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*Majoritarian Incentives, Pork Barrel Programs, and Procedural Control**

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Inherent in majority rule institutions is the incentive to particularize benefits and to collectivize costs, and this majoritarian incentive can lead to the adoption of economically inefficient distributive programs. These inefficient, or pork barrel, programs are often said to occur under a norm of universalism in which benefits are distributed among all legislative districts. The distribution of particularistic benefits is studied in the context of a legislative model that reflects the sequential nature of proposal making and voting. The set of distributive programs that a legislature will adopt in a perfect Nash equilibrium is characterized, and although inefficient programs will be adopted, the distribution of benefits is majoritarian and not universalistic. The set of programs that will be adopted depends on the amendment procedure used by the legislature, and the set corresponding to a closed rule that prohibits amendments includes very inefficient programs. Through the use of procedures, however, the legislature is able to control the extent of the inefficiency. For example, allowing amendments under an open rule limits, but does not eliminate, the inefficiency of the programs that would be adopted by the legislature. From an *ex ante* perspective, the legislature prefers an open rule to a closed rule for those policy jurisdictions in which inefficient programs can be expected to be proposed.

Introduction

Distributive policies often allow the concentration of benefits and the collectivization of costs,[1] and certain of these programs, commonly referred to as pork barrel programs, are believed to have social costs that exceed their social benefits.[2] In addition to economic inefficiency, these programs are frequently viewed as governed by a "universalism norm" under which benefits are distributed to most, if not all, political jurisdictions rather than to a minimal majority of districts, which the majoritarian structure of the political institution allows and Riker's (1962) size principle predicts.[3] Explanations of this pattern of inefficient programs and universalism fall into three broad classes.[4] The first identi-

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[1]Lowi (1964) refers to such policies as distributive in his typology of distributive, regulatory, and redistributive policy domains.

[2]The term "pork barrel program" will be used to refer to an economically inefficient distributive program.

[3]Mayhew (1974) discusses the universalism tendency in Congress.

[4]Collie (1988a) surveys the theory of distributive policy with a focus on explanations of minimal winning versus universalistic coalitions. The focus here is on the conjunction of the distribution of benefits, legislative procedure, and the inefficiency of programs.

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fies political, in addition to economic, benefits associated with the programs and concludes that such programs have a political rationale even if they have no economic rationale. The second is based on the illusion that such programs provide identifiable benefits but have costs that either are not understood or are underestimated by voters. The third places restrictions on the set of alternatives as a means of generating a universalism norm and/or pork barrel programs.

This paper provides an explanation for pork barrel programs and for the distribution of benefits among legislative districts without reliance on a distinction between political and economic benefits, a form of illusion, or restrictions on the set of alternatives. That is, the benefits from the program, whatever their nature or source, can be less than the costs, or the taxes, required to fund the program. The electorate and the legislators who represent them are assumed to be rational, to know the costs and benefits, and to understand the full consequences of their behavior. The explanation presented for the adoption of inefficient programs thus is based solely on the majoritarian incentives created by district-specific preferences and majority rule as intermediated by the institutional procedures that govern proposal making and voting in a simple model of a legislature. Since inefficient programs can be expected in this setting, the legislature might seek to control that inefficiency through the choice of the procedures it uses to govern consideration of programs.[5]

The theory is an application of recent work by Baron and Ferejohn (1989a, 1989b) and Baron (1989), who study a model reflecting the sequential nature of legislative action as structured by the rules employed to govern proposal making, amending, and voting. The theory is noncooperative, and members of the legislature are assumed to be unable to make credible commitments to act contrary to their interests either at the time they are to vote on a proposal or when they have an opportunity to make a proposal. An inability to commit in this manner implies that members will act in accord with their preferences and their expectations about what will result in the future if no program were to be adopted in the current session. Those expectations are in turn structured by institutional characteristics and procedures.[6]

The theory seeks to answer three questions, the first two of which pertain to policy and the third pertains to procedure: (1) in such a setting, why would a legislature adopt a pork barrel program that has costs that exceed its benefits? (2) how in that event benefits would be distributed among legislative districts? and (3) how the legislature may limit the inefficiency of pork barrel programs through institutional procedures that govern amendments?

The approach taken to the first question is to identify, in terms of their costs

[5]For example, an open rule that allows amendments to proposed programs will be shown to reduce, but not eliminate, the inefficiency of the programs that the legislature would adopt.

[6]The analysis is thus in the spirit of the approach initiated by Shepsle (1979) but differs in methodology.

and benefits, the set of programs that the legislature will adopt. A critical political benefit-cost ratio is derived and provides a lower bound on the extent of the inefficiency of the set of programs that could be adopted. That ratio is a function of the size of the legislature, a parameter of the preferences of members, and the procedures employed by the legislature to govern amendments. In accord with the intuition typically associated with majority rule, the source of inefficient programs is the collectivization of costs and the majoritarian incentive to distribute benefits among the minimal number of districts needed to secure passage. Although in equilibrium benefits are distributed among a minimal majority of districts, the distribution is unequal among those districts, with the district of the member who made the proposal having the largest share.

Since inefficient programs are expected in this majoritarian setting, a legislature would be expected to attempt to moderate those incentives. Such measures could be of two forms: behavioral and institutional. Behavioral measures might include attempts to develop norms or patterns of behavior motivated by collective interests rather than by individual interests. Such norms would presumably pertain to the proposal-making and voting strategies of members and would be intended to restrict those strategies so as to serve some collective interest. To be credible, however, norms should be founded on sequentially consistent expectations about the responses of others to one's actions. Those expectations may, for example, arise from the use of strategies that penalize a member for taking actions that are contrary to the interests of others.[7] In contrast, norms that might be established by an *ex ante* agreement among members may not be sequentially rational if when members have the opportunity to act they prefer to deviate from the agreement because their *ex post* incentives differ from their *ex ante* incentives. In the theory presented here, the strategies of members are required to be sequentially rational so that at each point in the legislative process those strategies are best responses to the strategies of other members.

Rather than focusing on norms that restrict strategies as a means of limiting the inefficiency of distributive programs, institutional procedures will be considered that entitle members with certain rights to respond to the actions of others. The institutional procedures considered allow amendments to proposals, and although such procedures may not prevent inefficient programs, they can limit the extent of the inefficiency. In particular, assigning an open rule to proposals is a simple means of precluding from adoption certain of the inefficient programs the

[7]In their Proposition 2, Baron and Ferejohn (1989a) provide an internally consistent theory that may be interpreted as the establishment of a norm based on an infinitely nested configuration of punishment strategies. Such strategies, however, can support as an equilibrium any of the alternatives before the legislature and thus have no predictive power. Furthermore, the strategy configurations that support the equilibrium may not be robust in a legislature in which membership may change as a result of elections or members incur costs associated with being prepared to implement complex punishment strategies.

legislature would adopt under a restrictive procedure. This provides an explanation for the use of an open rule in, for example, committee jurisdictions in which inefficient programs might be anticipated.

The theory presented here rests on members' expectations about future behavior in the event that a proposed program is rejected. In deciding whether to vote for or against a proposal, a member must compare the consequences resulting from adoption of the proposal with what can be expected if the proposal is rejected and the legislature moves to the next session in which some other proposal can be expected to be made. When a proposal has been made, a member will vote for it not just if it will provide benefits that exceed that member's share of the tax burden but instead will vote for it if it provides benefits that are at least as great as the tax share plus the expectation of the outcomes that can result in the equilibrium in the subgame that would commence if the current proposal were defeated. Those expectations pertain both to the proposals that can be anticipated in the future if the present one fails and to how members can be expected to vote on those proposals. In particular, if members expect that some proposal will be adopted in the future, they will vote for the current proposal if it is at least as attractive as the proposal they anticipate will pass in the future, even though both the current proposal and the proposal anticipated in the future have costs that exceed their benefits.

Although a subgame may have multiple equilibria, the theory presented here is based on stationary equilibria. That is, at any point in the legislative process, members are assumed to expect that if in a future session they were to reach a point at which the structure of the subsequent subgame is the same then as it is at the present, members will act as they find it in their interest, given those expectations, to act at the present. This restriction pins down expectations, and the resulting stationary equilibrium provides answers to the questions posed above. Justification for a focus on stationary equilibria is given below.

The next section surveys the theoretical literature on pork barrel programs, and the model is introduced in the subsequent section. Then, the set of pork barrel programs that can be adopted under a closed rule is characterized, demonstrating that inefficient programs can be adopted as a consequence of majoritarian incentives. Institutional means of mitigating those majoritarian incentives are then considered with an emphasis on the role of amendment procedures. Conclusions are offered in the final section.

The Literature: An Interpretation of the Theories

The theoretical research on distributive policies has recently been surveyed by Collie (1988a, 1988b), but the interpretation of that literature given here is somewhat different.[8] The theory presented here does not rely on, but can accom-

[8]The empirical literature on distributive and pork barrel programs is vast, and only a small portion of it will be mentioned here because the emphasis is on theoretical explanations for pork

modate, the traditional explanations for pork barrel programs. The first class of explanations is based on a distinction between economic and political benefits that result from project expenditures that provide political benefits to members of the legislature. Shepsle and Weingast (1981, 1984) and Weingast, Shepsle, and Johnsen (1981) make such a distinction by arguing that economic costs, such as expenditures for construction of facilities, can provide political benefits when, for example, workers on a construction project earn rents when labor markets are not perfectly competitive. A distinction between political and economic benefits can explain economically inefficient programs and, depending on the magnitude of the political benefits, can be consistent with projects being funded in all districts.

Niou and Ordeshook (1985) criticize this distinction by arguing that rents are economic benefits and treating them also as political benefits amounts to double counting. A distinction between political and economic benefits does not involve double counting to the extent that programs provide targeted benefits or expenditures that serve as an (imperfect) substitute for patronage that has political, and particularly electoral, benefits. To the extent that the benefits and expenditures on a program can be targeted to those constituent or interest groups that are likely to be politically active (e.g., more likely to vote and/or to make campaign contributions), political benefits can be generated. Such politically targeted benefits can explain economically inefficient distributive programs and can be consistent with universalism.[9]

An alternative explanation for the adoption of pork barrel programs is that constituents or voters suffer from an illusion in the sense that they recognize the benefits that the projects in their districts provide, but they fail to recognize the cost they bear because of the projects funded in other districts. This form of explanation is distinguished from the divergence of political benefits from economic benefits and the targeted-benefits–dispersed-costs explanations because it pertains to the case in which all constituents receive benefits that are exceeded by the tax cost they actually bear. This explanation must find its coherence in a psychological theory of perception rather than in the theory of rational behavior. The remainder of this section focuses on theories that are based neither on political benefits nor on illusion.

The fundamental intuition from the social choice literature is that empha-

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barrel programs. Ferejohn (1974) studied rivers and harbors programs and found that omnibus legislation distributed projects in 75% to 90% of the districts. Arnold (1979) analyzed the expansion of the model cities program as a result of district-specific incentives and emphasized the role of the bureaucracy in building support for the program. Murphy (1974) analyzed the programs developed by the House public works committee, and Cox and Tutt (1984) studied the development of a universalism norm in the Los Angeles County Board of Supervisors.

[9]Explanations based on targeted political benefits and dispersed costs resulting in political support for incumbents is a variant of Olson's (1965) theory of active interest groups.

sized by Buchanan and Tullock (1962): majority rule allows the concentration of benefits and the collectivization of costs.[10] From the perspective of social choice thoery as applied to programs with perfectly divisible, particularistic benefits and transferrable utility, any inefficient pork barrel program can be defeated by some less inefficient program and hence by the grand coalition, which prefers no program to any inefficient one. Even if a program provides benefits that exceed the costs, the cooperative game has no core, so the theory provides no prediction. Riker's (1962) size principle states, however, that, if some program were to be adopted in a constant-sum game, a majority-rule legislature would allocate divisible, particularistic benefits among a minimal majority of districts.[11]

Weingast (1979) considers a one-shot distributive game with nontransferable utility in which the alternatives are a set of n projects, each of which provides benefits to a single legislative district and has a tax cost that is distributed uniformly among legislative districts. The individual projects are each economically efficient, so the game is positive sum. He concludes that the core of this game consists of the set of minimal winning coalitions.[12] This result follows from the implicit assumption that some program of projects in at least a majority of districts will be adopted by the legislature, which is equivalent to assuming that the only feasible alternatives are those that defeat the status quo.[13] With this restriction, minimal winning coalitions cannot be defeated, and any supermajority coalition can be defeated by a minimal winning coalition.

Weingast (1979) then takes an *ex ante* perspective by placing the members of the legislature behind a veil of ignorance so that they do not know which minimal winning coalition will form. Each member of the legislature then prefers a universalistic program that includes all projects to a lottery over the possible minimal winning coalitions. This result follows directly from the assumption that the projects have benefits that exceed their costs, since increasing the size of the coalition increases the aggregate net benefits and makes the lottery

[10] In particular, see chapter 11 for an analysis based on cooperative game theory.

[11] See Schofield (1980) for alternative solution concepts for cooperative games that can give rise to coalitions larger than minimal size.

[12] For the case of perfectly discriminatory taxation, Buchanan and Tullock (1962, 164–65) show that inefficient pure public goods can be sustained as a solution of a negative-sum game. The goods considered in this paper are not public, and the tax distribution is taken to be fixed.

[13] A minimal winning coalition is, of course, defeated by a majority formed by any subset of that coalition plus members whose projects would not be approved. Any such coalition, however, is defeated by the status quo. This stripping process applies to both positive-sum and negative-sum games and is equivalent to showing that there is no core. Requiring that any program considered by the legislature defeat the status quo makes a minimal winning coalition invulnerable. This interpretation is due to Fiorina (1981). For an example similar to Weingast's model, Buchanan and Tullock (1962, 162) argue that with nontransferrable utility pork barrel programs can be adopted by a majority coalition, but as pointed out by Fiorina, the majority proposal is defeated by a proposal that strips from the bill one of the majority's projects.

more attractive. Thus, not knowing which minimal winning coalition will form, members prefer the program with the largest net benefits, which is the program in which all the projects are adopted.[14] Because each project has benefits that exceed its cost, Weingast's theory does not explain both universalism and inefficient pork barrel programs.

Weingast (1979) argues that universalism and inefficient programs can result if a norm of universalism develops at a time when efficient programs are available and persists when the set of available programs becomes inefficient. The norm persists because legislators will find themselves in a position in which each has an incentive to add a project in his or her district. Inefficient programs and a norm of universalism can then persist. This does not explain, however, why *ex post* the legislature cannot strip inefficient projects nor why *ex ante* the legislature cannot terminate the universalism norm in the same manner that it chose it.

Shepsle and Weingast (1981) extend Weingast's (1979) model by incorporating political benefits of project expenditures, externalities associated with the projects, and interdistrict effects resulting from project expenditures. With the same methodology used by Weingast, they provide a sufficient condition for a legislature to have an *ex ante* preference for universalism over a lottery among the possible minimal winning coalitions. They assume that all expenditures in a district count as political benefits, so if there were no externalities and no interdistrict effects, their condition reduces to a (weak) preference for universalism even when the projects provide no benefits. If there is no divergence between political and economic benefits, and no externalities or interdistrict effects, their condition is the same as that provided by Weingast. This theory thus relies on the political benefits of expenditures to predict both universalism and economic inefficiency and requires that the sum of economic and political benefits exceed the tax cost of the projects.

Fiorina (1981) argues that legislative procedures and structure can yield equilibria in distributive policy settings, such as that considered by Weingast (1979) and Shepsle and Weingast (1981) in which social choice theory yields no prediction. He considers an "amendment control process" that limits amendments to either adding, striking, or replacing a project in an omnibus bill. This legislative procedure leads to a prediction that a minimal winning coalition will result and that the specific coalition that will form is the one with the least-costly projects. He also considers a committee structure in which a germaneness rule allows committees to make proposals in this jurisdiction and concludes that this

[14]Collie (1988a, 438) argues that "the theoretical engine driving the universalistic result is uncertainty." The "increasing aggregate net benefits" condition, however, is necessary for the result. Uncertainty about which minimal winning coalition will form is only one means by which a universalism norm could result in this setting.

structure may result in no program being adopted. He then makes an *ex ante* veil of ignorance argument and concludes that universalism would be expected to result but that reciprocity among committees is a necessary condition for universalism. Although this theory is founded on the features of legislative structure and procedures, it does not provide an explanation for inefficient programs.

Ferejohn, Fiorina, and McKelvey (1987) present a noncooperative theory of distributive programs in which they explicitly incorporate voting in a model in which members of a legislature have available a finite number of projects each of which provides benefits to a single district and has costs that are collectivized. Members can propose programs, a set of projects, and can offer any amendment. Ferejohn, Fiorina, and McKelvey note, however, that legislative procedures typically identify the status quo as a privileged alternative with the property that any program must be voted against the status quo before it is approved.[15] Consequently, no program can be adopted that does not defeat the status quo. They then note that if there is a program that defeats the status quo and defeats all other programs that defeat the status quo, it will be approved under sophisticated voting for any amendment agenda; that is, it is an agenda-independent winner. They then give conditions under which such an agenda-independent winner exists. When it exists, it consists of projects in a minimal majority of districts, and those projects are the least costly set of projects with that property. They present two conditions under which such a winner exists. First, if each district has only one project, an inefficient program can be a winner if it provides benefits at least as great as half the associated costs. If each district has multiple projects, their second condition requires that the program provide sufficiently great benefits that the member does not care which other projects are funded in other districts.[16] Although this second condition is very strong, the theory does provide a prediction of a specific minimal majority and indicates the difficulty of obtaining, in a model with a minimal institutional structure, an equilibrium with both inefficient programs and universalism.

Niou and Ordeshook (1985) provide a noncooperative explanation of the simultaneous presence of a norm of universalism and inefficient expenditure programs. Legislators are assumed to maximize their probability of reelection, which is an increasing function of the benefits they deliver to their constituents. Constituents are able to choose between electing legislators who will seek efficient programs and legislators who will serve constituent interests by delivering benefits to them, given what other legislators do. If the benefits of a program are

[15]This descriptively realistic property breaks cycles in the dominance relation. That is, since no proposal can appear after the status quo in the agenda, any proposal defeated by the status quo is innocuous. Inefficient programs that defeat the status quo thus can be winners. This formalizes the implicit assumption made by Weingast and by Shepsle and Weingast.

[16]This issue will be addressed more precisely below.

at least half its costs, constituents have a dominant strategy of choosing a legislator who seeks to serve their interests even if the program is inefficient. This conclusion results because, in contrast to the social choice literature, districts (legislators) act noncooperatively and the choices available to them are restricted to two: seek efficiency or seek to provide benefits even if they are less than the cost. Voters thus are confronted with a choice between bearing their share of the collective cost but receiving no benefits or bearing those costs and receiving a share of the benefits. Given that a majority of the other legislators will seek to provide some benefits to their district, a district prefers to elect a legislator who will do likewise.[17] Universalism is thus supported as an equilibrium, although not uniquely so. That is, it is also an equilibrium to elect a legislator who seeks efficiency if a majority of other legislators seek efficiency. This theory is not based on a model of a legislature; instead, the legislature is assumed either to operate under a norm of universalism or to have outcomes determined by minimal winning coalitions. The theory presented here is based on an explicit model of legislative structure and behavior.

The Model

A unicameral, majority-rule legislature is considered with one member representing each of n ($n \geqslant 3$ and n odd) legislative districts. The legislature has before it an opportunity to undertake a particularistic distributive program that is characterized by the aggregate benefits B it provides and by the tax cost T required to supply it. The theory is not intended to determine which of several programs is best or how a given program could be made more efficient. Instead, the objective of the analysis is to characterize, as a function of B and T and of the procedures that characterize proposal making, amending, and voting, which programs the legislature will adopt and which programs it will not adopt.

The legislative process in each session begins with a member being selected at random by the chair to make a proposal for the distribution of the benefits B among the legislative districts. This may be thought of as the assignment of a member to the committee, represented as a unitary actor, that has jurisdiction over such distributive proposals. This neutral selection procedure is employed because it treats each member in the same manner and does not favor any particular set of programs. Once a proposal has been made, it is said to be on the agenda, and its disposal on the floor is governed by an amendment rule. Two amendment rules will be considered. The first is a closed rule, or a restrictive procedure, under which the proposal is immediately voted up or down. If it passes, the benefits are distributed, and the legislature has completed its task and

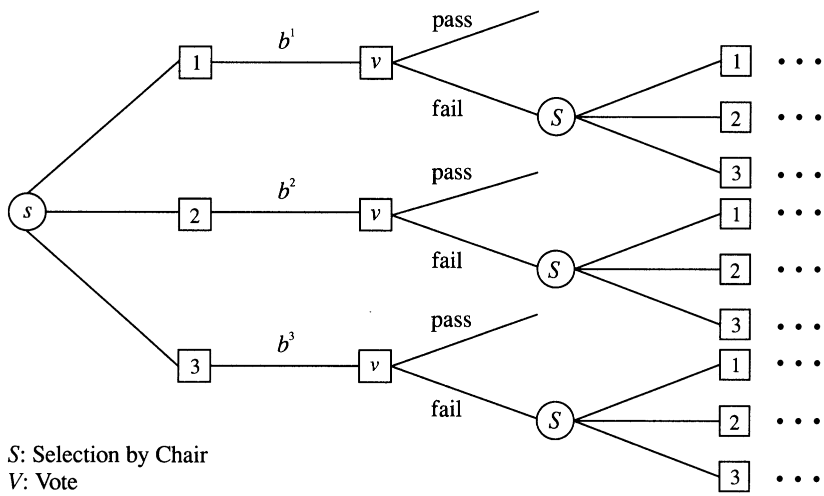
[17] More formally, a district that is pivotal has a dominant strategy of electing a legislator who will seek benefits.

adjourns. If it fails, the legislature continues to the next session in which a member is selected to make a proposal and the legislative process continues. Under a closed rule, an agenda never consists of more than a single alternative. The legislative process is illustrated in Figure 1 for the case of a closed rule.

The second amendment rule is a simple form of an open rule in which the proposal made by the member selected is subject to an amendment on the floor by one of the other members. That is, under a simple open rule, once a proposal is on the agenda, a member, other than the author of the proposal, is recognized and may either make an amendment (in the nature of a substitute) or may introduce a motion to close the amendment process. That motion is subject to a majority vote, and if it is successful, the proposal on the floor is then voted up or down. If that proposal is defeated, another member is selected to make a proposal and the process continues. If an amendment is proposed, the agenda consists of the proposal and the amendment. A vote on the proposal against the amendment is then required, and if the amendment wins, it is on the agenda at the beginning of the next session. Then, in that session another member, other than the author of the proposal on the floor, is recognized and may offer an amendment or may move that the amendment process be closed. Once the amendment process has been closed and a proposal has been adopted by the legislature, the benefits are distributed and the legislature adjourns.

This model is intended to be interpreted in the following manner. There is a population P^* of potential distributive programs, each of which is characterized by its benefit-cost ratio $B/T \in P^* = [0, \infty)$, that may come before the legislature. A draw from P^* is made and that program, characterized by its particular B/T, is then available for consideration by the legislature in accord with the process described above. That is, a member is selected to make a proposal for the distribution of B among the legislative districts. This program may be such that some proposal for the distribution of its benefits would be passed in equilibrium by the legislature, or it may be such that no proposal could be passed. The objective is to determine which programs would be adopted and which could not be and to explain how the benefits will be distributed among the legislative districts in those programs that would be adopted. The analysis thus will be conducted for a hypothetical program drawn from P^*, and a "critical political benefit-cost ratio" will be characterized as a function of the size of the legislature and a parameter of the preferences of members. Any program that has a benefit-cost ratio that exceeds this critical ratio would be proposed and approved by the legislature even if it is inefficient, and those that have a benefit-cost ratio below the critical level would not be proposed and thus would not be adopted. An empirical test of the predictions of this theory would thus examine a cross-section of possible programs and relate those programs to the critical ratio corresponding to the legislative procedures and to preferences.

Figure 1. Legislative Process: Closed Rule



More formally, a program in P^* is characterized by the total benefits B that it can provide and by its corresponding tax cost T, and a proposal is a bill specifying the allocation of those benefits and costs across legislative districts. The benefits may be thought of as resulting from a collection of perfectly divisible "projects" that have total benefits B and can be distributed in any manner among the n legislative districts. A distribution $b = (b_1, \ldots, b_n)$ of total benefits satisfies $b_i \geq 0$ and $\Sigma_{i=1}^{n} b_i \leq B$, so the set B of alternatives is $B = \{b \mid b_i \geq 0, i = 1, \ldots, n, \Sigma\, b_i \leq B\}$. The structure of the model is such that either all or none of the benefits will be distributed, so the tax burden of providing the benefits B is T. A program is economically efficient (neutral) (inefficient) if $B/T > (=) (<) 1$. The tax distribution is assumed to be fixed according to patterns of income and asset holding that are independent of how the benefits are distributed, and that distribution $t = (t_1, \ldots, t_n)$ is assumed to be uniform across the districts, so $t_i = (1/n)\,T$. A proposal passed by the legislature thus results in net benefits z_i for member i given by $z_i \equiv b_i - T/n$. That is, the net benefits to district i are the benefits b_i distributed to that district less its share of the total cost.

The strategies of members involve proposal making and voting. Since the tax distribution is fixed, a proposal can be represented as a distribution b. A history h_τ of the game at time τ is a record of the proposals made, who made them, the votes of all members, and what proposals, if any, are on the agenda. The set of possible histories at time τ is denoted H_τ. At a point τ in the legislative game at which proposals can be made, a pure strategy s_i^τ of member i is

$$s_i^\tau : H_\tau \rightarrow \mathrm{B}$$

and if a vote is called for at time τ, a pure strategy is[18]

$$s_i^\tau : H_\tau \rightarrow \{\text{yes, no}\}$$

A proposal strategy s_i^τ with the property that the $\Sigma_{j=1}^{n} b_j = 0$ corresponds to making no proposal. Members may choose randomizations of their pure strategies.

At the beginning of each session, a procedure as described above determines which of the members is selected to have the opportunity to make a proposal. The final structural element of the model is the amendment rule that determines whether and when an amendment can be made. All information about preferences, the program (B and T), and the structure of the legislature are assumed to be common knowledge.

The preferences of members of the legislature are assumed to be over the net benefits to their district and over when those benefits are received. Preferences $U_i(b, t, \tau)$ for an allocation of benefits b and a distribution t of taxes made in session τ are thus specified as

$$U_i(b, t, \tau) = \delta^\tau(b_i - t_i) \tag{1}$$

where $\delta \in [0, 1]$ is a common discount factor representing time preference. To simplify the analysis, the discount factor is assumed to be the same for all members.[19] Discounting takes place when the legislature moves to a new session.

A perfect Nash equilibrium is sought, so equilibrium strategies must be optimal for each member, given the strategies of other members, when restricted to each subgame. The perfectness requirement means that no member can commit to future actions that are not in his or her interest at the time at which the member is to act. Thus, a member is unable to commit not to make a proposal or to vote in a particular manner. Instead, members vote for or against a proposal based on the net benefits it would provide and on the expectation of the net benefits that could result if the proposal were defeated and the legislature moved to the next session. Similarly, a member will make a proposal if a majority will vote for it and if it provides him or her nonnegative net benefits.

The value $V(g, \tau) = (V_1(g, \tau), \ldots, V_n(g, \tau))$ of the subgame g that begins at time τ is the expectation of the distribution of benefits minus taxes that can result from the equilibrium play from that time on. The continuation value of rejecting a proposal and continuing to the next session is $\delta V(g, \tau)$. The focus

[18] Weakly-dominated voting strategies are ruled out.

[19] The parameter δ may also be viewed as a common probability of reelection for the member, which for the members of the House in recent elections has been close to one. With this interpretation, members are assumed to care only about the benefits delivered to their constituents while they are in office.

is on stationary equilibria that have the property that for times τ and τ', $V(g, \tau) = V(j, \tau')$ whenever g and j are structurally identical subgames. Two subgames are structurally identical if in each subgame the extant agenda, the sets of alternatives at every future time, and the sequence of moves are identical. If all subgames are structurally equivalent, as they are under a closed rule, the stationary value will be denoted as $V = (V_1, \ldots, V_n)$. The stationarity restriction is equivalent to requiring that, except for the extant agenda, the strategies are history independent, so members will make the same action in structurally identical subgames. That is, stationarity rules out the infinitely nested, contingent punishment strategies of the type shown by Baron and Ferejohn (1989a) to result in any distribution being supportable as a noncooperative equilibrium.[20]

In games with many equilibria that are supportable only by highly complex strategies, it seems reasonable for real players to begin their analysis by evaluating strategies that are simple to implement and that require modest degrees of rationality. Indeed, the more complex the game the more likely is it for players to focus on strategies with these properties. This suggests concentrating attention on equilibria that have a focal property of simplicity and limited rationality as discussed by Schelling (1960). Stationary equilibria have these properties, since they are simple and treat structurally equivalent subgames in an identical manner, even though the histories leading to them are different.[21] The notation is summarized in Table 1.

Pork Barrel Programs under a Closed Rule

The Consequences of Majoritarian Incentives

Member i will vote for a proposal b if and only if

$$z_i = b_i - t_i = b_i - \frac{T}{n} \geqslant \delta V_i \tag{2}$$

where δV_i is i's continuation value in the equilibrium for the subgame that begins if the proposal is defeated. The voting strategy of a member thus is based both on the benefits and tax burden associated with the current proposal and on his or

[20]The strategies required to support most distributions are very complex, however, and are composed of infinitely nested punishments that require members to calculate a strategy that specifies which action to take in response to every possible deviation at every possible node in the game. Those strategies also require members to have the capacity to keep track of every possible history of play. Yet in the actual play of the game (i.e., along the equilibrium path), the first proposal made receives a majority vote, and the game ends. Consequently, the infinitely nested punishments and the capacity to track every possible history are never used. This raises the issue of whether members would actually devise infinitely nested punishment strategies and develop the capacity to track every conceivable history.

[21]Current research with Ehud Kalai is intended to demonstrate that when simplicity and limited rationality are represented formally the only remaining equilibria have the stationarity property.

Table 1. Notation

B	total benefits to be allocated
$b = (b_1, \ldots, b_n)$	a proposal for the distribution of benefits; $b \in \mathrm{B}$
T	tax cost of providing benefits B
$t_i = T/n$	tax burden of district i
$z_i = b_i - T/n$	net benefits for district i
$U_i(b, t, \tau) = \delta^\tau(b_i - t_i)$	utility when benefits are distributed at time τ
δ	discount factor (closed rule)
δ_a	discount factor (open rule) with a amendments per session
$V_i(g, \tau)$	value of subgame g at time τ for member i
$\bar{V}$	stationary value for a closed rule
v_i	stationary value for an open rule
$R(n, \delta)$	critical political benefit-cost ratio for a closed rule
$R^p(n, \delta, \eta)$	critical political benefit-cost ratio for a closed rule and political benefits
η	proportion of expenditures that represent political benefits
$R^O(n, \delta_a)$	critical political benefit-cost ratio for a simple open rule
$P^C(n, \delta)$	set of programs adopted under a closed rule
$P^p(n, \delta)$	set of programs adopted under a closed rule and with political benefits
$P^O(n, \delta)$	set of programs adopted under a simple open rule

her expectations about future outcomes as summarized by the continuation value. It is important to note that if V_i were negative, the member would be willing to vote for a program that is economically inefficient as long as the benefits b_i exceed the sum of the tax cost t_i and the loss δV_i that he or she anticipates if the current proposal were to be defeated.

Each member understands that members will vote according to equation (2) and thus knows that he or she can make a proposal that will receive a majority of the votes. Since a proposal is voted up or down under a closed rule, it need attract the votes of only $(n - 1)/2$ other members, and each member will make a proposal that attracts the "least-costly" votes. If member k were to have a value V_k of the game lower than that of the other members, members when recognized would seek to attract the vote of member k. Understanding this, k would "hold out" for a larger share of the benefits, or equivalently, the other members would "bid up" the value of the game for member k. If that value V_k were above the value V_j for another member j, a member i would make a proposal to attract the vote of j. In equilibrium, the values of the legislative game for each member thus must be the same; that is, $V_i = \bar{V}, \forall\, i$, where $\bar{V}$ denotes the common value.[22] In making a proposal, the member selected will thus randomize proposals equally among the other members. Member i's proposal thus

[22] This may be proven formally by considering member i's randomization between attracting the vote of member j and attracting the vote of member k.

will allocate benefits of $(1/n)\ T + \delta\bar{V}$ to some $(n - 1)/2$ other members, 0 to the $(n - 1)/2$ remaining members, and will allocate $B - ((n - 1)/2)\ (T/n + \delta\bar{V})$ to his or her own district. The proposal of member i is thus a permutation of the proposal[23]

$$b = \left(B - \frac{n-1}{2}\left(\frac{T}{n} + \delta\bar{V}\right), \frac{T}{n} + \delta\bar{V}, \ldots, \frac{T}{n} + \delta\bar{V}, 0, \ldots, 0\right) \tag{3}$$

To determine the value $\bar{V}$ of the game, note that the probability is $(1/n)$ that member i will be selected to make the proposal in which case from equation (3) i will receive $B - ((n - 1)/2)(T/n + \delta\bar{V})$. The probability is $(n - 1)/n$ that a member j, $j \neq i$, will be selected to make a proposal. Then, there is a one-half probability that i will receive $(1/n)\ T + \delta\bar{V}$ of benefits and a one-half probability that i will receive no benefits in j's proposal. Since that proposal will be adopted, i will bear the tax burden (T/n). The value of the game to member i is thus

$$\bar{V} = \frac{1}{n}\left[B - \frac{n-1}{2}\left(\frac{T}{n} + \delta\bar{V}\right) - \frac{T}{n}\right] + \frac{n-1}{n}\left[\frac{1}{2}\left(\frac{T}{n} + \delta\bar{V} - \frac{T}{n}\right) + \frac{1}{2}\left(-\frac{T}{n}\right)\right] \tag{4}$$

Solving for $\bar{V}$ yields

$$\bar{V} = \frac{B - T}{n} \tag{5}$$

[23]The equilibrium proposal allocates benefits among a minimal majority of districts and allocates more to the district of the member whose proposal is selected than to the district of any other member. The difference D between the net benefits received in equilibrium by the proposer i and the net benefits received by the district of a member who votes for the proposal is

$$D = z_i - \delta\bar{V} = \frac{1}{2n}[B(2n - (n + 1)\delta) - T(2 + (n + 1)(1 - \delta))] - \frac{\delta}{n}(B - T)$$
$$= B\left[1 - \frac{\delta}{n}\frac{n + 1}{2}\right] - \frac{T}{n}(1 - \delta)\left(\frac{n+1}{2}\right)$$

which for $\delta = 1$ is

$$D = \frac{n-1}{2n}B$$

The member making the proposal thus captures the benefits $((n - 1)/2)(B/n)$ that under equal division would be received by the $(n - 1/2)$ members who receive zero in the successful proposal.

This value is supported by the proposal-making and voting strategies specified in equations (3) and (2), respectively.[24]

If the tax burden T exceeds the benefits B, the program is economically inefficient, but as indicated in equation (2), each member who receives $(T/n) + \delta\bar{V}$ will vote for the proposal. Thus, an inefficient program can be approved. This result obtains because from equation (2) each member understands that members will vote for a proposal that covers their share of the tax burden and their expectation, represented by $\delta\bar{V}$, of future outcomes if the current proposal were to be defeated. Note that a universalistic proposal will never be made when the program is inefficient, since in that case $z_i = (B - T)(1 - ((n - 1)/n)\delta) < 0$ when $B < T$.

To interpret this, it is useful to return to the discussion of expectations. The equilibrium is based on the stationarity restriction that requires that the value of every identical subgame be the same. Strategies are based on that value, but no restriction is placed on what that value is. Instead, the value is determined endogenously, given the expectations that members will choose the strategies in equations (2) and (3) that are consistent with that value and constitute a subgame perfect equilibrium. That is, a member j recognizes that if the current proposal is defeated some member will in the next session have an opportunity to make a proposal and, reasoning as above, will make a proposal that is a permutation of the current proposal.[25] The value of the subgame commencing upon defeat of the current proposal will, given the stationarity restriction, be $\bar{V}$, and hence member j is willing to vote for the current proposal. These expectations are rational provided that members can be expected to make a proposal in future subgames. In this sense the theory provides an endogenous explanation of the formation of expectations.[26]

In contrast to social choice theory, an equilibrium exists here because proposals are considered sequentially. In voting, each member considers only the current proposal and what can be anticipated to happen in the future when other proposals will be made and voted on. This means that under a closed rule no member has an opportunity to offer a counterproposal that would strip benefits and costs from the proposal on the floor. This is inessential, however, since, as will be demonstrated in the next section, when a counterproposal can be made under an open rule its author prefers to redistribute benefits in his or her favor rather than to strip benefits from the proposal on the floor.

To determine how inefficient a program can be and be passed by the legislature, it is necessary to determine when a member selected prefers to make a

[24] The uniqueness of this equilibrium will be discussed below.

[25] Recall that members are unable to commit not to make a proposal, and thus a member will make a proposal if, given the equilibrium strategies of other members, it is in his or her interest to do so.

[26] Alternative expectations are considered below.

proposal. If selected, member i will wish to make a proposal if his gain z_i from passage of that proposal is nonnegative, where

$$\begin{aligned} z_i &= B - \frac{n-1}{2}\left(\frac{T}{n} + \delta\bar{V}\right) - \frac{T}{n} \\ &= B\left[1 - \left(\frac{n-1}{2}\right)\frac{\delta}{n}\right] - \frac{T}{n}\left[1 + \left(\frac{n-1}{2}\right)(1-\delta)\right] \end{aligned} \tag{6}$$

Consequently,

$$z_i \geqslant 0 \Leftrightarrow \frac{B}{T} \geqslant R(n, \delta) \equiv \frac{2 + (1-\delta)(n-1)}{2n - \delta(n-1)} \tag{7}$$

where $R(n, \delta)$ is the critical political benefit-cost ratio. If a program has a benefit-cost ratio B/T at least as great as $R(n, \delta)$, a member has an incentive to make the proposal in equation (3), and that proposal will be adopted by a majority vote. The critical political benefit-cost ratio is strictly less than one, so all efficient programs will be adopted but so will those inefficient programs with a benefit-cost ratio satisfying $B/T \geqslant R(n, \delta)$. The set $P^C(n, \delta)$ of programs that can be adopted under a closed rule is thus

$$P^C(n, \delta) \equiv \left\{\frac{B}{T} \,\middle|\, \frac{B}{T} \geqslant R(n, \delta)\right\}$$

The critical political benefit-cost ratio is a strictly decreasing function of δ, so the less patient (lower δ) are members the smaller (in the sense of set containment) is the set of inefficient programs the legislature will approve. Conversely, more patience (higher δ) implies that a member is willing to vote for a more inefficient proposal. This results because lower impatience means that a member is "more concerned" about the possibility that an inefficient program will be adopted in the future; hence, fewer benefits need be offered to attract his or her vote for the current proposal. The benefits remaining for the proposer are thus greater, so the set of inefficient programs that can be adopted is larger the higher is the discount factor. That is, if $\delta' > \delta$, then $P^C(n, \delta) \subset P^C(n, \delta')$. For example, for $\delta = 0$,[27]

$$R(n, 0) = \frac{n+1}{2n} \tag{8}$$

and for $\delta = 1$,

$$R(n, 1) = \frac{2}{n+1} \tag{9}$$

[27] This is the result obtained by Niou and Ordeshook (1985) and also by Buchanan and Tullock (1962, 162).

Inefficient programs thus can be adopted by the legislature, and they result because of the majoritarian incentive to concentrate benefits when costs are collectivized.[28]

The critical political benefit-cost ratio $R(n, \delta)$ is a strictly decreasing function of n, so the larger is the number of districts over which the tax burden can be spread the more inefficient is the set of programs that can be adopted. That is, if $n' > n$, then $P^C(n, \delta) \subset P^C(n', \delta)$. As the size of the legislature increases, the limit of the critical ratio is

$$\lim_{n \to \infty} \mathrm{R}(n, \delta) = \frac{1 - \delta}{2 - \delta}$$

so the lower is δ the less inefficient is the set of programs that can be passed in a large legislature. In the limit as δ approaches one, a program with no benefits could be adopted in a large legislature operating under a closed rule.

The result that inefficient programs can be adopted even when there is no divergence between economic and political benefits and no tax illusion is a consequence of the majoritarian incentive to concentrate the distribution of benefits

[28]To relate the theory developed here to that of Ferejohn, Fiorina, and McKelvey (1987) let the benefits B be divisible into Kn projects, where $K \geqslant 1$ is a measure of how finely divisible the projects are. If each district has only one available project so that the maximum benefits a district can receive are (B/Kn), then an agenda-independent alternative exists if their condition $U1$ holds or if

$$\frac{B}{Kn} - \frac{1}{n}\left(\frac{n+1}{2}\right)\xi\left(\frac{B}{Kn}\right) > 0$$

where $\xi = (C/B)$ and C is the cost. A program thus can be adopted by the legislature if

$$\frac{B}{C} > \frac{n+1}{2n}$$

Next, suppose that each district can have Kn projects adopted so that the maximum benefits any district could receive are B. Then, an agenda-independent alternative exists under their condition $U2$ if

$$\frac{B}{Kn} - \frac{1}{n}\xi B > 0$$

or

$$\frac{B}{C} > K$$

Thus, if there are $10n$ projects that may be allocated among the districts, an agenda-independent alternative exists if benefits are greater than 10 times the costs. Letting the benefits be more finely divisible (larger K), the limit of the ratio of the benefits to the costs is infinite. Consequently, for completely divisible benefits as considered here, the costs must be zero for there to be an agenda-independent alternative.

when the costs are collectivized. As long as members have no means to commit not to make proposals when they have the opportunity to do so, the opportunity to seek benefits at the expense of others seems unavoidable when a closed rule governs the consideration of proposals.

The following proposition summarizes the results of this section.

PROPOSITION 1: With a closed rule, the stationary equilibrium has the following properties:

1. Inefficient pork barrel programs will be adopted, and the programs can be more inefficient the larger is the number of districts over which the tax burden can be spread.
2. The set $P^C(n, \delta)$ of programs that will be adopted is an increasing function of the patience δ of members.
3. Pork barrel programs distribute benefits only among a minimal majority of districts.
4. Distributions of benefits among those districts receiving a positive share are asymmetric with the district of the member selected receiving a share that exceeds that of any other member. The member selected thus has proposal power.
5. The first proposal selected is passed by the legislature.

Political Benefits

These results can be extended to the case of program expenditures that provide political benefits. Suppose that the expenditures are proportional to the magnitude of the benefits, so if benefits b_i are distributed to district i, the expenditures in that district are $b_i(T/B)$. Let $\eta \in [0, 1]$ denote the proportion of the expenditures that represent political benefits and assume that that proportion is the same for every district. The economic and political benefits then are $b_i(1 + \eta(T/B))$, and the value $\bar{V}^p$ of the game is given by[29]

$$\bar{V}^p = \frac{\mathrm{B} - \mathrm{T}(1 - \eta)}{n}$$

Then, the critical political ratio $R^p(n, \delta, \eta)$ is given by

$$R^p(n, \delta, \eta) = \frac{H + \left(H^2 + 4\left(1 - \delta\frac{n-1}{2n}\right)\left(\eta\frac{n-1}{2n}(1 - \delta(1 - \eta))\right)\right)^{1/2}}{2\left(1 - \delta\frac{n-1}{2n}\right)}$$

[29]The expression for $\bar{V}^p$ is determined in a manner analogous to that used to derive equation (5).

where $H = ((n - 1)/(2n))(1 - \delta(1 - \eta)) + (1/n) + \eta((n - 1)/(2n) - 1)$. It is straightforward to verify that $R^p(n, \delta, 0) = R(n, \delta)$ and $R^p(n, \delta, 1) < R^p(n, \delta, 0)$. Also, $R^p(n, 1, 1) = ((n - 1)/(n + 1))$ and $R^p(n, 1, \eta) = (1 - \eta + (1 - \eta - \eta^2))/(n + 1)$. The following proposition is then immediate:

> PROPOSITION 2: Under a closed rule, the critical political benefit-cost ratio $R^p(n, \delta, \eta)$ is a strictly decreasing function of the proportion η of political benefits provided by the expenditures, so political benefits allow more inefficient programs to be adopted. That is, $P^c \subset P^p \equiv \{(B/T) \mid (B/T) \geq R^p(n, \delta, \eta)\}$.

Political benefits resulting from in-district expenditures associated with the provision of economic benefits thus can result in more inefficient programs to be adopted. In contrast to the model of Shepsle and Weingast (1981), however, political benefits are not a necessary condition for the adoption of inefficient programs.

Expectations of Efficiency

The stationary equilibrium characterized above predicts that a legislature will pass an inefficient pork barrel program as long as it satisfies equation (7). This equilibrium is based on expectations that if the current proposal were to be defeated, the member selected in the next session would make a proposal and members would vote for that proposal if it satisfied equation (2). Thus, even though the continuation value is negative when B is less than T, members expect that the future will be no more promising than the present. To understand the sense in which these expectations are internally consistent, it is useful to consider the possibility of "expectations of efficiency"; that is, expectations that the legislature will in the future defeat any inefficient proposal that is made. That is, suppose that members operate under a behavioral norm governing voting so that all members believe that an inefficient program will not be passed in the future. In the context of the model, using these beliefs in their voting on proposals in the current session corresponds to a continuation value of zero.[30] Such expectations, however, will be shown to be inconsistent with the strategies that members would choose when they hold those beliefs.

To show that an inefficient program would still be adopted when efficiency expectations are in place, note that with such expectations the value $V_i(g, 2)$ for the subgames beginning in the second session is zero. The member selected thus can make a proposal that offers benefits (T/n) to $((n - 1)/2)$ other members, and having a continuation value of zero, they will vote for the proposal. Hence,

[30] Alternatively, all members can be envisioned as pledging to vote against any program that is inefficient. Strategies, however, must constitute a perfect equilibrium, so that the pledge has to be consistent with the behavior of each member at the time that that member has an opportunity to act.

a member selected will make a proposal whenever

$$\frac{B}{T} \geqslant \frac{n+1}{2n} \tag{10}$$

which has a limit of 1/2. The value of the game then can be shown to be the same as that given in equation (5). Consequently, when equation (10) is satisfied, efficiency expectations result in a (nonstationary) equilibrium in which proposals are made and passed and the value of the game is negative. Since an inefficient program will pass, expectations that correspond to no inefficient proposal being passed in the future are inconsistent with the strategies that would be adopted in the first session given those expectations. That is, given efficiency expectations, members expect that an inefficient program satisfying equation (10) will be adopted, which implies that efficiency expectations are inconsistent with the strategies that members would choose when they have an opportunity to do so. That is, the beliefs they hold at the beginning of the first legislative session are inconsistent with the beliefs they are assumed to have at the beginning of the second session. The subgames at the beginning of each session are identical, however, so such inconsistent expectations seem implausible.

Although efficiency expectations are inconsistent with the strategies of members whenever equation (10) is satisfied, they are not inconsistent with stationary equilibrium strategies when that condition is not satisfied. For example, when $(B/T) < ((n + 1)/2n)$, a member selected to make a proposal does not have sufficient benefits available to induce a majority to vote for it. Efficiency expectations thus are not inconsistent with a stationary, perfect equilibrium if the benefit-cost ratio is less than $((n + 1)/2n)$. This is the limit on the inefficiency of pork barrel programs developed by Buchanan and Tullock (1962) and by Niou and Ordeshook (1985).

This analysis indicates that the stationary, symmetric equilibrium characterized above corresponding to programs with benefit-cost ratios satisfying equation (7) is not unique when equation (10) is not satisfied. The latter equilibrium, however, may be thought of as involving exogenously specified expectations that are then confirmed by strategies that form a perfect equilibrium given those expectations. A theory, however, is better if it allows expectations to arise endogenously, and the equilibrium characterized by equations (2)–(4) seems superior on this dimension to the one based on efficiency expectations. That is, the theory that predicts that programs will be passed if they satisfy the critical ratio in equation (7) is based only on the restriction that expectations are to be the same in all structurally identical subgames. The expectations that then arise from equation (4) are endogenously derived and give rise to the critical ratio in equation (7). In this sense the equilibrium resulting from efficiency expectations seems compelling than the equilibrium in which expectations arise endogenously from only the stationarity restriction.

It may seem that the stationarity restriction is particularly strong because it leads to the prediction that the value of the game is negative, yet members still make proposals and a majority is willing to vote for the one selected. The restriction, however, is to be understood as reflecting the expectation of members that inefficient programs can be adopted. At least in the case in which equation (10) is satisfied, expectations that an inefficient program would not be adopted are inconsistent with the individual incentives that members have to vote for a proposal that covers their share of the tax cost.

Procedural Control and the Inefficiency of Pork Barrel Programs

The above analysis provides an explanation for the adoption of economically inefficient distributive programs based on the incentives inherent in majority rule institutions. To limit that inefficiency, the parent body would be expected to adopt institutional procedures that either restrict the ability of members to make proposals or entitle members with rights to counter proposals with amendments. In the House, restrictions on proposal making in the form of committee jurisdictions or germaneness are employed, but such restrictions are not intended to affect whether proposals can be made within a jurisdiction. Since in the model considered here a member selected to make a proposal may be viewed as constituting a (unitary-actor) committee, restrictions on proposal making are inconsistent with the model.

The more natural approach to controlling inefficiency is to entitle members with an opportunity to offer amendments to any proposal brought to the floor. In addition to being in accord with concepts of democratic theory, the procedural requirement that members have an opportunity to offer amendments to distributive proposals comports with practice in the Congress. Pork barrel programs typically are not considered under a closed rule in the House, and in the Senate all bills are nominally subject to amendment.[31] In practice both the House and the Senate use restrictive procedures, modified and closed rules in the House and unanimous consent agreements in the Senate, that permit but restrict amendments either explicitly or by a time limitation. This section is concerned with the implications of amendment rules for the adoption of inefficient programs and for the distribution of benefits among the legislative districts. The principal conclusion is that procedures that allow amendments can improve the efficiency of the set of projects that the legislature would adopt.

Evidence from the House suggests that legislation of a distributive nature tends to be considered under an open rule. Bach and Smith (1988, 115–16)

[31] Not all distributive legislation receives an open rule. For example, as soon as the Democrats gained control of the Senate in 1987, the long-delayed Surface Transportation and Uniform Reallocation Assistance Act of 1987 was moved through the House under a closed rule.

present data on the assignment of rules in the House by committee jurisdiction. Legislation originating from "constituency committees" (Agriculture, Armed Services, Interior and Insular Affairs, Merchant Marine and Fisheries, Public Works and Transportation, Science, Space, and Technology, Small Business, and Veterans' Affairs) is predominately considered under an open rule. For the 94th Congress through the 98th Congress, 293 of 318 bills were considered under an open rule.[32] Less than 20% of the legislation from "prestige committees" (Appropriations, Budget, Rules, and Ways and Means) is considered under an open rule, whereas legislation from "policy committees" receives a slightly lower percentage of open rules than do the constituency committees.[33] These data suggest that a significant portion of the legislation coming from the constituency committees that deal with distributive programs is considered under an open rule in the House.

The choice of an amendment rule by a legislature may be made either *ex ante* or *ex post*. If an amendment rule were assigned *ex post* for each proposal, the majority that would vote for the proposal characterized in equations (3) and (4) would also vote for a closed rule. To prevent this the legislature may separate proposal making from the assignment of an amendment rule. This separation will be effective only if those responsible for the rule cannot be targeted to receive sufficient benefits to assign a closed rule, which would then be approved on the floor by a majority. This suggests that an *ex ante* assignment of rules may be the more realistic perspective for the distributive programs to which this theory is relevant. Consequently, an *ex ante* perspective will be taken, and thus the amendment rules are to be interpreted as general practices that the legislature applies in the case of the distributive programs in the policy domain considered here. Although the process by which the parent body would decide among institutional procedures is not modeled here, the legislature as a whole is assumed to choose by majority vote to assign *ex ante* an amendment rule to this class of distributive programs. That is, at the time the rule is chosen, the legislature does not have information on specific programs but knows that the set of programs that will become available is inefficient. From an *ex ante* perspective, a member of the legislature will prefer a rule that allows amendments if the set of programs that would be adopted under the rule is less efficient than the set of programs that would result under a closed rule. Thus, the focus is the effectiveness of

[32] Bach and Smith's (1988) explanation for the use of open rules is quite different from that provided here. In the 99th Congress, however, only 29 of 51 bills received open rules, which may mark a change in practice.

[33] Robinson (1963, 44) reports that "between 1939 and 1960, the House adopted eighty-seven closed rules and 1,128 open rules." Most of the closed rules were for fiscal bills or legislation pertaining to tariffs or social security. Robinson notes that closed rules are used for bills that are potentially subject to logrolling.

institutional procedures in limiting the inefficiency of pork barrel programs.

The first amendment rule to be considered is a simple open rule that allows an unlimited number of amendments but requires that they be put one at a time against the proposal on the floor. That is, when a proposal is on the floor, a member other than its author is recognized, and that member either may make an amendment or may make a motion, which itself is subject to a majority vote, to close the amendment process. If that motion is successful, an immediate vote on the proposal on the floor takes place. If an amendment is made, it is voted against the proposal on the floor, and the winner becomes the proposal on the floor. Since a proposal is either adopted or replaced by an amendment, there is always a proposal on the floor. The stationary equilibrium for a simple open rule is characterized in Baron and Ferejohn (1989a) for the case of $T = 0$ and an extension to the case in which $T > 0$ will be summarized here.

Whenever an amendment, which is in the nature of a substitute, is made and voted upon, discounting is assumed to take place, so the legislature may not distribute the benefits in the first session. The possibility of amendments thus may cause delay. Under a closed rule, a session of the legislature was defined to correspond to the consideration of a single proposal, and discounting took place at the beginning of each session. Under a simple open rule, the number of amendments that can be made during a session must be specified. The most straightforward manner of doing so is to consider the number of amendments allowed per session to be a parameter of the model and to assume that discounting takes place with each amendment. Thus, if a denotes the number of amendments per session and if the time preference rate is r, the discount factor δ_a is defined as $\delta_a \equiv \exp^{-r/a}$. Thus, $a = 1$ corresponds to a single amendment in each session, and if $r = 0.1$, then $\delta_a = 0.905$. Since the discount factor $\delta = \delta_1$ for a closed rule is $\delta = \exp^{-r}$, it follows that $\delta_a \geqslant \delta$. The case in which $\delta_a = 1$ corresponds to an infinite number of amendments per session when $r > 0$.

For the case of $B = 1$ and $T = 0$ and a simple open rule, Baron and Ferejohn (1989a) show that benefits may be distributed to more than a minimal majority of districts if δ is low and the legislature is small, but for large n the distribution is to a minimal majority. The number of districts to which benefits are allocated depends on the trade-off between (1) the majoritarian incentive to allocate benefits to as few districts as possible and (2) the incentive to reduce the probability of delay in distributing the benefits. That probability can be reduced by increasing the number of districts to which benefits are distributed so as to decrease the probability that whichever member is recognized next will be one who prefers to offer an amendment rather than one who prefers to move to close the amendment process. The majoritarian incentive is, however, dominant for even a moderate-size (e.g., $n > 10$) legislature.

When the program is inefficient, a universalistic distribution will never result. For example, for $n = 3$ and member 1 selected initially, the universalistic proposal b^1 that will be unanimously approved is[34]

$$b^1 = \left(\frac{B - (1 - \delta_a)\frac{2T}{3}}{1 + 2\delta_a}, \frac{\delta_a B + (1 - \delta_a)\frac{T}{3}}{1 + 2\delta_a}, \frac{\delta_a B + (1 - \delta_a)\frac{T}{3}}{1 + 2\delta_a} \right) \tag{11}$$

and the gain z_1 from submitting the proposal is

$$z_1 = \frac{B - T}{1 + 2\delta_a} \tag{12}$$

A member recognized thus will never make a universalistic proposal if the program is inefficient.[35] Consequently, as with a closed rule, under an open rule universalism is inconsistent with the adoption of inefficient programs. In the context of this model, this implies that the explanation for universalism and inefficient programs must be found in their political benefits.

The equilibrium proposal will distribute benefits to a minimal majority of districts, and the proposal b^1 if member 1 is selected is

$$b^1 = \left(\frac{B(4 - \delta^2) - \frac{2T}{3}(2 - \delta - \delta^2)}{4 + 2\delta - \delta^2}, \frac{2\delta B + \frac{2T}{3}(2 - \delta - \delta^2)}{4 + 2\delta - \delta^2}, 0 \right)$$

If member 2 is recognized, she moves that the amendment process be closed, and she and member 1 vote for that motion and then for b^1. If member 3 is recognized, he makes an amendment that is a permutation of b^1 that distributes zero to member 1, the same benefits to member 2 as in b^1, and the remainder to himself. That is, although member 3 could strip benefits from the proposal and thereby cause it to be defeated, he prefers to offer a proposal that yields him positive net benefits. The majoritarian incentive to obtain benefits at the expense of others prevails.

Even though consideration of proposals under an open rule results in a distribution of benefits to a minimal majority of districts, the incentive to adopt inefficient programs is importantly affected. The opportunity to offer an amendment is not used to strip the proposal on the floor. Instead, the opportunity to amend is used to offer a substitute that maximally advantages the amender. This yields a continuation value for any amender that is equal to the value of the game

[34] Any amendment is a permutation of this proposal with the amender having the first component.

[35] In general, $z_1 = (B - T)/(1 + (n - 1)\delta_a)$ for a universalistic proposal.

to the member selected to make the first proposal. Consequently, allowing amendments reduces the ability of the member selected to make a proposal that exploits others; that is, the continuation value for a member who is not initially selected to make a proposal is higher when that member may have an opportunity to make an amendment than when proposals are considered under a closed rule. To illustrate this, if $n = 3$ the distribution is among two districts, and the gain z_i to the member i selected to make the proposal is

$$z_i = \frac{2B - \frac{T}{3}(4 + \delta_a)}{4 + 2\delta_a - \delta_a^2} \tag{13}$$

Consequently, for a proposal to be made, the benefits must satisfy

$$\frac{B}{T} \geqslant R^O(3, \delta_a) \equiv \frac{4 + \delta_a}{6} \tag{14}$$

where $R^O(n, \delta_a)$ denotes the critical political benefit-cost ratio when proposals are considered under an open rule. As opposed to the case of a closed rule, this ratio is an increasing function of the discount factor. This results because an open rule mitigates the majoritarian incentive in a manner that outweighs the effect of dampening expectations about the adoption in the future of an inefficient program.

For a closed rule, the critical ratio $R(3, \delta)$ in equation (7) is

$$R(3, \delta) = \frac{2 - \delta}{3 - \delta} \tag{15}$$

For all $\delta \in (0, 1]$, the set of programs that can be adopted under an open rule is strictly smaller than under a closed rule. The possibility of an amendment thus prevents some pork barrel programs from being adopted that would be adopted under a closed rule. This results because the opportunity for a member to be recognized and to offer an amendment increases the cost of attracting his or her vote. Proposals thus must allocate more benefits to other members leaving less for the member selected to make the proposal. The majoritarian incentive remains, but the particularistic benefits that can be appropriated are diminished, so an open rule limits the extent of the inefficiency of pork barrel programs.

The stationary equilibrium for the general case of a simple open rule and an n-member legislature is presented in Appendix A, and only the critical political benefit-cost ratio will be presented here. The number of districts to which benefits are distributed is a minimal majority,[36] and the critical ratio is

$$R^O(n, \delta_a) = \frac{n + 1}{2n} + \frac{\delta_a}{2n} + \frac{\delta_a^3}{8n}\left(\frac{n - 3}{n - 1}\right)^2 \frac{1}{\mu} \tag{16}$$

[36] This is verified by numerical evaluation of the value function in (A.1) in Appendix A.

where

$$\mu = 1 - \frac{\delta_a}{n-1} - \frac{\delta_a^2}{2}\left(\frac{n-3}{n-1}\right)^2$$

The critical ratio $R^O(n, \delta_a)$ is less than one, so all efficient programs will be adopted under an open rule but so will inefficient programs with a benefit-cost ratio at least as great as that ratio. The set $P^O(n, \delta_a)$ of programs that can be adopted under a simple open rule is thus

$$P^O(n, \delta_a) \equiv \left\{\frac{B}{T} \,\middle|\, \frac{B}{T} \geqslant R^O(n, \delta_a)\right\}$$

The critical ratio for $\delta_a > 0$ is strictly greater than $(n + 1)/(2n)$ and is a decreasing function of n with a limit

$$\lim_{n\to\infty} R^O(n, \delta_a) = \frac{1}{2}$$

A simple open rule thus precludes from passage any program that has benefits that are less than half its cost.[37]

To indicate the effect of the number of amendments per session and of the size of the legislature, Figure 2 presents the critical political benefit-cost ratio $R^O(n, \delta_a)$ for various values of n and a. The critical ratio is an increasing function of the number of amendments and reaches its maximum of five-sixths for $n = 3$ and an infinite number of amendments per session. As indicated in the figure, the ratio increases only slightly in a and decreases rapidly toward its lower bound of one-half as the size of the legislature increases.

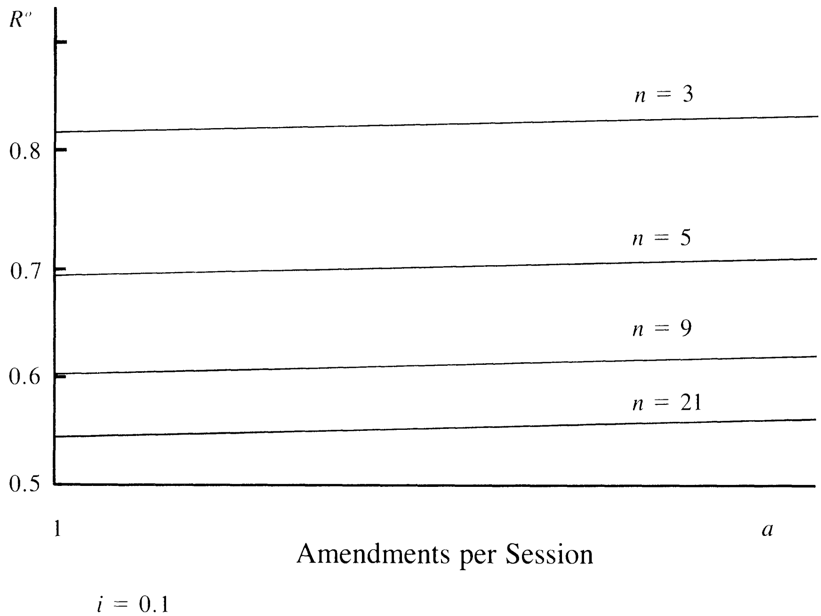
Because the benefits are allocated to a minimal majority of districts, the probability is one-half that the member recognized will make an amendment and thus that delay in the adoption of a program will result. The extent of that delay depends on the number of amendments that may be made in a session.

The impact of a simple open rule is summarized in the following proposition.

PROPOSITION 3: A simple open rule limits the inefficiency of the set of pork barrel programs that the legislature would adopt, that is, $P^O(n, \delta_a) \subset P^C(n, \delta)$, and inefficient programs never are universalistic. Any programs adopted have a benefit-cost ratio of at least one-half, and the critical political benefit-cost ratio is an increasing function of the possible number of amendments per session. Benefits are distributed to a minimal majority of districts, so delay in the distribution of benefits results with positive probability.

[37] This is the limit of the critical ratio in equation (10) that results from efficient expectations. It is also the limit of the condition developed by Buchanan and Tullock (1962) using cooperative game theory.

Figure 2. Critical Ratio with an Open Rule



The impact of a simple open rule in reducing the inefficiency of the set of programs that can be adopted suggests that allowing additional amendments may further limit that inefficiency. Although general results are not available, the special case of a three-member legislature may be illustrative of the effect of increasing the number of amendments. Consider an institutional procedure under which each member other than the author of the original proposal has the right to make an amendment to that proposal. This might correspond to the House's system of previously noticed amendments, published in the *Congressional Record* at least one day in advance of consideration by the Committee of the Whole, or to the Senate's use of unanimous consent agreements to govern amendment activity.[38] The amendments will be assumed to be made in the same session and to be voted according to an agenda amendment tree.[39] That is, the last amendment is voted against the previous amendment, and the winner is voted against the committee proposal. The survivor of this process is then voted against the status quo, which corresponds to continuation to the next session. The equilibrium in this setting is universalistic with an equal distribution of benefits to all districts, so programs are adopted only if the benefit-cost ratio is at least one (see

[38] See Oleszek (1984, 135–36, 178–85).

[39] See Ordeshook and Schwartz (1987) for a study of other amendment trees.

Appendix B). In a three-member legislature, the right to make an amendment is thus an effective means for a parent body both to eliminate inefficient programs and to distribute benefits in a universalistic manner. The generality of this result is an open question.

Another means of limiting the inefficiency of pork barrel programs is through the procedures used to close the amendment process. A simple open rule may be interpreted as allowing majority cloture of the amendment process, since only a majority of members is required to bring the proposal on the floor to a final passage vote. If a supermajority vote were required for cloture of the amendment process, the advantage of the member selected to make the original proposal would be further limited. For a three-member legislature, Baron and Ferejohn (1988) show that a universalistic outcome results under unanimous cloture. An inefficient program thus would never be adopted.

The parent body thus may be able to control majoritarian incentives and to prevent inefficient pork barrel programs through the procedural measures of either allowing each member to submit an amendment to any proposal or by requiring unanimous cloture of the amendment process. At least for a three-member legislature, these procedures eliminate inefficient programs and result in universalism. If an inefficient program provides sufficient political benefits, it, of course, can be adopted.

The theory developed here may be summarized by stating that if restrictive amendment procedures are assigned to proposals, very inefficient programs can result. The parent body can limit the inefficiency of programs by adopting *ex ante* less restrictive amendment procedures. Furthermore, this analysis suggests that the more restrictive the amendment procedure the more inefficient is the set of programs that can be adopted. If there are incentives for the use of restrictive procedures in addition to those considered here, this theory predicts that inefficient pork barrel programs may be a cost associated with those procedures.[40]

In the context of a legislature with a committee system, this theory predicts that a legislature would assign a closed rule to proposals of committees that are believed to have a set of feasible programs for which the benefit-cost ratio is at least one because that would avoid the possibility of delay that results with an open rule. A legislature would assign an open rule to proposals of committees that are believed to have a set of feasible programs that are inefficient.[41] If, however, the committee had better information about the benefit-cost ratio than did the legislature, the legislature may prefer to grant a restrictive amendment procedure to the committee's proposal so as to create an incentive for expertise

[40]In the context of a one-dimensional spatial model, Gilligan and Krehbiel (1987, 1989a, 1989b) provide an informational, or expertise, rationale for the assignment of restrictive amendment procedures to committee proposals.

[41]This, of course, assumes that the legislature has knowledge of the set of feasible programs in the committee's jurisdiction.

as shown by Gilligan and Krehbiel (1988, 1989a, 1989b). The theory here shows the possible cost of such a procedure.

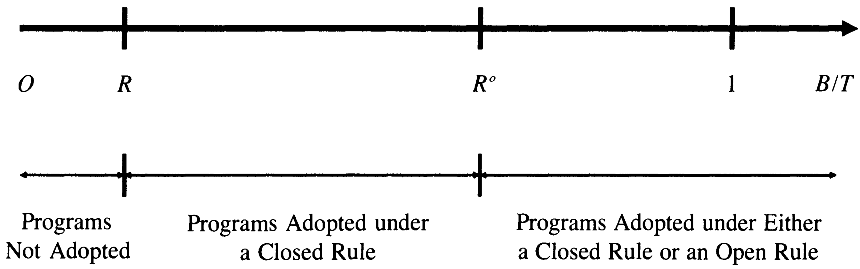
Conclusions

In a legislative model that reflects the sequential nature of proposal making and voting and in which credible commitment to future behavior that is not optimal at the time the member is to act is impossible, the majoritarian incentive to distribute benefits among a minimal number of districts is strong. This incentive can result in the adoption of inefficient distributive programs, but how inefficient those programs can be depends on the procedures employed by the legislature. The programs that can be adopted under a closed rule and the number of districts that receive benefits are summarized in Figure 3. Very inefficient programs will not be adopted, but those with a benefit-cost ratio above $R(n, \delta)$ can be adopted. As indicated in Figure 3, the inefficiency of adopted proposals can be limited by the assignment of a simple open rule to proposals, and it may be possible to eliminate inefficient programs entirely by conferring rights on members either to make amendments or to require unanimous consent to close the amendment process. The use of an open rule to control the inefficiency of distributive programs has a cost when the programs available for consideration are efficient, however, since an open rule may result in delay in adoption of the program. When the number of amendments permitted per session is high, the cost of delay is small, and an open rule will be preferred to a closed rule when the policy domain contains both efficient and inefficient programs.

This theory also indicates the strength of majoritarian incentives, since in equilibrium, benefits are allocated to a minimal majority of districts. This suggests that a noncooperative theory capable of explaining a distribution to a larger number of districts must involve the coordination of strategies among members. Baron (1989) provides a theory of legislative coalitions that can coordinate their proposal making but not their voting. In equilibrium, for efficient programs, benefits are distributed to approximately 70% of the districts. A theory of coordination of proposals among coalition members may thus be capable of explaining a broader distribution, but a universalistic distribution cannot be explained in the context of this model.

The explanation given here for the adoption of inefficient programs rests on majoritarian incentives and on a legislative process that neither allows incredible commitments nor allows unlimited and simultaneous consideration of proposals. This explanation is not inconsistent with other explanations that rely on a divergence between economic and political benefits or on a tax illusion. Indeed, if the parent body could eliminate the majoritarian incentive, the political benefits and illusion explanations would remain. The open question then is the extent to which the parent body can restrain majoritarian incentives through the amend-

Figure 3. Pork Barrel Programs under Closed and Open Rules



ment process or with other procedural or structural measures. The effect of such restraints on other aspects of committee performance must, of course, be taken into account as demonstrated in the models of Gilligan and Krehbiel (1988, 1989a, 1989b). Although much of the literature on the choice of legislative rules predicts that restrictive rules would be assigned to committee proposals, the theory presented here explains why a legislature might choose to assign an open rule to the proposals of a committee that was believed to have inefficient distributive programs in its jurisdiction.

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APPENDIX A
Stationary Equilibrium with a Simple Open Rule

The derivation of this equilibrium is similar to that in Baron and Ferejohn (1989a), so only the value v_i of the game for the member who is initially selected will be presented. It is important to note that this value is conditional on having been selected, so it corresponds not to V_i but to z_i in the case of a closed rule.

The value, expressed as a function of n, the number q of votes attracted, and δ, is

$$v_i = \frac{\dfrac{q}{n-1}B - \dfrac{T}{n}\left(\dfrac{q(q+1)}{n-1} + \delta\left(1 - \dfrac{q}{n-1}\right)\left(\dfrac{q}{n-1}\right) + \dfrac{\delta^3}{\phi}\left(1 - \dfrac{q}{n-1}\right)^2\left(1 - \dfrac{q+1}{n-1}\right)^2\right)}{1 + \delta\left(\dfrac{q^2}{n-1}\right) - \delta^2\left(1 - \dfrac{q}{n-1}\right)\left(\dfrac{1}{n-1} + \left(1 - \dfrac{q+1}{n-1}\right)\gamma\right)} \tag{A.1}$$

where

$$\gamma = \frac{\delta}{\phi}\left[\frac{q}{n-1} + \delta\left(1 - \frac{q}{n-1}\right)\left(\frac{n-q-2}{q}\right)\left(\frac{1}{n-1}\right)\right]$$

and

$$\phi = 1 - \delta\left(1 - \frac{q}{n-1}\right)\left(\frac{2q - n + 2}{q}\right)$$
$$- \delta^2\left(1 - \frac{q}{n-1}\right)\left(\frac{n - q - 2}{q}\right)\left(1 - \frac{q+1}{n-1}\right)$$

The expression in equation (16) is then obtained from the numerator of (A.1) using $q = (n - 1)/2$.

APPENDIX B
Characterization of an Equilibrium for the Right to Make an Amendment Procedure

This demonstration is a variant of that given in Baron and Ferejohn (1988). To prove this result, let the members be numbered in the order in which they make a proposal or an amendment, so member 1 makes the proposal. To avoid using open sets and to break ties, assume that a member who is indifferent between two proposals will vote for the one made last. Also, assume that some proposal will be adopted and that $\delta = 1$. Suppose that member 1 makes a proposal b^1 with $b_1^1 \geqslant (B/3)$. Then, the best response of member 2, taking into account the response of member 3, is to propose $b_2^2 = \max\{b_1^1, (1/2)B\}$, $b_1^2 = B - \max\{b_1^1, (1/2)B\}$, and $b_3^2 = 0$. For example, if member 1 were to choose $b_1^1 = 0.6B$, then $b_2^2 = 0.6B$ and $b_1^2 = 0.4B$. Member 3's best response is then $b^3 = (0, b_2^2, B - b_2^2)$. For the example, this is $b^3 = (0, 0.6B, 0.4B)$. This defeats both b^1 and b^2, but results in a value $V_1 = 0$.[42] Thus, for $b_1^1 > (B/3)$, member 1 receives zero if V_2 and V_3 satisfy $b_2^2 - (T/3) \geqslant V_2$ and $b_3^2 - (T/3) \geqslant V_3$.

Next, consider $b_1^1 < (B/3)$ and $b_2^1 = B - b_1^1$. Then, to defeat b^1 by attracting the vote of member 2, member 3 will have to allocate $b_2^1 > (2B/3)$ leaving less than $B/3$ for member 3. Member 3 can do better by defeating b^1 by allocating $b_1^3 = b_1^1$ to member 1 and retaining $b_3^3 = B - b_1^1 > (2B/3)$. This proposal will defeat b^2 unless $b_1^2 \geqslant b_1^1$. Member 2 thus will receive zero unless he can make defeating b^2 more costly to member 3. Consider increasing b_1^2 above b_1^1. Member 3's best response is to increase b_1^3 to equal b_1^2, but when b_1^2 reaches $(2B/3)$, member 3 prefers to propose $b^3 = (0, (2B/3), B/3)$. Member 2, of course, prefers this. Member 1 thus receives zero if $b_1^1 < (B/3)$. It is straightforward to verify that

$$b^1 = \left(\frac{B}{3}, \frac{2B}{3}, 0\right), \quad b^2 = \left(\frac{2B}{3}, \frac{B}{3}, 0\right), \quad b^3 = \left(\frac{B}{3}, \frac{B}{3}, \frac{B}{3}\right)$$

constitutes a stationary perfect equilibrium and that member 1 will make a proposal only if $B/T \geqslant 1$.

Note that under this amendment procedure the proposal made by member 1 is majoritarian and is amended to a universalistic proposal. Amendments thus are not to delete proposals but instead are either to redistribute the benefits and, in the case of the final amendment, to spread them equally among the districts.

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[42] If $b_1^1 = 0.4B$, then the best response of member 2 is $b^2 = (0, 0.4B, 0.6B)$ and the best response of member 3 is $b^3 = (0, 0.6B, 0.4B)$.

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