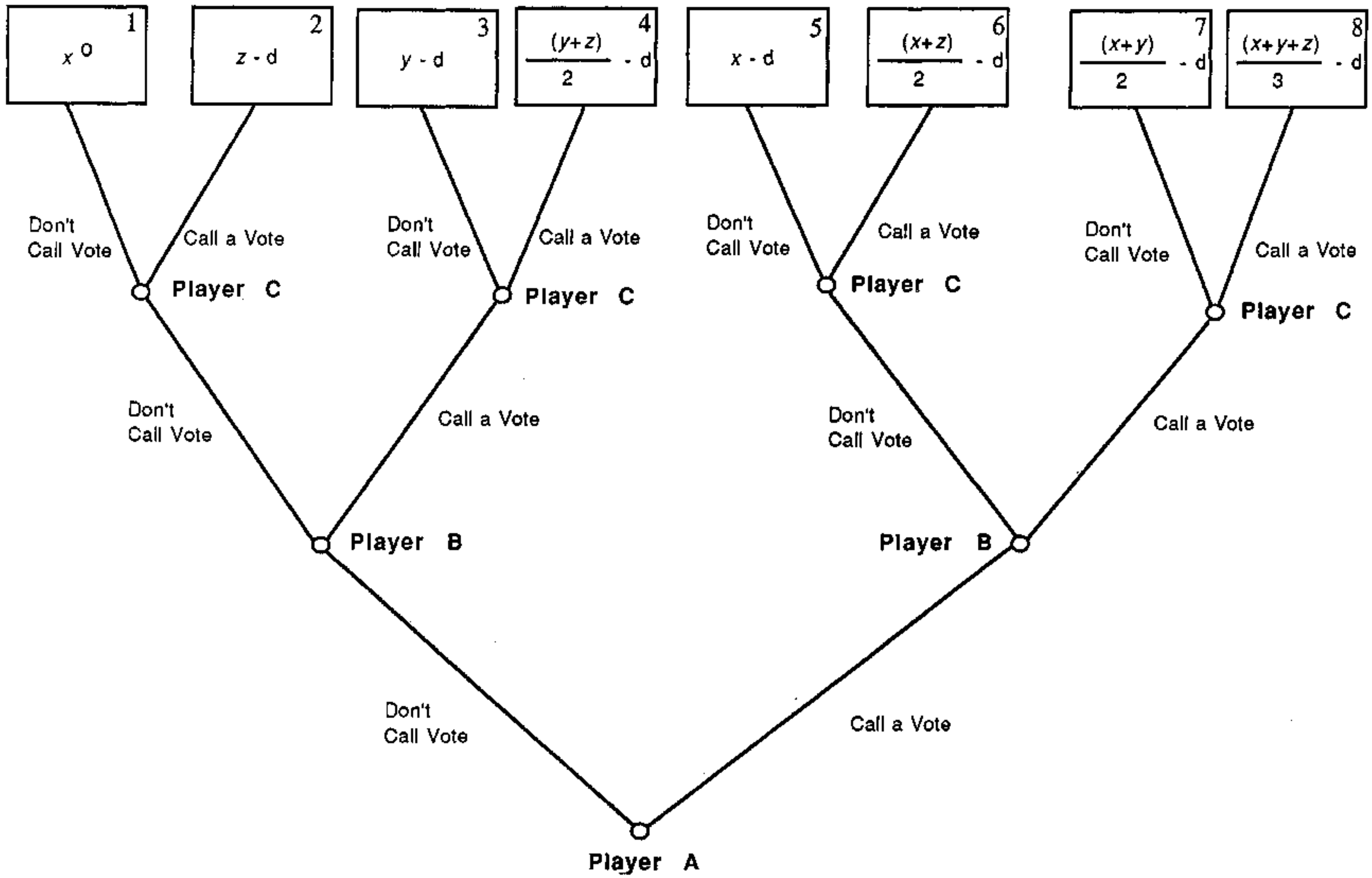


Figure 2

Subgame Generic Outcomes for the Two Stage Game

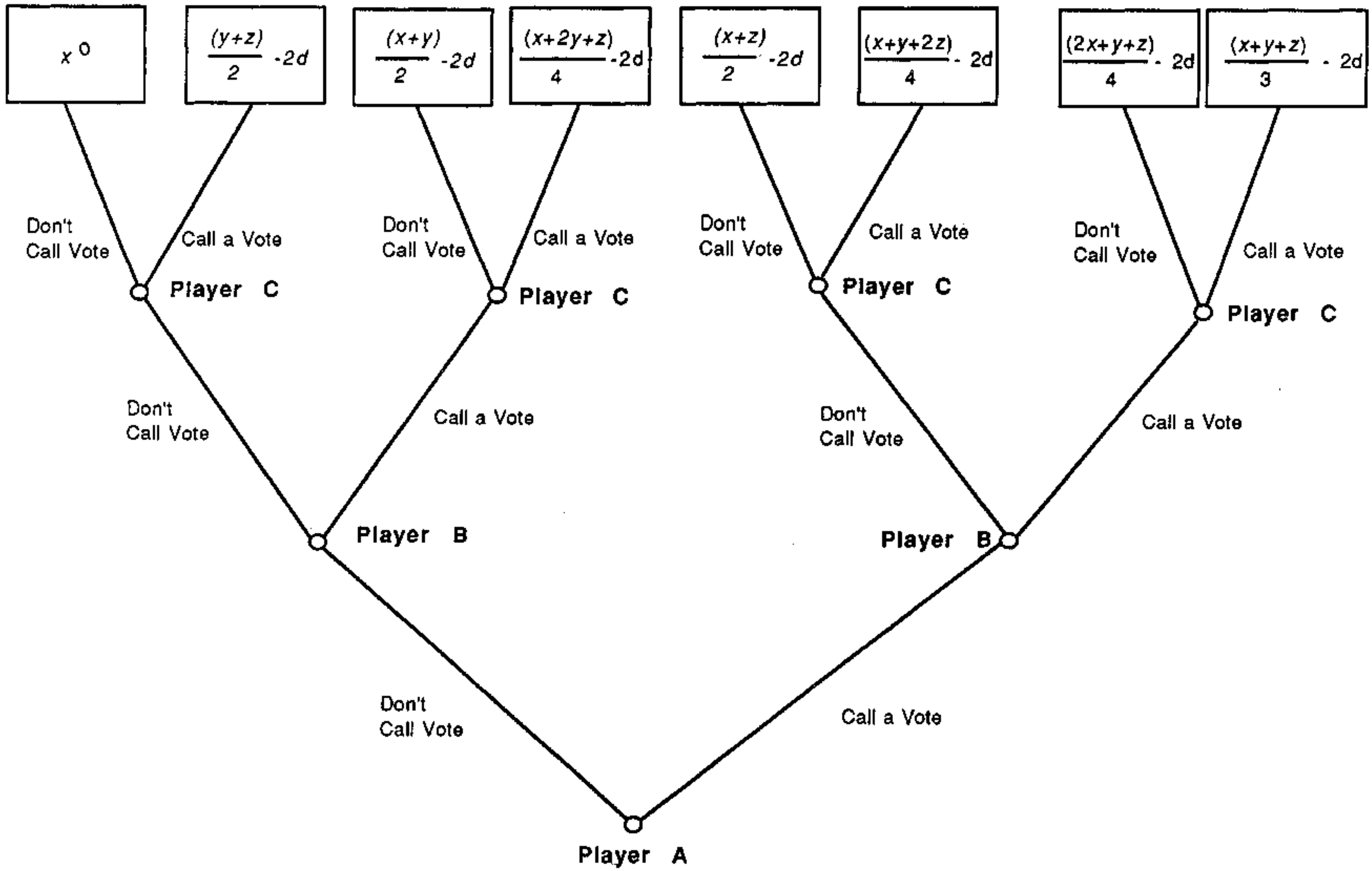


Figure 3

Outcomes for Core Configuration by Cost Treatment

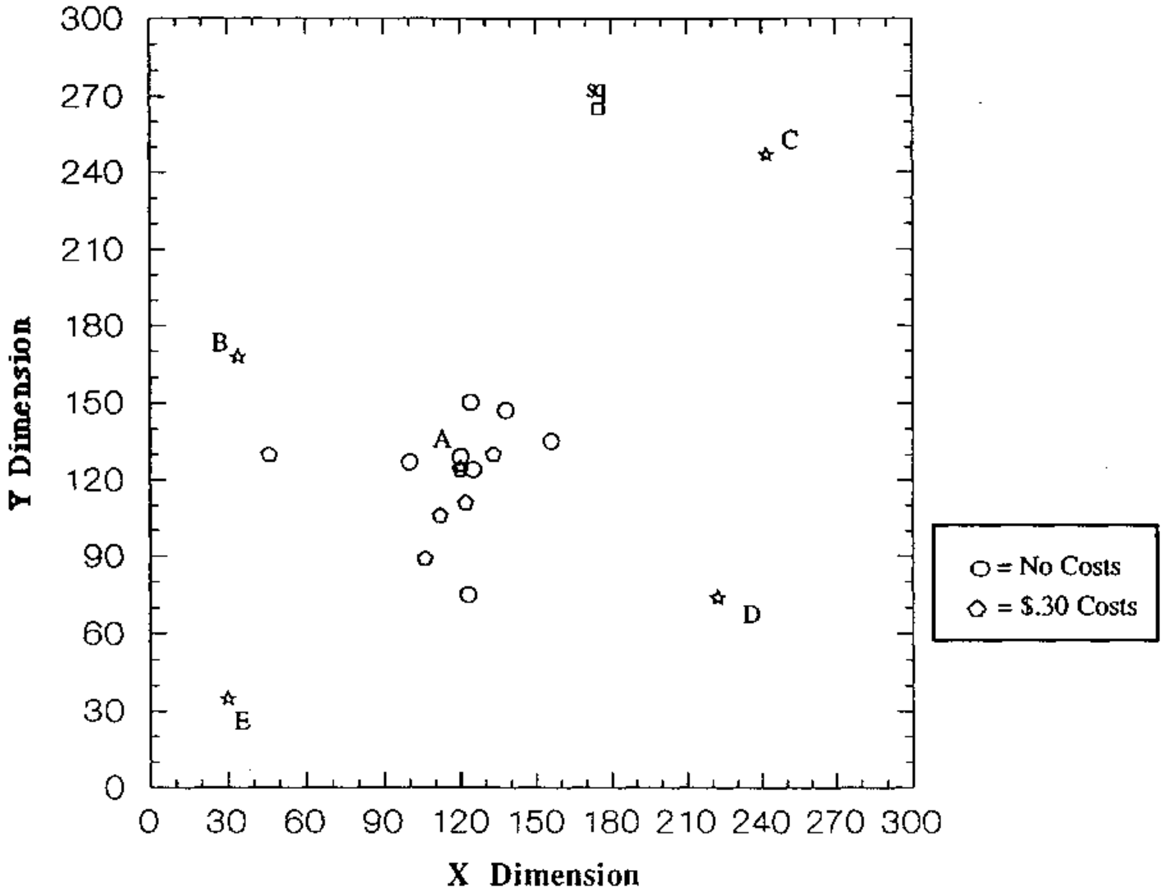


Figure 4

Outcomes for Star Configuration by Cost Treatment

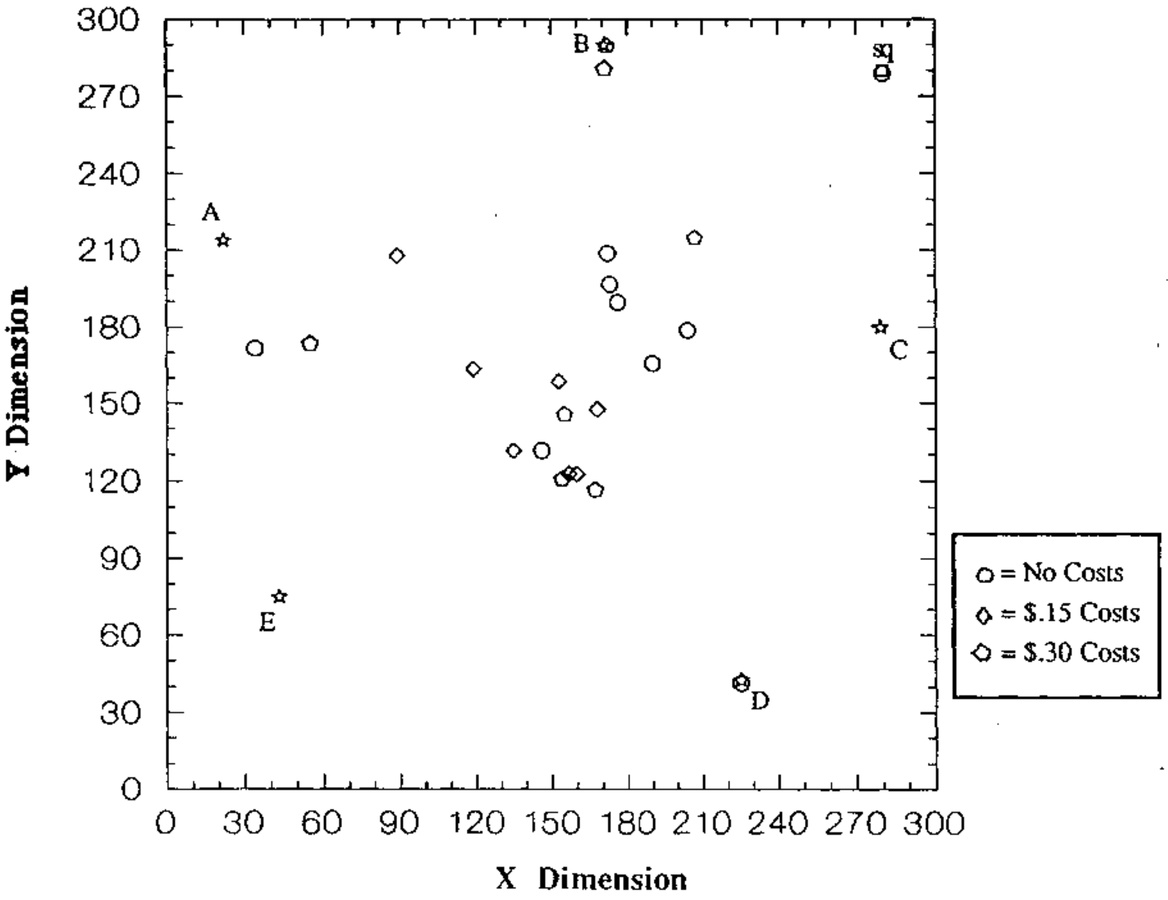


Figure 5

Estimated Probabilities by Cost Treatment for Adjournment Votes

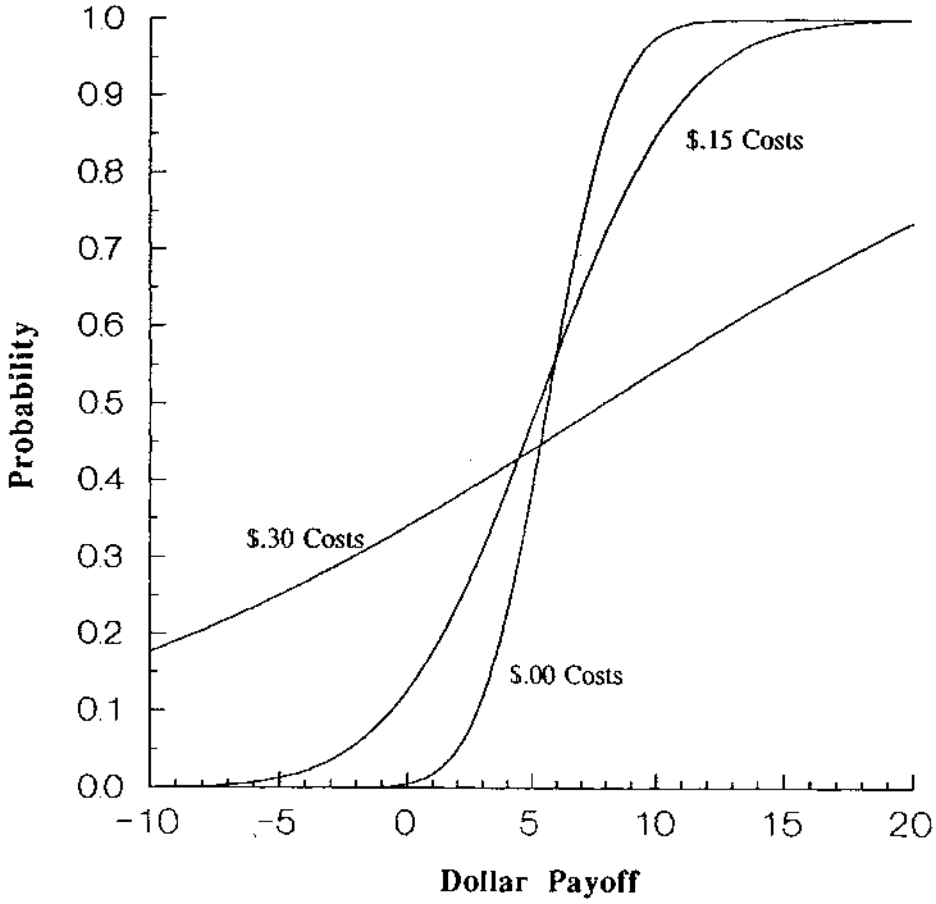
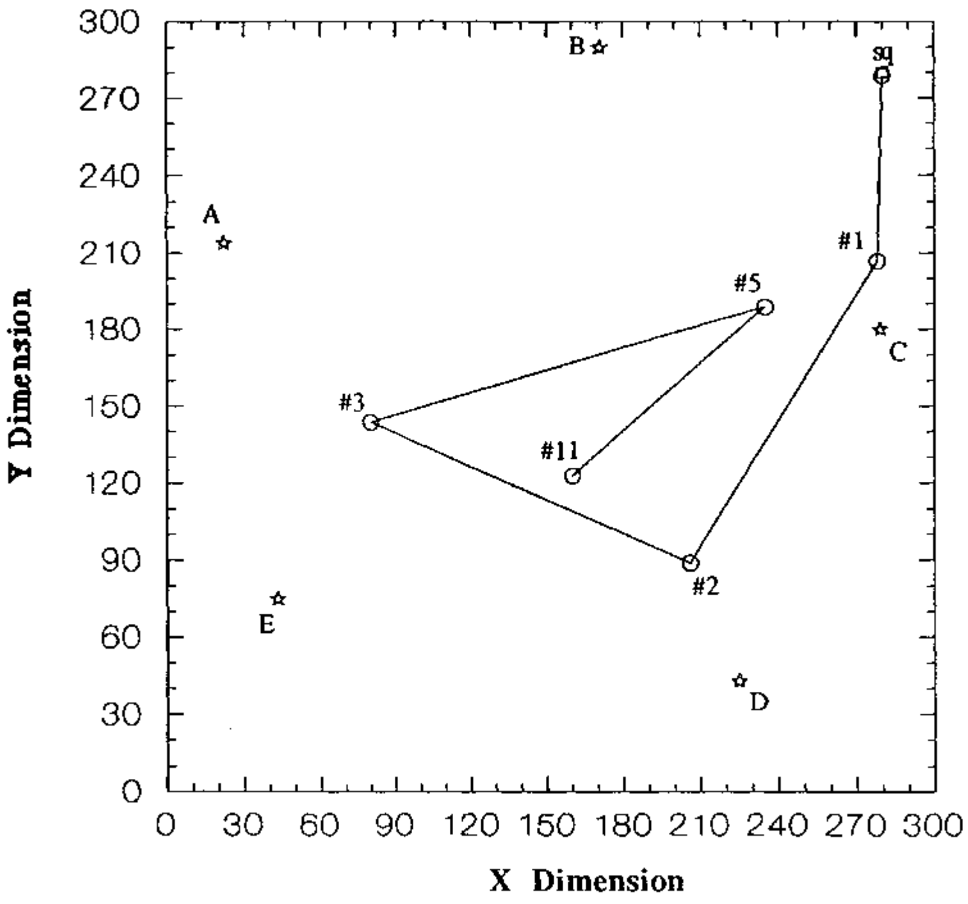


Figure 6

Agenda Trajectory for Trial CV20



Appendix

Theorem 1: For $\mathbf{d} \geq 0$, $x^o \in E(x)$ if and only if $\bigcup_{i \in N} P_i^c(x^o) \bigcap W(x^o) = \varnothing$

Suppose $x^o \neq E(x)$ but $\bigcup_{i \in N} P_i^c(x^o) \bigcap W(x^o) = \varnothing$. If $x^o \neq E(x)$ then there exists some alternative x^* that can defeat x^o.

First, suppose that $W(x^o) = \varnothing$. This implies there is no $S_j \in S$ that can defeat x^o and this contradicts our assumption that $x^o \neq E(x)$. However, we know that $W(x^o) = \varnothing$ holds only in very rare circumstances (when x^o is the Core -- see Cox, 1987) and this represents a special case, regardless of the size of costs.

Second, suppose $\bigcup_{i \in N} P_i^c(x^o) = \varnothing$. This implies that for any $x^* \in P_i(x^o)$ it is the case that $u^i(x^*) - \mathbf{d} < u^i(x^o), \forall i \in N$. But this means that every $P_i^c(x^o) = \varnothing$ and there exists no $x^* \in P_i^c(x^o)$. Consequently, x^* will not be proposed, since no individual will gain from calling a vote. Because x^* is never proposed it does not defeat x^o, thereby contradicting our assumption. However, this is also a rare circumstance, occuring only when $\mathbf{d} > \max_{x^* \in P_i(x^o)} u^i(x^*) - u^i(x^o), \forall i \in N$. Since the maximum utility for any actor is that actor's ideal point, then all ideal points must be distributed within $\mathbf{d}$ units of x^o.

Finally, suppose that $\bigcup_{i \in N} P_i^c(x^o) \neq \varnothing$ and $W(x^o) \neq \varnothing$ but that $\bigcup_{i \in N} P_i^c(x^o) \bigcap W(x^o) = \varnothing$. Pick any $x^* \in W(x^o)$. Then for at least one winning coalition, S_j, and for all $i \in S_j$, $u_i(x^*) > u_i(x^o)$. This means for at least one S_j, $x^* \in \bigcap_{i \in S_j} P_i(x^o)$. Suppose that costs are excessive, so much so that $\mathbf{d} > u_i(x^*) - u_i(x^o), \forall i \in N$, but not so large that $\bigcup_{i \in N} P_i^c(x^o) = \varnothing$. If $x^* \in W(x^o)$.and $x^* \in \bigcup_{i \in N} P_i^c(x^o)$ then $x^* \in \bigcap_{i \in S_j} P_i^c(x^o)$ for some S_j. But, because $\mathbf{d} > u_i(x^*) - u_i(x^o), \forall i \in N$, we have $x^* \notin \bigcap_{i \in S_j} P_i^c(x^o)$, a contradiction.

Subgames.

In this part of the appendix we develop the subgames for each alternative. We do so in order to facilitate discussions in the text and below. We begin from the premise that in this finite alternative game there are exactly three subgames and each is derived from the selection of a specific alternative. For instance, if alternative x succeeds, then each actor must calculate her best response to the actions of others when deciding to call an alternative to a vote. Ignoring for now the size of the costs, suppose actors consider a specific alternative which is now the status quo at the kth stage of the game. Figure A1 represents the games for each of the alternatives. The topmost game tree illustrates the subgames for all players if x is the current status quo. The branch in which no one calls a vote results in the game ending at the current status quo. Since this is the kth stage of the game, an individual's payoff will be $u_i(x)-(k-1)d$. That is, actors will receive their value for alternative x minus the costs absorbed prior to the kth stage of the game. Solving, via backward induction, actor C will always choose to call a vote. C's choice at each node is represented by the heavy black lines on the figure. At the leftmost pair of outcomes, C would choose to call a vote so long as costs are trivial -- that is, so long as $d < u_C(z)-u_C(x)$. In the middle two nodes it is easy to show that C would always prefer to call a vote. In expectation it must be that $\frac{u_C(x)+u_C(z)}{2}-kd > u_C(x)-kd$. But this amounts to the requirement that $u_C(z) > u_C(x)$ which is true by the preferences we have assumed for actor C. Finally, for the rightmost pair of nodes, it must be that $\frac{2u_C(x)+u_C(z)}{3}-kd > u_C(x)-kd$. But again, this reduces to $u_C(z) > u_C(x)$. For actor B on her left node, knowing what C will do, will not call a vote if $u_B(z)-kd > \frac{u_B(x)+u_B(z)}{2}-kd$. Since this reduces to $u_B(z) > u_B(x)$ and given that B prefers z to x, she will not call a vote at this node. The same holds true at the right node where B prefers a one-half chance of z to a one-third chance of z. Consequently, she will not call a vote. Finally, actor A will call a vote, resulting in x being brought forward with half a chance versus not being brought forward at all. This may seem a bit strange, since A is bringing the status quo to a vote. Yet, this is a protective measure on the part of A to ensure that the status quo has some chance of remaining, since z will defeat it with certainty.

The thick line traced from an outcome back to the first player's move constitutes the equilibrium for the subgame. When beginning with alternative x, the expectation for the subgame, with trivial costs, is $\frac{u_i(x)+u_i(z)}{2}-kd$. In the same manner equilibria can be calculated for each of the subgames beginning with alternatives y and z (they are $\frac{u_i(x)+u_i(y)}{2}-kd$ and $\frac{u_i(y)+u_i(z)}{2}-kd$, respectively).

It was noted above that for the subgame where x is the initial alternative, non-trivial costs result in a strategy switch by C when $d > u_C(z)-u_C(x)$. For the y subgame A switches strategies when $d > \frac{u_A(x)+u_A(y)}{2}$. Finally, for the z subgame, B switches strategies when $d > \frac{u_B(y)+u_B(z)}{2}$. These costs are independent of any number of stages in the game.

<Figure A1 About Here>

Proposition 1: For the n-stage game, the expectation for always calling a vote is $\frac{u_i(x)+u_i(y)+u_i(z)}{3}-nd$.

First consider the outcome from the single stage game taken from Figure 1 where all actors play a strategy of calling a vote. This gives $\frac{u_i(x)+u_i(y)+u_i(z)}{3}-d$. If alternative x comes to the floor (with probablity one third), its subgame in the second stage is $\frac{u_i(x)+u_i(z)}{2}-2d$. That is, either x or z will subsequently win, with the costs doubled. As noted above, the equivalent subgames for alternatives y and z are $\frac{u_i(x)+u_i(y)}{2}-2d$ and $\frac{u_i(y)+u_i(z)}{2}-2d$ respectively. In expectations at the second stage we have:

$$\frac{1}{3}\left(\frac{u_i(x)+u_i(z)}{2}-2d\right)+\frac{1}{3}\left(\frac{u_i(x)+u_i(y)}{2}-2d\right)+\frac{1}{3}\left(\frac{u_i(y)+u_i(z)}{2}-2d\right)=\frac{u_i(x)+u_i(y)+u_i(z)}{3}-2d$$

By the same reasoning, at the third stage, actors will hold the following expectations:

$$\frac{1}{3}\left(\frac{u_i(x)+u_i(z)}{2}-3d\right)+\frac{1}{3}\left(\frac{u_i(x)+u_i(y)}{2}-3d\right)+\frac{1}{3}\left(\frac{u_i(y)+u_i(z)}{2}-3d\right)=\frac{u_i(x)+u_i(y)+u_i(z)}{3}-3d$$

By induction, for the n<u>th</u> stage, expectations are:

$$\frac{1}{3}\left(\frac{u_i(x)+u_i(z)}{2}-nd\right)+\frac{1}{3}\left(\frac{u_i(x)+u_i(y)}{2}-nd\right)+\frac{1}{3}\left(\frac{u_i(y)+u_i(z)}{2}-nd\right)=\frac{u_i(x)+u_i(y)+u_i(z)}{3}-nd$$

It is worth noting that the likelihood of any alternative being brought to the floor remains unchanged. It is the costs to voting that change and these are strictly a function of the number of voting stages.

Proposition 2: For any alternative selected in the first stage, as the number of stages grows very large, the expected outcome converges on an equal probability of all alternatives.

Suppose at the first stage Actors A and B choose not to call a vote and C calls a vote. For the moment we will ignore costs. This would result in alternative z defeating the status quo (see Figure 1 in the text). Now suppose in the second stage all actors chose strategies yielding the subgame for alternative z. In the second stage, in expectations, this yields $\frac{u_i(y)+u_i(z)}{2}$. Looking forward to the third stage, in expectations, actors choose strategies that yield a one half chance of the subgames for alternatives y and z. In turn this gives $\frac{u_i(x)+2u_i(y)+u_i(z)}{4}$. In the fourth stage, expectations are

$$\frac{1}{4}\left(\frac{u_i(x)+u_i(z)}{2}\right)+\frac{1}{2}\left(\frac{u_i(x)+u_i(y)}{2}\right)+\frac{1}{4}\left(\frac{u_i(y)+u_i(z)}{2}\right)=\frac{3u_i(x)+3u_i(y)+2u_i(z)}{8}.$$

Generally, expectations for the n<u>th</u> stage are given by

$$\frac{1}{3}\left(\frac{[2^{n-1}u_i(x)]+f(x)}{2^{n-1}}\right)+\frac{1}{3}\left(\frac{[2^{n-1}u_i(y)]+g(y)}{2^{n-1}}\right)+\frac{1}{3}\left(\frac{[2^{n-1}u_i(z)]+h(z)}{2^{n-1}}\right),$$ where

$f(x)=\left[(1-\lceil n \bmod 3\rceil)+2(1-\lceil(n-3)\bmod 6\rceil)\right]u_i(x)$ and $g(y)$ and $h(z)$ are variants thereof. Taking the first term, containing $u_i(x)$, in the equation it is easy to show that as the number of stages grows very large, the expectation for x converges on $\frac{u_i(x)}{3}$.

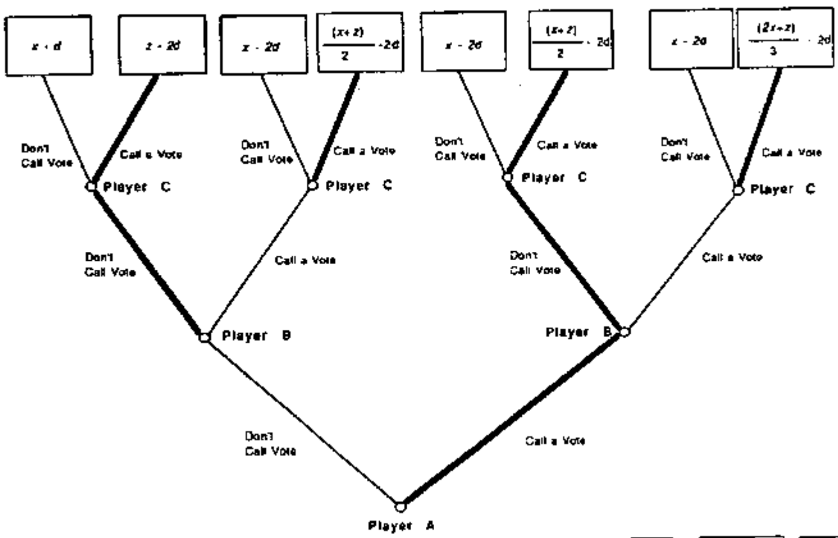
What happens as $\lim_{n\to\infty}\frac{1}{3}\left(\frac{[2^{n-1}u_i(x)]+f(x)}{2^{n-1}}\right)$? This term can be broken into two parts: $\frac{1}{3}\left(\frac{2^{n-1}u_i(x)}{2^{n-1}}\right)$ and $\frac{1}{3}\left(\frac{f(x)}{2^{n-1}}\right)$. In the first part, the terms 2^{n-1} cancel, leaving $\frac{u_i(x)}{3}$. In the second part of the equation, the numerator oscillates between -1, +1 and 2, depending on whether the stage is even, odd, or part of the sequence beginning from 2 and increasing by 3 units. For the denominator as $n \to \infty$ then $2^{n-1} \to \infty$. For this second part of the term, it is the case that $\lim_{n\to\infty}\frac{1}{3}\left(\frac{f(x)}{2^{n-1}}\right) = 0$. Therefore the first term converges to $\frac{u_i(x)}{3}$. A similar story is true for the remaining terms in the equation for the n<u>th</u> stage expectations. This leaves the expectations for a very large number of stages to converge on $\frac{u_i(x)+u_i(y)+u_i(z)}{3}$.

It is worth noting that the case given above involves beginning from a single proposal z. Similar demonstrations could be made beginning with any node on Figure 1 or Figure 2.

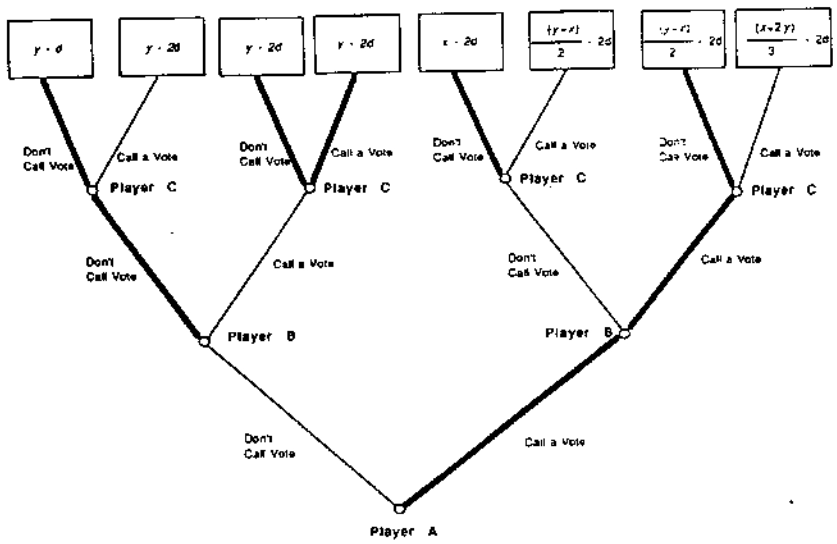
Figure A1

Subgames for Different Status Quo

Subgames Where X is the Current Status Quo



Subgames for Y as the Current Status Quo



Subgames When Z is Current Status Quo