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Abstract

There are two common views of pork barrel spending. One view, reflecting most conventional wisdom, as well as some leading academic research, is that pork barrel spending reduces general welfare at the expense of narrow interests, that is, antithetical to responsible policymaking, especially in times of crisis. An alternative view is that pork "greases the legislative wheels" making possible the enactment of socially beneficial legislation that would otherwise not pass. In this paper we argue that the applicability of both arguments depends on the information structure. Under full information, but with heterogeneous ideology across legislators, policy compromise may be sufficient to pass beneficial legislation, with pork only lowering social welfare. In contrast, when agents are heterogeneous in their ideology and in their information about the economic situation, allocation of pork may be crucial to passage of legislation appropriate to the situation. However, it does so not simply by bribing legislators to accept legislation they view as harmful, but also by conveying information about the necessity of policy change, where it may be impossible to convey such information in the absence of pork. Moreover, pork will be observed when the public good is *most* valuable precisely because it is valuable and an informed agenda setter wants to convey this information.

"... trading of that sort [i.e., pork to pass bills] has characterized the fight for almost every major, controversial measure of domestic legislation in the last half century ...

Frederick Lawton ... who had been for decades a career official at the Office of Management and Budget (as it now is called), once told me of a summons to Franklin Roosevelt's office in 1938, when the last big piece of New Deal legislation ever passed, the Fair Labor Standards Act, was teetering before the House of Representatives. "Fred," President Roosevelt said, as I heard the story, "I want you to go across the street [to the State Department building] find a vacant office with a desk, two chairs and a telephone, take a copy of the Budget Document with you, call me and give me the room number and then wait there all day. From time to time. members of Congress, sent by me, one by one, will knock on your door. And when they do, Fred, let them in, shut the door, open the Budget, and give them whatever they ask."

<div align="center">Presidential scholar Richard Neustadt (as quoted in Evans, 2004)</div>

1 Introduction

A major complaint of observers of Congress is the prevalence of pork barrel spending: projects benefitting specific groups or districts at public expense. Conventional wisdom is that legislators take advantage of their opportunity to pad legislation with pork to the point where it harms the general interest. The common association of pork with "politics as usual" is contrasted in the public eye with responsible policy making, in which legislators put aside their love of pork and concentrate on socially beneficial legislation. This view supports proposals to ban or limit pork or "earmarks" with the aim of improving social welfare.

An alternative view (as embodied in the above quotation) is that pork is the "grease" that makes the legislative process work. In order to get the votes to pass legislation, it is necessary to build legislative coalitions. Legislators are brought into coalitions not only by the nature of the legislation on the table, but also by the favors they get conditional on delivering their votes. Under this view, pork barrel spending is a necessary evil in order to adopt socially beneficial legislation. It does *not* disappear when high-priority legislative initiatives are adopted, but in fact may be critical to the passage of such legislation–witness the failure of the 2008 Troubled Asset Relief Program legislation to pass in the House of Representatives on September 29th and its subsequent passage merely four days later when pork was added; or, the passage of major health care legislation in the U.S.[1] This more

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[1]See http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/10/03/MNR813AHDN.DTL and http://www.lasvegassun.com/news/2009/dec/20/reid-compromise-gives-sweet-medicaid-deal-nebraska

"pragmatic conventional wisdom" takes account of the realities of the legislative process and the role of pork in "greasing the wheels" so that important legislation may be passed.[2]

A Coasean interpretation can be given to the pragmatic conventional wisdom. If a change is welfare-improving on net–but there are gainers and losers–then, absent transaction costs, there are transfers that make the change Pareto improving. The standard argument is one of ex-post compensation. In a legislative context, compensation is ex-ante, but conceptually the argument is the same.[3]

On the other hand, so much pork may be put into a bill that, in the end, legislation meant to be socially beneficial might actually lower social welfare. More formally, while the Coase theorem applies within the coalition, it fails to apply for society as a whole. Coalition members are compensated if they prefer the status quo to the adopted policy, but districts outside the coalition are not compensated. Hence, an equilibrium that requires the distribution of pork may be one where social welfare is lower rather than higher. Rather than the ends justifying the means, the means corrupt the ends.

The purpose of this paper is to examine carefully both the simple conventional wisdom that distribution of pork lowers social welfare and the "pragmatic" conventional wisdom that pork may be welfare-increasing because it allows formation of coalitions to pass socially beneficial legislation. Our general conclusion is that pork may indeed be welfare-improving, but the circumstances under which we find this to be the case are quite different than what is generally considered in discussions of "greasing the legislative wheels". Moreover, we argue that what allows pork to be a welfare-improving tool is precisely what is widely condemned, namely, the benefit given to specific groups at public expense.

We show that while pork may lead to socially beneficial outcomes under full information, the case for the pragmatic conventional wisdom becomes strongest when one moves away from a perfect information world. Buying votes with pork to enable the passage of legislation is then only part of the story. The extent to which an agenda setter is willing to distribute pork ("give them whatever they ask") may reveal information about the im-

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[2]Evans (2004) presents a detailed study of the use of pork as "greasing the wheels" of the legislative process.

[3]There is the issue of whether both sides will actually carry out the trade, but our analysis concerns whether such a compensation scheme exists so as to make the net change welfare-improving, rather than any problem of commitment in this sort of trade. Our critique and reformulation of the "greasing-the-wheels" argument is distinct from commitment problems and we do not focus on them.

portance of legislation. The possibility of information revelation will affect the nature of the legislative bargains that allow legislation to pass, perhaps significantly so, as well as the welfare implications of allowing versus restricting pork. Hence, the pragmatic view that pork is necessary to "lubricate" the legislative process is incomplete without considering how incomplete information affects the use of pork.

In existing models of pork under complete information (for example Battaglini and Coate [2008], discussed below), pork will be distributed to coalition members when the value of public goods and/or pre-existing fiscal obligations is low, but legislators will forgo pork when the value of public goods and/or pre-existing obligations is high. In sharp contrast, under incomplete information, pork may be higher when the public good is most valuable, not when it is least valuable. That is, pork is not antithetical to "responsible policy making" but in fact part of the response of policy to a high valuation of the public good. We also find that pork may be given out (and improve welfare) even when the government budget constraint is very tight. Pork barrel spending is not strictly decreasing in debt or other public obligations.

The nature of legislative bargaining means that we cannot view policy choice under imperfect information as simply signaling information. Signaling and coalition building together require aiding and hurting different legislators – and in different states of nature – differentially. This determines the distribution of pork consistent with passing legislation. The need for differential benefits implies that coalition building requires policies that in themselves may benefit specific constituencies at the general expense. To the extent that this characteristic defines pork, then pork is the quintessential policy that underlies the pragmatic conventional wisdom. Outlawing pork – that is outlawing policies with this characteristic – will be shown to make responses to situations calling for higher expenditure on vital public goods impossible, and hence may be welfare reducing. We should stress that we do not claim that information transmission is the primary motivation for pork barrel spending. Rather, the extent to which pork barrel spending is used to build a legislative majority, as well as its distribution, reveals information about the importance the proposer puts on legislation. When the proposer is, in addition, better informed about the legislation's content and its potential effects, this information is valuable and may play an important role in coalition building and in the passing of socially-beneficial legislation.

The plan of the paper is as follows. In the next section we review some existing mod-

els of pork barrel spending. In section 3 we set out the basic model and the legislative process. In section 4 we derive the political equilibrium and its normative properties under full information. Section 5 presents the general characterization of an asymmetric information equilibrium, including some discussion of asymmetrically informed legislators in the real world, and shows that when pork is restricted to be zero under asymmetric information there is no signaling of relevant information. In section 6, we consider coalition building under asymmetric information. In section 7 we discuss the possible welfare-enhacing role of pork under different legislative protocols. Section 8 presents conclusions. Proofs of the propositions and additional derivations can be found in the appendices.

2   Existing Models of Pork in Legislatures

There are a number of papers that consider the allocation of pork barrel spending in a legislative setting, though generally without investigating its dependence on variation in either economic circumstances or the social value of other legislation.

Buchanan and Tullock (1962) introduced focus on the decision making process within the legislature where the extent of pork barrel spending reflected vote-trading between legislators over projects. Early formal modeling by Shepsle and Weingast (1981, 1984) and Weingast, Shepsle, and Johnsen (1981) argued that it is the political benefits of geographically concentrated projects – in addition to their economic benefits – that explain their widespread use. Projects generate employment and income in the districts in which they are built, which is a political benefit to the legislator representing the district. In these studies, and in most subsequent literature, there was no discussion either of using pork to pass legislation or of how its social cost may vary depending on economic circumstances.

Baron and Diermeier (2001) consider a model of legislative bargaining where the agenda setter uses transfers to legislators to build legislative coalitions to pass policy measures. There is heterogeneity of legislators' preferences over policy, but agreement across legislators about the state of the world, which is common knowledge. Hence, though the allocation of transfers will depend, as in our model, on the suitability of the status quo to the state of the world, the assumption of full information means there is no need for the agenda setter to transmit information.

Battaglini and Coate (2008) present a model capturing the dependence of policy-making

regimes on the state of the world, by extending the Baron and Ferajohn (1989) legislative bargaining framework to a dynamic setting. Depending on the social value of public goods and on the level of outstanding debt, which determines pre-existing claims on revenues, the economy may be in either of two "regimes". In BAU ("business as usual"), the agenda setter distributes pork to members of the (minimum winning) coalition. In contrast, in RPM ("responsible policy making"), when the social value of public spending is high and/or debt is high, no pork is distributed to reflect the combination of high value of public good spending and low "discretionary" revenue.

RPM is not surprising if there is general agreement on the high social value of public goods, that is, general agreement on the existence and magnitude of a "crisis". Similarly, general agreement on public goods expenditure in a time of acknowledged crisis is possible when legislators are homogeneous in their preferences over spending. That is, all agree there is a crisis, on its depth, and on what should be done. This is the assumption of Battaglini and Coate (2008): legislators are identical in their preferences, specifically having identical valuation of public goods expenditures in different states of nature; and they are equally informed and hence in agreement about the state of nature. Politics is entirely distributive, that is, determines who receives pork when there is agreement on politics as usual. Alternation of who has the spending power, combined with the possibility of adopting policy measures with less than unanimous legislative consent, leads to pork barrel spending in non-crisis times, but no pork in crises when spending on public goods is highly valued.[4].

As indicated in the introduction, we do not see such a simple dichotomy, where pork disappears in times when certain types of spending are agreed to have a high social value. This is no doubt due in part to such agreement being less common than the above paragraph suggests. Even considering a single economic policy, legislators differ in their beliefs about what the economic situation is, as well as which policies they consider optimal in specific situations.[5] In fact, as we will argue, the assumption of homogeneous legislators – both in their information and in their ideological preferences – is crucial for this dichotomy where

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[4]The central role of "minimum winning coalitions" in this line of research is sometimes contrasted with "universalism" in the provision of pork (see, for example, Weingast [1979]). We follow much of the literature in assuming MWCs in a legislative equilibrium and not addressing the phenomenon of supermajority coalitions.

[5]Of course, this point is more general, since the "representative agent" assumption is an approximation. For many questions, this assumption, though not strictly true, can be justified because the basic results are not changed by adding the complication of heterogeneity.

pork is observed only when there is not "important" legislation to be passed. We will argue that once the useful but unrealistic assumption of identical legislators is dropped, the opposite is in fact true: pork or other distributive measures may be positively (rather than negatively) correlated with the social value of non-pork spending, as the quote from Neustadt suggests.

Our paper is related to the role of information in legislative organization, as in Gilligan and Krehbiel (1987) and Krehbiel (1991, 2004). This literature explores how existing legislative institutions and procedure may assist or hamper the transmission of information within a legislature, when certain legislators (such as committee members) are better informed. Our paper follows their assumption that agenda setters may be better informed than other legislators. Moreover, we show how legislative procedure (that leads to a distribution of bargaining power) affects both positive predictions and normative assessments of the role of pork barrel spending.

Finally, our paper is also related to Cukierman and Tommasi (1998a,1998b), in which the known ideological bias of the agenda setter, combined with asymmetric information, makes it impossible to adopt policy appropriate to the state of nature, if it coincides with the agenda-setter's bias. We show that the addition of pork to the policy menu may make it possible to adopt such policy in this situation, that is, when an agenda setter is known to favor a policy independent of the state of nature. We return to this below. In this paper we explore the possibility that there are uses for pork other than bribing in which the agenda setter can transfer information by giving pork to other legislators and forgoing it herself. We hope that our theoretical work will inform future empirical explorations of the of role pork barrel spending as a communication device in legislatures.

3 Model

3.1 Set-up

Consider a legislature consisting of n districts. Each district i consists of a measure-one continuum of identical households with the following preferences over the consumption of

private and public goods, and leisure:

$$u\left(c^i, l, g\right) = c^i - \frac{l^{\frac{1}{\varepsilon}+1}}{\varepsilon + 1} + \left(z + \alpha^i\right) v\left(g\right),$$

where g and c^i are the consumption of public and private goods, respectively, and l is the supply of labor. $z + \alpha^i$ is a parameter that affects the marginal value of the public good to households and includes a term z that is identical across districts and another term α^i that is idiosyncratic to the specific district. Districts may have one of three valuations for the public good, $\alpha^i \in \{-\alpha, 0, \alpha\}$, with $\alpha > 0$, representing right-leaning, centrist and left-leaning districts (where here "left" is defined as having a stronger preference towards the provision of public goods.) Let n^L, n^C and n^R represent the number of districts of each type, with $n^L + n^C + n^R = n$. The households maximize utility over the following budget constraint:

$$c^i = (1 - \tau) l + s^i,$$

where τ are labor taxes, the pre-tax wage is equal to unity, and s^i are transfers from the central government (pork). The households' first order conditions give

$$l\left(\tau\right) = \left[\varepsilon \left(1 - \tau\right)\right]^\varepsilon, \tag{1}$$

which reflects the fact that distortionary taxes affect the supply of labor. (Though ε is literally the elasticity of labor supply, it primarily governs the extent to which taxes are distortionary, and could be interpreted more generally as the inefficiency inherent in the tax system.) Thus households' indirect utility over taxes, public consumption, and transfers is:

$$U\left(s^i, \tau, g; \alpha^i, z\right) = \frac{\varepsilon^\varepsilon \left[(1 - \tau)\right]^{\varepsilon+1}}{\varepsilon + 1} + \left(z + \alpha^i\right) v\left(g\right) + s^i.$$

The first term is a combination of households' utility from consumption *net* of s^i (that is, from after-tax labor income) and from the disutility of labor l. Note that this is only a function of τ and is identical across all individuals. We may write this indirect utility function as

$$U\left(s^i, \tau, g; \alpha^i, z\right) = \hat{u}\left(\tau\right) + \left(z + \alpha^i\right) v\left(g\right) + s^i, \tag{2}$$

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where $\hat{u}(\tau)(\equiv \frac{\varepsilon^{\varepsilon}(1-\tau)^{\varepsilon+1}}{\varepsilon+1})$ denotes the utility from leisure and labor-financed consumption.

3.2   Information structure

We will explore two information structures, consistent with the discussion in the introduction. First, we explore complete information, where the all districts observe the values of α^i $\forall i$ and of z. We then turn to asymmetric information, where all districts know the values of α^i $\forall i$, but only the agenda setter observes the value of z. Other legislators have expectations based on a prior distribution, where z can take on one of two values $z \in \{\underline{z}, \bar{z}\}$ with probabilities $\{1-p, p\}$ respectively. We assume that $p < \frac{1}{2}$ and will state explicitly whenever this assumption affects our results. Let $z^e \equiv p\bar{z} + (1-p)\underline{z}$ be the expected value of z prior to the legislative round. These information assumptions represent the potentially superior information of agenda setters on some policy matters discussed below in section 5.1.[6]

3.3   Legislative Procedure

We consider the case with three legislators, with $n^R = n^C = n^L = 1$.[7] We consider an open-amendment procedure, where the coalition formateur, to use Baron and Ferejohn's (1998) term, induces one other legislator to form a proto-coalition. In what we will call the "*proposal round*", the formateur proposes legislation, which faces an up or down vote on the floor (among all legislators). If at least one other legislator votes in favor of the proposal, it is enacted into law and implemented. If the legislation does not pass, it moves to the "*amendment round*" in which the other member of the proto-coalition may propose any number of amended versions of the legislation. Each of these amended versions is simply a new proposal of tax, public good, and pork allocations, which is put up to a vote in the legislature. It passes if two or more legislators votes in favor, in which case the legislation is implemented.[8] If none of the amended proposals obtains the support of two legislators, a

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[6]A more general formulation where the values of α^i are also private information is also solvable, but provides no additional insights. The added complication in this case is that the coalition partner faces a signal extraction problem on observing the agenda setter's legislative proposal. Using pork does not aid in resolving the signal-extraction problem, but does still allow signalling of the need for certain legislation.

[7]When there are more than three legislators, the basic arguments are the same. It is important, though that $n^R < m$ and $n^L < m$ so that no partisan legislator can pass legislation without the support of centrists.

[8]The order in which multiple counter-proposals are offered is immaterial to equilibrium outcomes in this model.

status quo policy is enacted. There is no discounting between the initial proposal and the amended counterproposal.

This bargaining protocol reflects an extreme of the distribution of bargaining power. The proposer of the amended legislation has the maximum bargaining power, subject to informational constraints. In an earlier version of this paper–available upon request–we solved for a closed-amendment procedure, reflecting the opposite extreme where the coalition formateur, as agenda setter, has the maximum bargaining power. The model delivered similar insights, but was less tractable, and the results were less stark than in this model.

It should be apparent that it is "cheapest" for a left-wing or right-wing coalition formateur to build a proto-coalition with the centrist (C) legislator. For concreteness we assume the formateur is left-wing, i.e., $\alpha^F = +\alpha$.[9] She proposes a policy $\{g, \tau, s^C, s^F\}$, where s^C and s^F denote pork to the centrist and the leftist districts, respectively.[10] A feasible policy satisfies

$$g + s^C + s^F \leq R(\tau) - X \tag{3}$$

where X denotes prior fiscal obligations which must be met (for example, debt service or non-discretionary public spending) and $R(\tau)$ is government revenue as a function of τ defined by

$$R(\tau) \equiv 3\tau\varepsilon^\varepsilon (1 - \tau)^\varepsilon,$$

from $R(\tau) = 3\tau l(\tau)$ and $l(\tau)$ given by (1). We naturally assume that $X < R(\tau^{\max})$, where $\tau^{\max} = \frac{1}{\varepsilon+1}$ is the revenue-maximizing tax rate. Any prior obligations exceeding this level would not be serviceable, and in a richer dynamic model, with non-defaultable debt, such levels of debt would violate the government's transversality condition.

In the case of asymmetric information, only the formateur knows the value of z with certainty. Other legislators, including the proto-coalition member selected to amend the legislation, have the prior z^e, augmented with any information gained within the legislative process.

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[9] We do not model how the coalition formateur is chosen. She could be randomly chosen, with our analysis focusing on the information transmission problems when the formateur has a partisan bias. Studying a partisan formateur or agenda setter is of particular interest. When the formateur is a centrist, no informational problem exists, as her choice of coalition partner fully reveals the value of z.

[10] For ease of exposition, the formateur will be female, the independent legislator male.

3.4 Preferred no-pork policies and the status quo

We may denote the most preferred policy of any legislator in the absence of pork as

$$\tau^*\left(\zeta, X\right) = \arg\max_\tau \left\{\hat{u}\left(\tau\right) + \zeta v\left(R\left(\tau\right) - X\right)\right\}. \tag{4}$$

$\tau^*\left(\zeta, X\right)$ is the tax rate (which implies a level of public good provision) that would be chosen by a legislator with public-good preferences ζ, who faces pre-existing fiscal obligations of X and is prohibited from distributing pork. We note that $\tau^*\left(\zeta, X\right)$ is increasing in both ζ and X.[11] This equation may be solved for

$$\zeta v_g\left(R\left(\tau^*\left(\zeta\right)\right) - X\right) = \mu\left(\tau^*\left(\zeta, X\right)\right). \tag{5}$$

That is, a legislator with preferences ζ and who is constrained not to distribute pork will equate her marginal value of the public good $\zeta v_g\left(g\right)$ to the marginal cost of raising a unit of tax revenues $\mu\left(\tau\right)$. This marginal cost (per legislator) is given by

$$\mu\left(\tau\right) \equiv -\frac{\hat{u}_\tau\left(\tau\right)}{R_\tau\left(\tau\right)} = \frac{1-\tau}{3\left(1-\tau-\varepsilon\tau\right)}.$$

We begin with the general case where the status quo policy is between those that would be socially optimal in states $\bar{z}$ and $\underline{z}$ in the absence of pork. That is, using (4), the status quo policy τ^q satisfies

$$\tau^*\left(\bar{z}, X\right) > \tau^q > \tau^*\left(\underline{z}, X\right)$$

Since the values of $\bar{z}$ and are $\underline{z}$ common knowledge (if not the realization of z under asymmetric information), this assumption seems reasonable. In the case of asymmetric information, we will look at the more restrictive assumption that the status quo policy is what would be chosen by a social planner who distributes no pork and who does not know the value of z, that is, $\tau^q = \tau^*\left(z^e, X\right)$. (This assumption makes the status quo socially optimal ex-ante, thus making it harder for pork to be socially beneficial.)

Our assumption about the status quo policy combined with the assumption that the coalition formateur is left-wing (i.e., with policy preference $\alpha > 0$) implies that the following

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[11]$\tau^*\left(\zeta, X\right)$ solves $v'\left(R\left(\tau^*\left(\zeta, X\right) - X\right)\right)\frac{1-\tau^*\left(\zeta,X\right)-\varepsilon\tau^*\left(\zeta,X\right)}{1-\tau^*\left(\zeta,X\right)} = \frac{1}{3\zeta}$, which implies the above derivatives.

must be true of desired tax rates in the absence of pork:

$$\tau^* \left(\bar{z} + \alpha, X \right) > \tau^* \left(\bar{z}, X \right) > \tau^q > \tau^* \left(\underline{z}, X \right)$$

The potential problem faced by the formateur under asymmetric information comes from the relationship between her own preferred policy when $z = \underline{z}$ and that of the centrist when $z = \bar{z}$, as summarized by the relation between $\tau^* \left(\bar{z}, X \right)$ and $\tau^* \left(\underline{z} + \alpha, X \right)$. If $\tau^* \left(\bar{z}, X \right) > \tau^* \left(\underline{z} + \alpha, X \right)$ – that is, when the difference in policy preferences due the state of nature outweighs the difference due to different ideology – there exist changes in taxes and spending alone that both signal that the state is $\bar{z}$ and are not too extreme for the centrist to accept. The interests of the two legislators are sufficiently aligned to allow credible signalling of the state of the world with policy alone.

If however, $\tau^* \left(\underline{z} + \alpha, X \right) > \tau^* \left(\bar{z}, X \right)$, the formateur's ideology is such that she prefers higher spending in normal times ($z = \underline{z}$) than the centrist does even in a crisis ($z = \bar{z}$). In this case, the centrist doesn't know whether the formateur's proposed increase in taxes (which the centrist would accept when $z = \bar{z}$ but not when $z = \underline{z}$) reflects a crisis or simply the formateur's taste for public goods. The formateur can gain the centrist's agreement to raise taxes above the status quo τ^q if she can convince him the state is $\bar{z}$ rather than $\underline{z}$, but her ideological preference for high spending presents her with a cheap talk problem.[12]

It is this case that we want to study in considering the possible signaling role of pork. Accordingly, from here on we assume that $\alpha > \bar{z} - \underline{z}$ (implying $\tau^* \left(\underline{z} + \alpha, X \right) > \tau^* \left(\bar{z}, X \right)$), so that the ranking of preferred policies is

$$\tau^* \left(\bar{z} + \alpha, X \right) > \tau^* \left(\underline{z} + \alpha, X \right) > \tau^* \left(\bar{z}, X \right) > \tau^q > \tau^* \left(\underline{z}, X \right). \tag{6}$$

We further assume that X is sufficiently high that $\mu \left(\tau^q \right) > \frac{1}{3}$. We make this assumption because if $\mu \left(\tau^q \right) < \frac{1}{3}$, a social planner would increase the tax rate and distribute pork to some combination of the three districts.[13] Hence this assumption ensures that pork is

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[12] This is is the Cukierman and Tommasi (1998) environment. There the ideological bias of (for example) a left-wing policymaker implied she wanted to change policy in her desired direction even if there was no change in the state of the world. She has no way of signalling that the changed state of the world calls for a leftward policy shift, so that she is unable to enact socially optimal policy. This is exactly the problem here where no pork is available. However, the addition of pork (or an additional policy dimension) may enable the left-winger to signal and enact optimal policy.

[13] The actual distribution is indeterminate due to the transferability of utility through pork.

not socially beneficial per se, that is, it ensures that pork is used only due to its political, coalition-building, or informational value.

4   Full Information

We begin with the case of full information where the state z is common knowledge.

4.1   Political equilibrium

The model is solved via backward induction. If the centrist rejects the formateur's initial proposal, we arrive at the amendment round, where the centrist makes a take-it-or-leave-it offer to the formateur. If the formateur rejects this counterproposal, the status-quo policy is implemented. Equilibrium in the amendment subgame is a feasible policy (one that satisfies (3)) that maximizes the centrist's utility, while satisfying a participation constraint for the formateur ((8a) below) that ensures that she is no worse off in equilibrium than under the status quo. Formally,

$$U_{amend}^C \equiv \max_{g,\tau,s^F,s^C} \hat{u}\left(\tau\right) + zv\left(g\right) + s^C, \tag{7}$$

subject to

$$\hat{u}\left(\tau\right) + \left(z + \alpha\right)v\left(g\right) + s^F \geq \hat{u}\left(\tau^q\right) + \left(z + \alpha\right)v\left(g^q\right), \tag{8a}$$

$$g + s^C + s^F \leq R\left(\tau\right) - X, \tag{8b}$$

$$s^C \geq 0, \tag{8c}$$

$$s^F \geq 0. \tag{8d}$$

The last two equations are non-negativity constraints on pork to the centrist and the formateur. $\{\tau^q, g^q\}$ denotes the status quo policy, and we assume that the status quo allocates no pork to any legislator (i.e., $s^C = s^F = 0$ with g^q given by $g^q = R\left(\tau^q\right) - X$). As the solution to this maximization problem is unique, the centrist has no reason to put more than one amended bill to a vote.

Anticipating the outcome of the amendment round, in the proposal round, the formateur makes the centrist a feasible offer that maximizes her utility and ensures the centrist's

acquiescence. This proposal solves

$$\max_{g,\tau,s^F,s^C} \hat{u}\left(\tau\right) + \left(z + \alpha\right) v\left(g\right) + s^F \tag{9}$$

subject to (8b) through (8d) and

$$\hat{u}\left(\tau\right) + zv\left(g\right) + s^C \geq U_{amend}^C. \tag{10}$$

It is easy to see that the best the formateur can achieve in the proposal round is to propose the exact outcome that would obtain in the amendment round. She faces the same constraints faced by the centrist in the amendment round, in addition to the need to make the centrist no worse off than in the amendment round. The maximization problem in both cases maximizes joint surplus, and the participation constraint (10) ensures that this surplus is split in the same way in both cases. Equilibrium is thus the outcome of the amendment subgame. The formateur is indifferent between proceeding to the amendment round, where she accepts this proposal, and making the proposal herself in the proposal round. In either case, equilibrium is characterized by the solution to (7) to (8d).

Several regimes are possible, depending on which of the non-negativity constraints (8c) and (8d) is binding. In addition to the regimes of RPM, where neither legislator receives pork, and BAU–to which we refer as Complete BAU (CBAU), and in which both legislators get pork, both existing in Battaglini and Coate (2008)–a third, intermediate, region is possible when legislators differ in their policy preferences. Specifically, in what we call Partial BAU (PBAU), only one of the two legislators obtains pork. This arises when one legislator desires a change in tax and spending policy $\{g, \tau\}$ and provides the other legislator–who is less interested is such a policy shift–with pork.

The CBAU regime comes closest to the "conventional common wisdom" that pork is uses mainly to benefit coalition members at the expense of society as a whole. PBAU, in contrast, comes closer to the Coasean view of the "pragmatic common wisdom" wherein policy compromise may be Pareto optimal for the coalition, but is only feasible if losers are compensated (via pork).

4.2 The "standard" versus the "pragmatic" conventional wisdom about pork

If legislators had the same preferences over policy (that is, the same α), our model under full information is identical to a single-period version of Battaglini and Coate (2008). The standard conventional wisdom about pork would hold. Pork is given out when debt obligations X are low or the (commonly-agreed-upon) marginal value z of the public good g is low. Both reflect cases where the marginal costs of increased taxation and forgone public goods are low relative to the value of pork to coalition members. This is the "Business as Usual" (BAU) regime. Conversely, if X and z are high, no pork is given out in the "Responsible Policy Making" (RPM) regime.

In the first case, since a minimum winning coalition determines a policy that is binding for all districts, coalition members exploit this power to give themselves political rents. They benefit directly from pork barrel spending targeted to their districts, but the costs of taxation or forgone public goods are borne by all districts. One may easily show that pork is always social-welfare reducing, because coalition members are compensated through pork–for the additional taxation and lost public goods that it entails–but other legislators are not.

In contrast, when legislators are heterogeneous in the value they place on public goods, they have different preferences over g even with full information on z, so that pork may be needed to form a legislative coalition to change public good spending. This case thus allows us to explore the pragmatic conventional wisdom that pork "greases the wheels" of the legislative process in order to enact socially desirable policies, resulting in a improvement in welfare. We show in this section that this intuition is correct only under specific circumstances. Pork may be socially beneficial when it is used to "buy off" a partisan coalition formateur whose preferences would lead her to block socially beneficial legislation.

We now turn to equilibrium in the two states to demonstrate these points.

4.3 Policy when z=z̄

When $z = \bar{z}$, both legislators agree that taxes should be increased to finance higher public expenditures. The assumption that τ^q lies below $\tau^*(\bar{z}, X)$ implies the following ranking:

$$\mu(\tau^q) < \bar{z} v_g (R(\tau^q) - X) < (\bar{z} + \alpha) v_g (R(\tau^q) - X). \tag{11}$$

For both legislators, the marginal cost of taxation is lower than the marginal value of the public good. The legislators differ, though, on how far they would increase taxes and spending.

Note that while the *relative* magnitudes in (11) are fixed, the *absolute* magnitudes are not. They will depend on pre-existing revenue needs X (or "fiscal space" for expenditure g when taxation is distortionary) and will in turn determine the nature of the equilibrium.

The first order conditions of the centrist's problem in the amendment round are given in Appendix A. Proposition 1 characterizes equilibrium under the open-amendment procedure.

Proposition 1 *When the value of $z = \bar{z}$ is known to all legislators, there are three regions of the state space which are mutually exclusive and exhaustive, as follows. When $\mu\left(\tau^*\left(\bar{z}, X\right)\right) \geq 1$, the regime is RPM. When $\mu\left(\tau^*\left(\bar{z}, X\right)\right) < 1$, the regime is CBAU if*

$$\left(\bar{z} + \alpha\right) v_g\left(g^q\right) + X < \hat{u}\left(\tau^{BAU}\right) + \left(\bar{z} + \alpha\right) v_g\left(\bar{g}^{BAU}\right) + R\left(\tau^{BAU}\right) - \bar{g}^{BAU}\hat{u}\left(\tau^q\right) \quad (12)$$

$$\text{and} \quad \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v_g\left(g^q\right) \geq \hat{u}\left(\tau^{BAU}\right) + \left(\bar{z} + \alpha\right) v_g\left(\bar{g}^{BAU}\right), \quad (13)$$

hold (where $\bar{g}^{BAU}$ and τ^{BAU} are defined by $\left(2\bar{z} + \alpha\right) v_g\left(\bar{g}^{BAU}\right) = 2\mu\left(\tau^{BAU}\right) = 1$) and PBAU with the centrist obtaining pork otherwise.

Proof. See Appendix E. ∎

To summarize, the state space can be divided into three regions, reflecting increasingly higher levels of pre-existing fiscal commitments X, as follows.

1) In a CBAU regime the tax rate and public goods are given by

$$\left(2\bar{z} + \alpha\right) v_g\left(\bar{g}^{BAU}\right) = 2\mu\left(\tau^{BAU}\right) = 1, \quad (14)$$

pork to the formateur is determined to satisfy her participation constraint (8a) and pork to the centrist being the remainder of the budget (8b) given $\left\{\tau^{BAU}, \bar{g}^{BAU}, s^F\right\}$. This will obtain for X sufficiently low to allow s^F and s^C to both be positive.

2) There exists an unambiguously higher value of X defined by $\mu\left(\tau^*\left(\bar{z}, X\right)\right) = 1$ such that if X is less than this value, the regime is PBAU.

3) Above this value, the regime is RPM with the tax rate and public good expenditure given by $\left\{\tau^*\left(\bar{z}, X\right), R\left(\tau^*\left(\bar{z}, X\right)\right) - X\right\}$

Intuitively, the regions may be understood as follows. With $z = \bar{z}$, the status quo values of τ and g are lower than the preferred policies of both the centrist and the formateur. When X is high, τ will be raised to $\tau^* (\bar{z}, X)$. This is the centrist's optimal no-pork tax rate consistent with $\bar{z}$ and all revenues are used for g. This policy leaves the formateur's participation constraint slack (since $\alpha > 0$), which means that the centrist could extract pork if he so desired. Equilibrium is therefore RPM if and only if $\mu (\tau^* (\bar{z}, X)) = \bar{z} v_g (R (\tau^* (\bar{z}, X)) - X) \geq 1$. The centrist is unwilling to forgo public goods or increase taxes relative to this policy, even if he were the sole recipient of pork.

At lower levels of X such that $\mu (\tau^* (\bar{z}, X)) = \bar{z} v_g (R (\tau^* (\bar{z}, X)) - X) < 1$ the same logic implies that pork will be allocated to the centrist and (as long as the formateur's participation constraint is slack) we are in PBAU.

Finally, for the lowest levels of X, we are in the CBAU regime. Net available revenue is enough to provide pork to both coalition members. The tax rate is set at a level such that the marginal cost of taxation summed over the coalition is equal to the marginal value of pork to a recipient and g is chosen to equate these to marginal value of g summed over coalition members, as shown in (14). In this region, variations in X will be reflected in variations in pork. The conditions (12) and (13) ensure that X is low enough to finance $\bar{g}^{BAU}$ from $R (\tau^{BAU})$, with revenues still remaining to distribute pork.

Notice that in CBAU, the $\{\tau, g\}$ policy mix is exactly at the mid-point between the preferences of the formateur and those of the centrist, i.e. $\mu (\tau^{BAU}) = (\bar{z} + \frac{\alpha}{2}) v_g (\bar{g}^{BAU})$. In the other regimes, the mix is closer to those of the centrist. In addition, note that in CBAU $\tau^{BAU} > \tau^* (\bar{z}, X)$ as higher taxes are required to finance pork (and potentially higher public goods spending required by the policy mix).

To better understand the equilibrium (and the reason the pragmatic CW doesn't hold when $z = \bar{z}$), it is useful to think of the centrist as altering policy in two stages in the amendment round. First, without allocating pork, he increases taxes and public expenditures until policy is at his ideal point $\tau^* (\bar{z}, X)$, given X. This policy makes the formateur strictly better off and her participation constraint is slack. The centrist can exploit the slack in the formateur's participation constraint to increase taxes (and cut public good provision) in favor of pork for his own district. (If $\mu (\tau^* (\bar{z}, X)) < 1$, he wishes to do so, otherwise, an RPM policy with $\tau = \tau^* (\bar{z}, X)$ is the best he can achieve.) If X is sufficiently low, (12) and (13) hold, and the centrist will continue to increase taxes and cut public good expenditures

to finance pork barrel spending even after the participation constraint of the formateur is binding, doing so by sharing rents with the formateur.

4.4   Policy when z=z̲

The assumptions that $\alpha > \bar{z} - \underline{z}$ and that the status quo policy τ^q is between $\tau^* (\underline{z}, X)$ and $\tau^* (\bar{z}, X)$ as in (6) imply the following ranking:

$$(\underline{z} + \alpha) v_g (R(\tau^q) - X) > \mu(\tau^q) > \underline{z} v_g (R(\tau^q) - X). \tag{15}$$

As before, all elements in this set of inequalities increase with X. The first order conditions of the centrist's problem in the amendment round are given in Appendix A and Proposition 2 characterizes equilibrium under the open-amendment procedure.

Proposition 2 *When the value of $z = \underline{z}$ is known to all legislators, there are three regions of the state space which are mutually exclusive and exhaustive, as follows.*
The regime is CBAU *when*

$$\hat{u}(\tau^q) + (\underline{z} + \alpha) v(g^q) > \hat{u}(\tau^q) + (\underline{z} + \alpha) v(\underline{g}^{BAU}) \quad and \tag{16a}$$

$$\hat{u}(\tau^q) + (\underline{z} + \alpha) v(g^q) + X < R(\tau^{BAU}) + \hat{u}(\tau^{BAU}) + (\underline{z} + \alpha) v(\underline{g}^{BAU}) - \underline{g}^{BAU}. \tag{16b}$$

(where $\underline{g}^{BAU}$ and τ^{BAU} are defined by $(2\underline{z} + \alpha) v_g(\underline{g}^{BAU}) = 2\mu(\tau^{BAU}) = 1$). If $\tau^q < \tau^*(\underline{z} + \frac{\alpha}{2}, X)$, the regime is RPM *if either $\mu(\tau^q) \geq 1$ or if*

$$\frac{(\underline{z} + \alpha) v_g (R(\tau^q) - X)}{1 - \underline{z} v_g (R(\tau^q) - X)} < \frac{\mu(\tau^q)}{1 - \mu(\tau^q)}; \tag{17}$$

otherwise the regime is PBAU-C *(pork only to centrist).*
If $\tau^q > \tau^*(\underline{z} + \frac{\alpha}{2}, X)$, the regime is RPM *if either $\mu(\tau^q) \geq 1$ or if*

$$\frac{\underline{z} v_g (g)}{1 - (\underline{z} + \alpha) v_g (g)} < \frac{\mu(\tau^q)}{1 - \mu(\tau^q)}, \tag{18}$$

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otherwise the regime is PBAU-F *(pork only to formateur).*

Proof. See Appendix E. ∎

To summarize, the state-space can be divided into three regions, ranked by increasing values of X as follows.

1) In a CBAU regime the tax rate and public goods are given by

$$(2\underline{z} + \alpha) v_g \left(\underline{g}^{BAU} \right) = 2\mu \left(\tau^{BAU} \right) = 1, \tag{19}$$

pork to the formateur is determined to satisfy her participation constraint (8a) and pork to the centrist being the remainder of the budget (8b), given $\left\{ \tau^{BAU}, \underline{g}^{BAU}, s^F \right\}$. This will obtain for X sufficiently low to allow s^F and s^C to both be positive.

2) There exists an unambiguously higher value of X, below which the regime is *PBAU*. If $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$, the cut-off value of X is defined implicitly by

$$\frac{(\underline{z} + \alpha) v_g \left(R \left(\tau^q \right) - X \right)}{1 - \underline{z} v_g \left(R \left(\tau^q \right) - X \right)} = \frac{\mu \left(\tau^q \right)}{1 - \mu \left(\tau^q \right)},$$

and the centrist obtains pork in *PBAU*. If $\tau^q > \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$, the cut-off is defined implicitly by

$$\frac{\underline{z} v_g \left(g \right)}{1 - (\underline{z} + \alpha) v_g \left(g \right)} = \frac{\mu \left(\tau^q \right)}{1 - \mu \left(\tau^q \right)},$$

and the formateur obtains pork in *PBAU*.

3) Above this cut-off value, the regime is *RPM*.

Intuitively, the regions may be understood as follows. As before, when X is low, net available revenue is enough to provide pork to both coalition members and we are in *CBAU*. The tax rate in *CBAU* does not depend on z because the marginal value of pork (equal to unity) is set equal the marginal cost of taxation to the coalition as a whole, which does not depend on z. In contrast, $\bar{g}^{BAU} > \underline{g}^{BAU}$ as a higher level of public goods is required to bring the marginal value of public goods to the coalition to 1 when $z = \bar{z}$. The conditions in (16) ensure that X is low enough to finance $\bar{g}^{BAU}$ from $R \left(\tau^{BAU} \right)$, with revenues still remaining to distribute pork.

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Conversely, when X is sufficiently high, all leftover revenues go to public goods, with none available for pork, that is, RPM. The tax rate remains at τ^q, with associated g^q. In contrast to the $z = \bar{z}$ case in the previous section, compromise without pork provision is impossible: the formateur would like to increase taxes and public goods, while the centrist would like to decrease both, as noted in (15).

At high levels of X, pork is not used for to achieve a Coasean compromise for two reasons. First, the opportunity cost of pork is high, due to the high the marginal cost of taxation and the marginal value of public goods due to large existing fiscal commitments. Second, when X is high the differences between the status quo and the optimal policies $\tau^*(\underline{z}, X)$ and $\tau^*(\underline{z} + \alpha, X)$ declines, as does the distance between the two. This is because most tax revenues are already pre-committed to finance X.

For intermediate values of X, pork aids policy compromise, as suggested by the "pragmatic conventional wisdom". Tax and expenditure policy may increase to favor the formateur's preferences, with the centrist compensated through pork barrel spending. Conversely, taxes and public goods may decrease to favor the centrist's preferences, with the formateur compensated through pork. Which of the two obtains depends on the location of the status quo τ^q, relative to the legislators' ideal tax rates $\tau^*(\underline{z}, X)$ and $\tau^*(\underline{z} + \alpha, X)$. If $\tau^q < \tau^*\left(\underline{z} + \frac{\alpha}{2}, X\right)$, the status quo is closer to the preferences of the centrist than those of the formateur. The coalition gains more surplus by shifting policy in favor of the formateur than in favor of the centrist. If pork is available, a Pareto improvement is available with the centrist being compensated for this policy shift. If $\tau^q > \tau^*\left(\underline{z} + \frac{\alpha}{2}, X\right)$, the status quo is closer to the preferences of the centrist than those of the formateur and the opposite policy shift is optimal for the centrist. These possibilities did not exist in Battaglini and Coate (2008) because all coalition members had the same preferences over g.

The conditions (17) and (18) determine whether the opportunity cost of pork is low enough for policy compromise to arise, or whether RPM is equilibrium. Specifically, the proof of the proposition shows that these conditions determine whether pork is valuable enough (relative to tax cuts and public good increases) to compensate the loser from a surplus-increasing compromise.

4.5 Assessing the "pragmatic" CW – does pork increase welfare under full information?

Whether pork increases welfare under full information depends on the state of the world z and on the location of the status quo. As a preliminary, we analyze the outcome of a legislative game where pork is exogenously restricted to zero. Without pork it is straightforward to see that the equilibrium is status quo when $z = \underline{z}$ and at $\tau = \tau^* (\bar{z}, X)$ when $z = \bar{z}$. (In both cases all tax revenues net of X go to public goods.) In the first case, note that when $z = \underline{z}$ the formateur wishes to increase public goods and taxes, while the centrist would like to shift policy in the opposite direction. Given the participation constraints of the two legislators, it is therefore impossible to come to any legislative compromise other than the status quo. When $z = \bar{z}$, in contrast, both legislators agree to increase taxes to $\tau = \tau^* (\bar{z}, X)$. As this is the centrist's most desired no-pork policy, this is precisely what he will propose in the amendment round. As the formateur prefers this policy to the status quo, this is the outcome of the amendment round. In the proposal round, the formateur must deter the centrist from proceeding to the amendment round, and thus must propose $\tau = \tau^* (\bar{z}, X)$ if legislation is to pass.

When $z = \bar{z}$, setting taxes at $\tau^* (\bar{z}, X)$ and allocating all net revenues to public goods is the socially optimal policy. Agreement on this policy does not require pork when the state is known and, as we have seen, will in fact be the equilibrium policy if pork is restricted to zero. Pork will only be used to increase the welfare of coalition members at the general expense (and perhaps even move policy away from the social optimum), consistent with the standard conventional wisdom. The pragmatic conventional wisdom gets no support, even though legislators differ in the preferences for public spending.

In contrast, when the formateur's preferences and the socially optimal policy are on opposite sides of the status quo policy, as is the case when $z = \underline{z}$, pork may lead to an increase in welfare depending on the position of the status quo policy, that is, the policy that would obtain if the coalition partners cannot agree on a change in policy. The socially optimal change is a decrease in τ and g, which the (leftist) formateur would oppose. In the absence of pork, no compromise can be reached. As we noted above, if $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$, legislative compromise will entail an increase in public goods and taxes, in favor of the formateur. But this is to the detriment of social welfare: While the centrist is compensated

for this undesirable policy shift, society as a whole is not. The impossibility of coalition building to change policy is to the benefit of social welfare–a point that the pragmatic CW ignores. Pork enables the passage of legislation, which is to the benefit of the coalition, but its costs outweigh its benefits for social welfare as a whole.

However, if the status quo policy is high enough (specifically, if $\tau^q > \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$), then pork may allow a move towards a lower public expenditure that would on net (that is, *inclusive* of pork) raise welfare. If pork were not available, policy would remain at the (inappropriately high) status quo since compromise would not be possible. Pork allows policy to move in the socially beneficial direction by "buying off" the formateur not to block the policy. The pragmatic conventional wisdom holds, but not because it allows the formateur to bring other legislators into the coalition, but because it allows other legislators "more in tune" with social welfare to bribe the formateur not to stand in the way.

If we assume that the status quo is at the level set by a social planner in the absence of knowledge about the state, that is, consistent with the expected value $z^e = p\bar{z} + (1 - p)\underline{z}$, according to

$$\tau^q = \arg\max_{\tau} \left\{ \hat{u}\left(\tau\right) + z^e v\left\{ R\left(\tau\right) - X \right\} \right\}.$$

then the pragmatic conventional wisdom would not hold under full information. Since we assumed that $p < \frac{1}{2}$, then $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$ and pork reduces social welfare, as described above. That means that, if the low state $\underline{z}$ is more likely and policy was set accordingly, the availability of pork lowers social welfare if either state obtains and the state is known! This result is summarized in the following proposition.

Proposition 3 *With perfect information, the availability of pork as a legislative instrument always lowers social welfare if $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$.*

Proof. See Appendix E. ∎

To summarize, the pragmatic conventional wisdom about the desirability of pork to allow legislation to be passed holds only under very specific circumstances. While pork may be a valuable tool to achieve the compromise needed for a policy change, as the pragmatic CW stresses, we show that when a policy change is needed (when $z = \bar{z}$), it can typically be reached by bargaining over policy directly. When policy compromise is impossible due to the absence of pork, this may be to the benefit of social welfare–a point that the pragmatic

CW ignores. Pork enables the passage of legislation, which is to the benefit of the coalition, but its costs outweigh its benefits for social welfare as a whole. If status quo is correct in an expected value sense and there is agreement about the state, it will not hold.

With this in mind we now turn to the case of asymmetric information and show that even if the status quo policy is at the ex ante optimal level, pork will in general be welfare-improving.

5   Asymmetric Information

Having studied the standard and the pragmatic conventional wisdom under full information–and showing that pork typically harms welfare even if it allows legislation to pass–we now analyze use of pork when there is asymmetric information about the state z. Our key results will be that pork may serve an important role in transmitting information about the state z and, hence, the need for policy change. The allocation of pork serves a different purpose under incomplete information, and may therefore be welfare improving more generally.

Key to the information value of pork is the notion that some legislators have superior knowledge of current economic conditions, or of the optimal legislation required for the current state of the world. We therefore begin with some examples of asymmetrically informed legislators. We note that observing pork in major legislative packages, such as TARP or health care as mentioned above, does not necessarily tell us whether it is being used to inform or to bribe legislators to get their support. Discriminating the actual functions of pork in specific cases is an interesting, albeit difficult task. It is particularly challenging given that our theory implies that in equilibrium pork barrel spending will have both informational and bribing roles.

5.1   Empirical motivation

5.1.1   Committee chairs

A leading example of legislative leaders being better informed is the case of standing committee chairs, for example in the U.S. House and Senate. Committee chairs (and to a lesser degree members) exhibit a higher level of expertise on topics covered by their committee due to self-selection into the committee, and through experience serving on the committee. The

drafter of legislation probably gains additional information about the state of the economy relevant to the proposed bill in the process of drafting legislation. Moreover, committee chairs and formulaters of legislation are better informed about topics for which they propose legislation due to the increased intensity of lobbying by special interest groups (who themselves are well informed about the topics on which they lobby) towards these legislators.[14] The permanent committee system in the U.S. Senate means that "the committees assumed the prerogative of determining which substantive provisions the Senate should consider, and they became policy-making bodies instead of merely technical aids to the chamber. Whereas the Senate formerly set the agenda, the committees came to be, in effect the Senate's "agenda-maker."[15] The same is true, perhaps even more so, in the U.S. House of Representatives, since House committee members specialize more than those in the Senate. As Asher (1974) puts it, "congressmen accomplish their business largely by relying on the judgment of others." See also Shepsle (1988) in this regard. In short, the organization and effective operation of Congress via the committee system means that those in positions of agenda-setting power on an issue are better informed and relied upon on that issue.

5.1.2 "Crises"

Although conventional wisdom is that all lawmakers may have similar information in times of extreme crisis when there is a "need for action", we do not agree. Though there may be a common perception that there is a crisis which calls for a policy response, there will likely be disagreement among lawmakers about the causes, development, and magnitude of the crisis. Hence, in addition to any differences in preferred response due to ideological differences, lawmakers will likely disagree about the nature of the crisis and hence about the policy response. This was certainly the case for the 2008 financial crisis in the U.S. and the Bailout bill in September and October, over which debates continue. This was true in other countries as well. In Spain in 2008, for example, there were heated debates between the incumbent PSOE party, led by Zapatero, and the opposition party PP, led by Rajoy, about the severity of the economic downturn.[16]

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[14]See, for example, Ansolabehere, Snyder, and Tripathi (2002).

[15]http://www.senate.gov/artandhistory/history/common/briefing/Committees.htm

[16]We are indebted to Monica Martinez-Bravo for bringinging this to our attention. See for example, http://www.libertaddigital.com/economia/zapatero-se-burla-del-congreso-con-un-discurso-triunfalista-en-plena-crisis-1276334002/

Another example concerns New York State. Though the state faced large budget short-falls in the current economic downturn, "a lot of [state] legislators don't feel the sense of emergency," or, as one legislator put it, "it's not clear that the sky is in fact falling".[17] In contrast, Governor Patterson viewed the fiscal shortfall with such alarm that he proposed cuts in his own "pet projects", it would appear to emphasize the severity of the budget situation.[18] This obviously points to heterogeneous beliefs about the magnitude of the State's budget crisis among state legislators, where the administration proposing budget cuts faces disagreement the how serious the problem really is. In this paper we explore the possibility that cuts in pet projects could be more than mere budgetary necessity, but also an attempt to signal information about the severity of the State's fiscal standing.

5.2 Asymmetric information

Under asymmetric information, our equilibrium concept is Perfect Bayesian Equilibrium (PBE). In the open-amendment procedure we consider, the PBE is defined as follows.

Definition 1 *A perfect Bayesian equilibrium (PBE) is defined as a proposal* $\left\{g^P, \tau^P, s^{F,P}, s^{C,P}\right\}$ *and an accepted counterproposal (amendment)* $\left\{g^A, \tau^A, s^{F,A}, s^{C,A}\right\}$ *that satisfy the following conditions.*

1. Given the centrist's beliefs on the state z, *which we denote* $\tilde{z}$, *the formateur (in each state* $z = \bar{z}$ *and* $z = \underline{z}$*) offers a proposal that satisfies the following:*

$$\max_{g^P, \tau^P, s^{F,P}, s^{C,P}} \hat{u}\left(\tau^P\right) + (z + \alpha)\, v\left(g^P\right) + s^{F,P} \tag{20}$$

subject to the constraints (8b), (8c), (8d) and

$$\hat{u}\left(\tau^P\right) + \tilde{z} v\left(g^P\right) + s^{C,P} \geq U^C_{amend}.$$

In other words, the proposal maximizes the formateur's utility subject to the budget constraint, the participation of the coalition member, and the non-negativity constraints.

2. Beliefs $\tilde{z}$ *are consistent with the strategies of the formateur when* $z = \bar{z}$ *and* $z = \underline{z}$.

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3. $\left\{g^A, \tau^A, s^{F,A}, s^{C,A}\right\}$ constitutes a subgame equilibrium in the amendment round and U_{amend}^C is the resultant utility to the centrist in the equilibrium of this subgame.

There are two types of candidate subgame equilibria to the amendment subgame. We assume that the centrist enters the amendment subgame without updating his prior beliefs on the state $\tilde{z} = z^e$–an assumption that will be confirmed in equilibrium. In a *Pooling* subgame equilibrium, the centrist makes a single counterproposal $\left\{g^A, \tau^A, s^{F,A}, s^{C,A}\right\}$ that would be accepted by the formateur, regardless of the state $z \in \{\underline{z}, \bar{z}\}$.

A pooling subgame equilibrium solves

$$U_{amend}^C \equiv \max_{\tau^A, g^A, s^{F,A}, s^{C,A}} \hat{u}\left(\tau^A\right) + z^e v\left(g^A\right) + s^{C,A},$$

subject to *two* participation constraints for the formateur, i.e. (8a) holding for both $z = \underline{z}$ and $z = \bar{z}$, the budget constraint (8b) and the non-negativity constraints (8c), (8d).

In a *Separating* subgame equilibrium, the centrist screens for the formateur's "type" (the state of the world), by making two counterproposals. The counterproposals are such that the formateur accepts one if $z = \bar{z}$ and the other if $z = \underline{z}$, so that screening reveals the state.

The incentive compatibility (IC) constraints, ensuring that the formateur accepts the counterproposal designated for the current state of the world, can be summarized as

$$\hat{u}\left(\bar{\tau}^A\right) + (\bar{z} + \alpha) v\left(\bar{g}^A\right) + \bar{s}^{F,A} \geq \hat{u}\left(\underline{\tau}^A\right) + (\bar{z} + \alpha) v\left(\underline{g}^A\right) + \underline{s}^{F,A} \tag{21a}$$

$$\hat{u}\left(\underline{\tau}^A\right) + (\underline{z} + \alpha) v\left(\underline{g}^A\right) + \underline{s}^{F,A} \geq \hat{u}\left(\bar{\tau}^A\right) + (\underline{z} + \alpha) v\left(\bar{g}^A\right) + \bar{s}^{F,A}, \tag{21b}$$

where $\bar{x}^A$ is an element of the counterproposal to be accepted when $z = \bar{z}$, and $\underline{x}^A$ an element of the counterproposal to be accepted when $z = \underline{z}$. These incentive-compatibility (IC) constraints ensure that the formateur chooses the appropriate counterproposal for the actual state z, over the alternative counterproposal.

The two proposals jointly solve (7), maximized now with respect to policies for both states $z = \underline{z}$ and $z = \bar{z}$, subject to two participation constraints (8a) holding for both $z = \underline{z}$ and $z = \bar{z}$, the non-negativity constraints (8c), (8d) and the IC constraints (21).

The proposal round has two candidate equilibria as well. In a pooling equilibrium, the formateur proposes the same legislation $\forall z \in \{\underline{z}, \bar{z}\}$. The centrist's beliefs are $\tilde{z} = z^e$ when observing this legislation and his participation constraint (10) must be satisfied with $z = z^e$.

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(The budget constraint and non-negativity constraints on pork must also be satisfied.)

In a *Separating* equilibrium the formateur proposes different legislation in the two states of the world. These legislative proposals each satisfy (9) and (10) with the appropriate value of z. In addition, information revelation requires that (21a) hold when $z = \underline{z}$ and (21b) when $z = \bar{z}$. (Again, the budget constraint and non-negativity constraints on pork must also be satisfied.) In one state, the full information policy analyzed above is proposed and in the other the formateur choice of policy is distorted by the need to signal the state. Coalition members' beliefs are $\tilde{z} = z$ when the optimal proposals of the $z = \bar{z}$ and the $z = \underline{z}$ formateurs are observed.

5.3   Restricting pork

As the case when pork is restricted to zero is a benchmark for welfare evaluation, we begin by analyzing this case and then turn to a characterization of equilibrium with pork. The unavailability of pork means that the maximization problem is as described in section 5.2, with the additional constraint that $s^C = s^F = 0$. Legislative bargaining is over g and τ, alone, which subject the budget constraint (8b), is equivalent to a choice of a single policy instrument τ.

From here on, we restrict our previous assumption on the status quo policy to the case where it is at the level that would be chosen by a social planner in the absence of information about the state, that is,

$$\tau^q = \tau^* \left(z^e, X \right). \tag{22}$$

This restriction serves two purposes. First, the optimality of τ^q when no legislator knows the state means that our results on the social value of pork are not driven by extreme assumptions about the default policy. Second, we showed above that under full information, the pragmatic conventional wisdom would not hold when $\tau^q < \tau^* \left(z + \frac{\alpha}{2}, X \right)$. Showing it holds under asymmetric information highlights the role of information asymmetries in making the argument for the possible welfare benefits of pork.

When pork is restricted to be zero, the only equilibrium is pooling at the status quo policy $\tau^q = \tau^* \left(z^e; X \right)$. Given the centrist's beliefs $\tilde{z} = z^e$, the status quo policy τ^q is already his optimal policy, so that any change in policy for the same beliefs would violate his participation constraint. This policy is acceptable to the formateur, regardless of z. Hence,

Figure 1: No information transmission without pork.

$\tau^*(\underline{z},X) \quad \tau^q=\tau^*(z^e,X) \quad \tau^*(\bar{z},X) \quad \tau^*(\underline{z}+\alpha,X) \quad (\bar{z}+\alpha)v_g(g^q)$
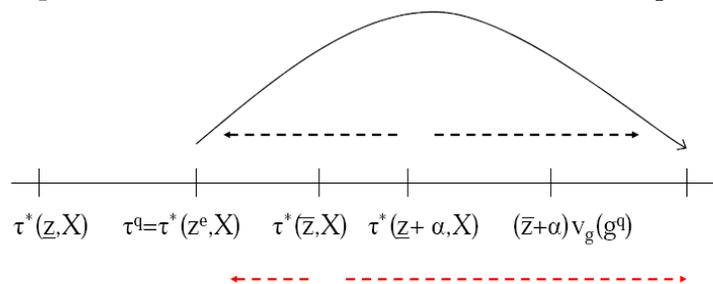
this is the only pooling equilibrium.

Screening (or signaling in the proposal round) is impossible because without pork the separating IC constraints and the centrist's participation constraint cannot be simultaneously satisfied. Separation cannot be achieved by decreasing taxes and public goods, as any such change would violate the formateur's participation constraint. Separation requires screening for the state $z = \bar{z}$ by increasing τ and g more than would be acceptable to the formateur if $z = \underline{z}$. That is, the tax rate must be no less than $\tau^*(\underline{z}+\alpha, X)$. However, the centrist strictly prefers $\tau^*(z^e; X)$ to $\tau^*(\underline{z}+\alpha, X)$ (or any higher tax rate) *even if* $\tilde{z} = \bar{z}$. Hence, no proposal satisfies both the separation and the centrist's participation constraint and no separating PBE exists. We are left with pooling at $\tau = \tau^q$.

The intuition of this claim is illustrated in Figure 1. Various preferred tax rates (in the absence of pork) are ranked along the number line in the figure: (1) the preferred tax rate of the centrist when the state is known to be $z = \underline{z}$; (2) the preferred tax rate of the centrist based on his prior $z = z^e$, corresponding with the status quo; (3) the preferred tax rate of the centrist when $z = \bar{z}$ is known; (4) the preferred tax rate of the formateur when $z = \underline{z}$; and (5) the preferred tax rate of the formateur when $z = \bar{z}$. Information transmission requires an increase in taxes (and public spending) to a point far enough to the right in the diagram that the formateur would not accept if $z = \underline{z}$, but would nevertheless accept when $z = \bar{z}$. This is indicated with the arrow above the axis. However, as $\alpha > \bar{z} - \underline{z}$, this point is farther from the centrist's preferred tax rate than is the status quo, even when $z = \bar{z}$.

We summarize these results as

Proposition 4 *If pork is exogenously restricted to zero, the unique PBE equilibrium is pooling at the status quo.*

Proof. Discussion in the text above. ∎

As no separating PBE exists, the unique PBE is the pooling equilibrium where the formateur proposes the status quo regardless of the state of nature z. *Information transmission in the legislature is never possible in the absence of pork.* The joint task of signaling and coalition building are at odds with each other when pork is unavailable. In contrast, with pork, information transmission is almost always possible, as we show in the following section.

6 Pork As A Signal

We now show that under asymmetric information about the state, pork can and will be used to signal z, that is, a separating equilibrium is possible when pork is available. Appendix B gives a full characterization of this separating equilibrium. Not only is signalling possible, but for all but the highest values of X, separation is the only equilibrium and no pooling equilibrium exists. Even when policy is RPM when $z = \underline{z}$, pork may be provided when $z = \bar{z}$ because it is pork that allows policy to respond to the high value of public goods. Hence, pork is not antithetical to "responsible policy-making", but integral to it. We summarize this main result as

Proposition 5 *For any X such that*

$$\mu\left(\tau^q\right) < \frac{\underline{z} + \alpha - z^e}{\underline{z} + \alpha - \bar{z}}, \tag{23}$$

a separating Perfect Bayesian Equilibrium exists in the asymmetric information game. There is a unique separating equilibrium and it always contains a positive amount of pork provided to at least one legislative district when $z = \bar{z}$.

Proof. See Appendix E. ∎

Propositions 4 and 5 are the main positive results of our analysis.[19] The combination of an informed but ideological formateur ($\alpha > 0$) and a true need for increased public expenditures ($z = \bar{z}$) creates a signal extraction problem. When pork is unavailable, this problem is insurmountable and the formateur cannot credibly convey her superior information to

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[19]These results hold under a closed-amendment procedure as well.

coalition partners nor can the centrist screen for the state. However, the availability of pork can solve this information transmission problem: information transmission is always possible with pork for all by the highest levels of X. This is in stark contrast to the predictions of the full information model.

We can now characterize asymmetric information equilibria, which are formally derived in Appendix B. For very low levels of fiscal obligations X we are in complete BAU equilibrium, where both legislative districts receive pork. When $g^q > \bar{g}^{FI}$, where $\bar{g}^{FI}$ is the level of public spending under full information when $z = \bar{z}$, the formateur when $z = \underline{z}$ prefers the full information CBAU policy of $z = \bar{z}$. Screening for the state $z = \bar{z}$ requires increases in public spending (at the expense of pork to the formateur) to deter the formateur from accepting this policy when $z = \underline{z}$.

At slightly higher levels of X, specifically when $\bar{g}^{FI} \geq g^q \geq \underline{g}^{FI}$, where $\underline{g}^{FI}$ is the equilibrium level of public spending under complete information when $z = \underline{z}$, the full-information equilibrium proposals are accepted without the need for costly screening/signalling.

At levels of X, specifically when $g^q \leq \underline{g}^{FI}$, the formateur when $z = \bar{z}$ is tempted by the $z = \underline{z}$ full-information policy. (At these levels of X we may be in CBAU or in PBAU.) Accordingly, costly screening is required when $z = \underline{z}$. This involves cutting public good expenditure in favor of pork to the centrist, up to a point where the formateur is no longer tempted by this proposal.

Finally, at the highest levels of fiscal obligations X, it is once again the $z = \underline{z}$ formateur that is tempted by the $z = \underline{z}$ proposal. For example, if the full information equilibrium is RPM in both states the agenda setter the agenda setter prefers the full-information proposal for $z = \bar{z}$ of $\tau = \tau^*(\bar{z}, X)$ and $g = R(\tau^*(\bar{z}, X)) - X$ to the status quo, regardless of the value of z. The policy under asymmetric information is RPM when $z = \underline{z}$, but the $z = \bar{z}$ policy is distorted by costly screening–involving pork barrel spending–to prevent the formateur from accepting this policy when $z = \underline{z}$. This case is outlined in detail in the following section.

6.1   Separating equilibrium – the basic argument

We prove the existence of a separating equilibrium by constructing such an equilibrium, where the essence of the construction is useful in understanding the result. The key point is that the formateur values spending less when $z = \underline{z}$ than when $z = \bar{z}$. Therefore a costly

marginal increase in tax revenues relative to the status quo could be used for an increase in g that is small enough that the formateur would accept it only if $z = \bar{z}$. The remaining tax revenues go as pork to the centrist; these are sufficient to make the centrist better off.

Crucial to the argument is that the marginal tax increase goes neither entirely to higher g nor to pork, but is divided in such a way to make both the $z = \bar{z}$ formateur and the centrist better off (the former to satisfy her participation constraint) but to leave the formateur no better off if $z = \underline{z}$ (to satisfy the separation condition).

Consider levels of X that are high enough that the full-information equilibrium is at the status quo when $z = \underline{z}$ (and at $\tau = \tau^*(\bar{z}, X)$ when $z = \bar{z}$). The natural candidate for a pooling equilibrium is pooling at the status quo.

Consider, however, a marginal deviation from the status quo where an infinitessimal increase (of unit measure) in tax revenues is used to finance a combination of higher public expenditure Δg and pork to the centrist of $\Delta s^C = 1 - \Delta g$, and such that

$$\Delta g = \frac{\mu\left(\tau^q\right)}{(\underline{z} + \alpha) \, v_g\left(g^q\right)} < 1. \tag{24}$$

In words, consider a fraction Δg of the tax increase such that the marginal cost of the increase in taxation is just equal to the marginal value of the increase in g to the formateur if $z = \underline{z}$. This is budget feasible since $(\underline{z} + \alpha) \, v_g\left(g^q\right) > \mu\left(\tau^q\right)$ (the left-wing formateur supports an increase in public goods spending even when $z = \underline{z}$).

This deviation is acceptable to the formateur when $z = \bar{z}$, as her utility changes by

$$\Delta g\left(\bar{z} + \alpha\right) v_g\left(g^q\right) - \mu\left(\tau^q\right)$$
$$= \mu\left(\tau^q\right)\left(\frac{\bar{z} + \alpha}{\underline{z} + \alpha} - 1\right) > 0,$$

This change in policy alone does not make the centrist better off, even when $z = \bar{z}$:

$$\bar{z}v_g\left(g^q\right)\Delta g - \mu\left(\tau^q\right)$$
$$= \mu\left(\tau^q\right)\left(\frac{\bar{z}}{\underline{z} + \alpha} - 1\right) < 0,$$

because $\underline{z} + \alpha > \bar{z}$. This was precisely the argument in Section 5.3: if ideology dominates economic conditions, signalling is not possible in the absence of pork.

But with the remaining tax revenues $(1-\Delta g)$ allocated as pork to the centrist the centrist is better off, if

$$\bar{z}v_g\left(g^q\right)\Delta g - \mu\left(\tau^q\right) + 1 - \Delta g \geq 0$$

or, using (24),

$$\frac{1 - \bar{z}v_g\left(g^q\right)}{\left(\underline{z} + \alpha\right)v_g\left(g^q\right)} \leq \frac{1 - \mu\left(\tau^q\right)}{\mu\left(\tau^q\right)}. \tag{25}$$

This inequality must hold whenever $\mu\left(\tau^q\right) \leq 1$, since $\bar{z}v_g\left(g^q\right) > \mu\left(\tau^q\right)$ and $\left(\underline{z} + \alpha\right)v_g\left(g^q\right) > \mu\left(\tau^q\right)$. Referring back to Proposition 2, note that this includes parts of the state space where pork would not be provided for either value of z under full information. Here, pork is provided when $z = \bar{z}$, i.e. when the public good is most valuable, but not when $z = \underline{z}$.

Using the fact that $z^e v_g\left(g^q\right) = \mu\left(\tau^q\right)$ to rewrite (25) gives (23) as a sufficient condition for the existence of a separating equilibrium involving pork.

As long as this condition holds, we can find a policy involving pork that is acceptable to the coalition if $z = \bar{z}$ but would not be if $z = \underline{z}$, thus signaling the state.

The intuition of why pork allows a policy response when $z = \bar{z}$, a response that would not be possible if pork were outlawed, may be explained as follows. The combined task of signalling and coalition building requires aiding and hurting different legislators–and in different states of nature–differentially. As demonstrated above, if *few* enough of the tax resources are allocated to public good expenditure, only when $z = \bar{z}$ would the formateur be willing to tolerate the cost of public funds required to finance them, hence signaling that $z = \bar{z}$. However, for this to be an equilibrium, the residual tax revenues cannot simply be "burned", which points to the coalition-building aspect of pork. As was the case when pork was restricted, a tax-expenditure trade-off that is unacceptable to the formateur when $z = \underline{z}$ will also be unacceptable to the centrist in either state of nature. Rather than disposing of the remaining tax revenues, the centrist extorts them as rents.

The popular view of pork is that it is wasteful because it sacrifices the common good for sectorial interests. But this is precisely what makes pork a potent information-transmission tool. The joint task of signalling and coalition building cannot be achieved with common-good instruments alone if different factions disagree on the nature of the common good. An additional, discriminatory instrument is required, and pork is particularly suited for this task.

We note that this additional instrument need not be pork. Other policies (such as specific

legislative details) that have differential effects both across legislative districts and across "states of nature" could potentially serve the same purpose. In equilibrium, the information constraints requires the formateur to suffer harm (differentially relative to the $z = \underline{z}$ state), while the participation constraint requires making the centrist better off than he would be in status quo. Hence, redistribution is required both across districts and across states of nature. Policies that are usually viewed as inefficient may be required. Use of a policy that affects the "common good" would not work.

6.2 Illustration of "Kosher Pork"

The result that pork is allocated when $z = \bar{z}$ under asymmetric information in cases where RPM holds in both states under full information may be better understood from Figure 2, showing points of indifference with the status quo and the (top, dark blue) budget line. It is particularly illustrative to choose a high value of X, at which both legislators prefer public goods to pork regardless of z. In the absence of a rent-seeking motivation, information revelation is the primary role for pork. The circle marker shows the status quo, which is also equilibrium when $z = \underline{z}$, as we are considering parameter values, for which the $z = \underline{z}$ equilibrium is RPM.[20]

Screening for the state $\bar{z}$ requires a policy that the formateur would accept when $z = \bar{z}$, but not when $z = \underline{z}$. Revealing the state thus requires policies that are below the (second solid line from top, green) indifference curve of the formateur when $z = \underline{z}$. This indifference curve is drawn under the assumption that the formateur gets no pork (an assumption that is confirmed in equilibrium). For any proposed tax rate, separating requires a level of public good that the formateur would not tolerate at that tax rate if $z = \underline{z}$.

The vertical distance between the budget constraint and the level of public good proposed will be given to the centrist in the form of pork s^C. The formateur does not receive pork, as it does not help separate her from the formateur when $z = \underline{z}$, and provides her with a lower marginal utility than that of public good provision. The lowest (solid red) curve is the indifference curve of the centrist when it has been revealed that $z = \bar{z}$, while taking into account that the centrist receives all residual pork. It thus represents the centrist's participation con-

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[20]Parameter values used to create this figure were chosen for clarity of illustration, rather than to match realistic values. They have been chosen, moreover, so that the $z = \underline{z}$ equilibrium is RPM.

straint in the coalition conditional on his having learned the state $\bar{z}$. As the centrist prefers public goods to pork, once he has learned that $z = \bar{z}$, the centrist's participation requires policies that are above his indifference curve. Feasible legislative outcomes–regardless of legislative procedure–are therefore points within the lens between the green and red curves–the informational constraint and the centrist's participation constraint–and which in addition fall above the formateur's participation constraint when $z = \bar{z}$. (This latter constraint is not shown to avoid cluttering the figure. Its inclusion restricts feasible legislative outcomes only in the lower part of the lens.) The essence of Proposition 5 is to show that this lens is a non-empty set, so that profitable deviations from the status quo that reveal the state $z = \bar{z}$, are feasible.

In the open-amendment procedure we study, the centrist obtains all surplus. Thus equilibrium is the feasible legislative outcome that maximizes the centrist's utility. This point– illustrated with a square–is the point of tangency between the informational constraint and an indifference curve for the centrist. The (upper, red) dotted line represents the relevant indifference curve. Finally, an additional (lower, black) dotted line signifies points of indifference relative to the status quo for the average district, when $z = \bar{z}$. All points above this line represent higher social welfare compared to the status quo, when $z = \bar{z}$. As can be seen, an equilibrium involving pork is welfare improving.

Information transmission is costly. Under full information, when $z = \bar{z}$, equilibrium would be at $\tau^* (\bar{z}, X)$. This is the preferred pork-free policy of the centrist, which would occur at a point of tangency between the budget constraint and an indifference curve of the centrist. Given the high level of pre-existing fiscal commitments X, this policy is superior in a Pareto sense to the asymmetric information equilibrium. With asymmetric information, pork requires higher taxes and lower public good provision. Pork is costly, but necessary for information transmission and legislative change, and therefore socially valuable.

It is worth noting the importance of legislative procedure for this result. An open-amendment procedure gives maximal bargaining power to the centrist, whose policy preferences (not including pork) are identical to those of the average district. To take the opposite extreme, consider a closed-amendment procedure, which gives maximal bargaining power to the (partisan) formateur. Feasible legislation when $z = \bar{z}$ is as described above, but equilibrium is now the feasible policy that gives the formateur the highest utility. As the $z = \bar{z}$ formateur's indifference curve cannot be made tangent to the informational constraint

(they must have different slopes at any given point, as the formateur obtains no pork in either state, and has different trade-offs between taxation and public spending depending on z), equilibrium is at the intersection between the informational constraint and the centrist's participation constraint–on the far right hand side of Figure 2. With a closed-amendment procedure, legislation involves very little pork in this example (equilibrium is very close to the pork-free budget constraint). Nevertheless, equilibrium is slightly below the welfare indifference curve, and pork is welfare reducing.

How does one reconcile a lower allocation of pork (in a closed- relative to an open-amendment procedure) with lower social welfare? The answer lies in the fact that the partisan formateur uses the bargaining power bestowed upon her by the closed-amendment procedure to extract rents in terms of policy, rather than pork. Pork allows political compromise though information transmission. The formateur proposes legislation as close as possible to her (partisan) policy preferences that the centrist would accept–aided by some pork to sweeten the deal. But as the centrist's preferences are

$$\hat{u}(\tau) + \bar{z}v(g) + s^C$$

and those of the average district, when $s^F = 0$ are

$$\hat{u}(\tau) + \bar{z}v(g) + \frac{s^C}{3},$$

the centrist's binding participation constraint means that the average district is worse off, relative to the status quo. Ultimately, welfare-improving pork requires legislative procedure that gives sufficient bargaining power to "moderate" (in the sense of close-to-average) legislators.

7 Welfare-Improving Pork

The previous section demonstrated how pork may improve social welfare under certain conditions. We now try to ascertain whether such conditions are likely to arise in reality. To address this question, we solve the model computationally and calculate social welfare with and without the availability of pork.

Figure 2: Kosher Pork
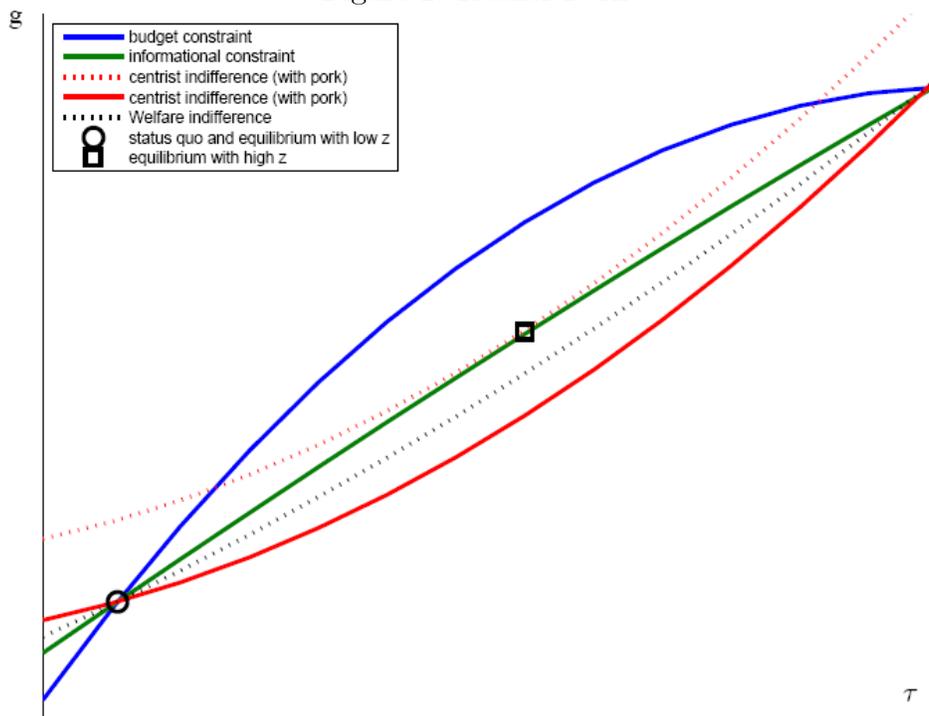
We present here the computational solution with standard functional forms and parameter values from the existing literature. We chose the logarithmic form for the $v(g)$ function. We set $\varepsilon = 1.7$, an elasticity commonly used in macroeconomic models (see for example Greenwood, Hercowitz, and Huffman, 1988).

The remaining variables $\bar{z}$, $\underline{z}$, p and α relate to fiscal policy and political economy and were chosen as follows. The sum of US Federal government expenditures on public consumption plus investment never exceeded 17% percent of GDP in the post-war era. As $\bar{g}^{BAU}$ is an upper bound on public good provision in the model, we fix parameters so that $\bar{g}^{BAU}$ comprises 17% of GDP. Consistent with our view of $\bar{z}$ being (relatively rare) times of crisis, we look for large shocks to public spending in the post-war data. Specifically, we look for years when the ratio of public purchases to GDP jumped by two standard deviations or more. This occurred six times or 9% of the years in the sample. We therefore choose $p = 0.09$ and set the gap between $\bar{z}$ and $\underline{z}$ to match the magnitude of such a 2-standard-deviation event (an increase of 2 percentage points in the ratio of government purchases to GDP.) Experimenting with

various values of p or of the gap $\bar{z} - \underline{z}$ did not affect our results qualitatively.[21]

Finally, our model assumptions require $\alpha > \bar{z} - \underline{z}$. With no clear way to pin down quantitatively the degree of political polarization on fiscal issues we present solutions to the model with $\alpha = 1.5\,(\bar{z} - \underline{z})$, but results are similar for other values of α. Exploring a range of parameter values led to results that were qualitatively similar. In addition, we note that the parametrization allows comparison with quantitative work in Azzimonti, et al's (2008) analysis of a full-information model of pork barrel spending: our choice of parameter values is roughly in line with the values arising from their calibration.

Results are shown in Figures 3 to 5. We solved the model for a range of X values, shown along the x-axis in all figures as a percentage of government revenues. "Reasonable" values of X depend on ones interpretation of this variable. Many political economy models of the determinants of fiscal policy consider only discretionary spending. With this assumption, X can be interpreted as debt service, which doesn't typically exceed 20% of revenues in industrialized countries.[22] A broader interpretation of X might include non-discretionary public spending, in which case its value may be much higher, often exceeding half of all revenues. For the sake of completeness, we show the entire range of X values from 0 to nearly 100% of revenues.

Figures 3 and 4 show how fiscal policy changes as increasing shares of revenues are pre-committed (higher values of X to total revenues). Solid lines in the figures reflect outcomes when $z = \underline{z}$ and dashed lines reflect outcomes when $z = \bar{z}$. Not surprisingly, as seen in Figure 3, tax rates increase (left panel) and government spending declines as X increases. As expected, public goods are higher, and therefore tax revenues are lower, when $z = \bar{z}$.

Figure 4 shows, however, that pork barrel spending responds non-monotonically to changes in both fiscal commitments X and the value of public goods z. At low levels of X (below 10% of total revenues in the figure) the economy is in Complete BAU for both values of z. Accordingly, pork barrel spending is high (exceeding 2% of GDP), but lower when $z = \bar{z}$ (less than 0.5% of GDP).

As X increases, the nature of pork barrel spending changes qualitatively. At higher

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[21]We experimented with a gap between $\bar{z}$ and $\underline{z}$ that range from those that deliver government spending to gdp gap between the two regimes of 1/100 of a percent to 10%. On p we experimented with values ranging from 1% to 50%.

[22]X should not be intepreted as total debt, as there is no need to repay the entire stock of debt from revenues of a single period.

Figure 3: Taxes (left) and public goods (right) as a percentage of GDP
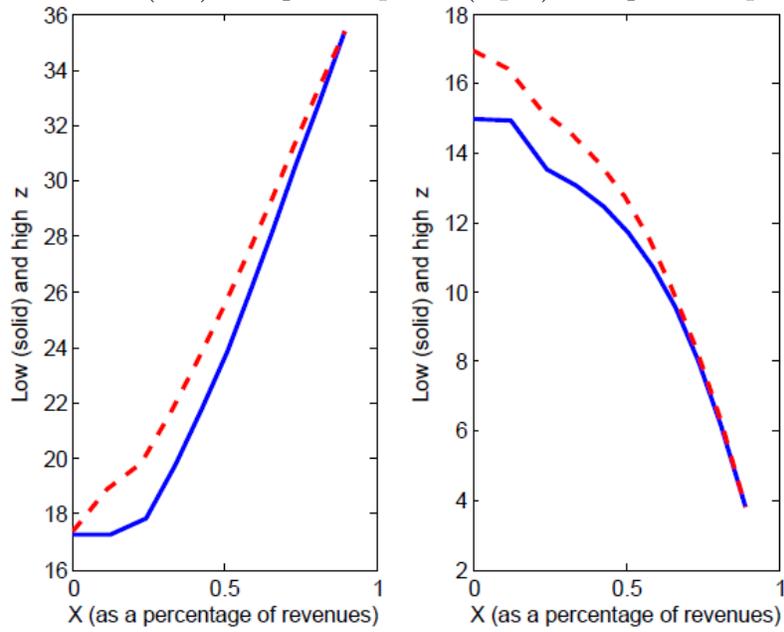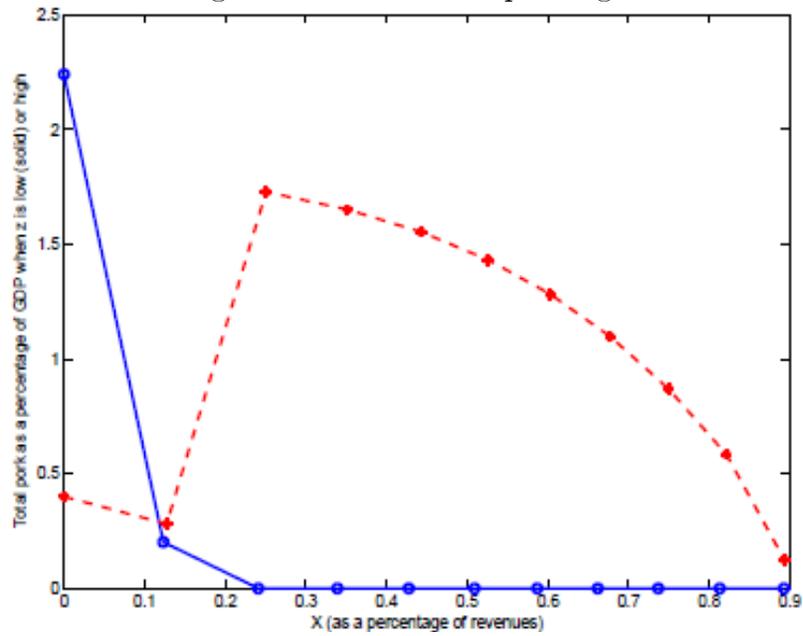

Figure 4: Pork Barrel Spending

levels of X (approximately 20% of tax revenues or higher) the economy would be in Partial BAU or RPM under full information. In the displayed imperfect information case, however, signalling the state z requires an RPM policy when $z = \underline{z}$ and a Partial BAU policy when $z = \bar{z}$, as in the analysis of the previous section. Pork is not provided when $z = \underline{z}$, but rather when $z = \bar{z}$ (ranging from 0% to 1.5% of GDP). Pork is *increasing* in the demand for public goods in this range and is non-monotonic in pre-existing fiscal commitments.

When X is very large such that condition (23) is violated, we are in RPM regardless of the value of z. As Figure 4 shows, however, this occurs only at very high levels of X, when non-discretionary fiscal commitments consume almost the entire budget. Condition (23) holds and pork is used as part of the policy process, in all but the most extreme cases of fiscal duress. Pork's informational role is central to this result: Under full information, the economy would be in RPM once X exceeds 60% of revenues with the same parameter values, regardless of the value of z.[23]

How does the availability of pork in the legislative process affect social welfare? The answer from our computational solutions is shown in Figure 5. Its left-hand side panel displays the difference between *expected* social welfare when pork is allowed and when pork is exogenously restricted to zero. The right-hand side panel shows the social welfare value of pork when $z = \bar{z}$. In both cases, welfare is measured as the consumption households would be willing to forgo to allow pork to be used in the legislative process, as a percentage of GDP. For low values of X, the economy is in complete BAU. While pork plays a signalling role in this case, pork consumes a large portion of fiscal resources, making its costs outweigh its benefits. As X increases, however, pork barrel spending is used primarily for informational, rather than rent-seeking purposes. Pork allows the centrist to learn when the state is $z = \bar{z}$ and to agree to higher public spending in this case. Information would not be revealed without pork, and policy would be sub-optimal. Welfare is therefore higher when pork is allowed for higher values of X.

As X increases further, the social value of pork diminishes. As X takes on an increasing share of revenues, the difference between public good provision in the two states of the world decreases; this can be seen in Figure 3. The value of "getting policy right" becomes smaller

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[23]With homogenous agents, RPM occurs at far lower values, when X exceeds 20% of revenues. With heterogeneous agents, the economy is in Partial BAU when the ratio of X to revenues is in the 20% to 60% range.

Figure 5: Social value of pork as a percent of GDP in expectation (left) and when z is high (right)
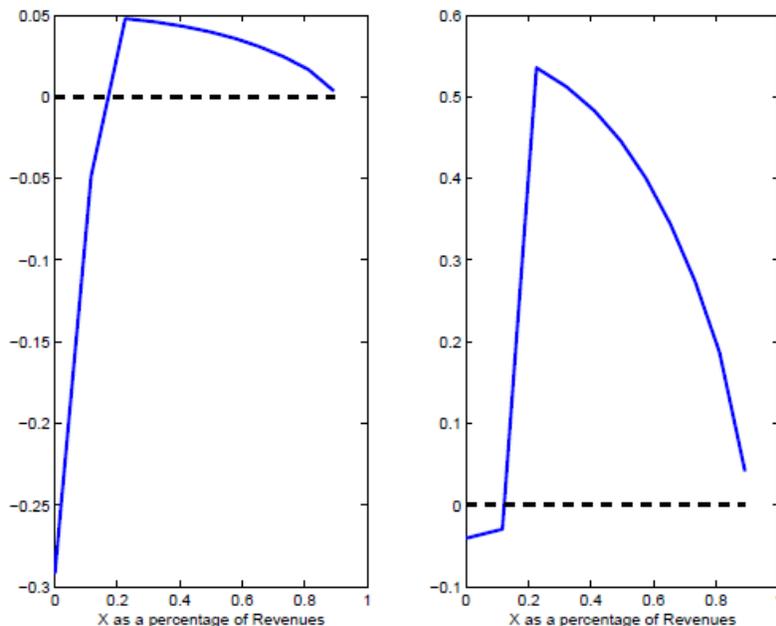
and so the social value of pork as a tool for information transmission declines. At the limit as X exhausts all fiscal resources, the difference between optimal public good provision for the two states of the world approaches zero. The value of signalling goes to zero and eventually legislators no longer choose to use pork to inform the centrist. This explains why there exists an upper bound on X, given implicitly by (23), above which pork is no longer distributed in equilibrium. As we have noted, however, this bound is reached only when non-discretionary fiscal commitments exhaust almost all tax revenues.

Pork is "kosher" for a large range of X. Its expected welfare value is typically small, however, never exceeding 0.05% of GDP in the parameterization we have chosen. But as can be seen from the right-hand side panel of the figure, focusing attention on the state $z = \bar{z}$, the social value of pork is rather large, exceeding 0.5% of GDP. The difference between the two panels is due to the fact that $z = \bar{z}$ occurs less than 10% of the time. Obviously, higher values of p would lead to higher expected values of pork.

In this section, we demonstrated that pork might play a socially beneficial role for reasonably chosen parameter values. The social value of pork does, however, depend on economic conditions–higher when debt (or other non-discretionary fiscal commitments) are large. From

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a positive perspective, our model implies non-trivial effects of the value of public goods and the magnitude of debt on pork barrel spending. At low levels of debt, pork barrel spending is higher when the demand for public goods is low, as previous research has suggested. But at higher levels of debt, this relationship may be reversed, with more pork barrel spending when public goods are most valuable. While the overall relationship between public debt and pork barrel spending is negative, this relationship, too, is not monotonic.

8   Conclusions

Pork barrel spending is generally viewed as "politics as usual" with lawmakers choosing to make expenditures to benefit their constituents at the general expense and to be distinguished from "responsible policy making" when public goods have high value. In this paper we have re-examined this view when all legislators are not equally informed and differ in the value they assign to public spending in the current economic situation. We argued that once one considers legislators who are heterogeneous both in ideology and their information about the economic situation, allocation of pork may serve a function in the legislative process of enabling the formation of coalitions to pass legislation appropriate to the situation.

Pork "greases the wheels" of the legislative process, but does this not by bribing legislators to accept legislation they view as harmful, but by conveying information about the state of the world and hence the value of policy change. We showed that it may be impossible to convey such information if signaling must be done via policies that affect general welfare directly. Hence, conceptually, we think it is incorrect to argue that pork is simply "politics as usual" that is a sign of the absence of responsible policy-making. As we argued in the previous section, pork is not antithetical to "responsible policy making" but in fact may be crucial to policy being able to respond to a high valuation of the public good.

More generally, our results suggest that if signaling the value of policy change is important, it may better to use changes in policy that has no broad social benefit in order to convey information and build coalitions rather than using changes in policy with direct social benefits. Or, a leader may want to signal the importance she assigns to larger policy goals (for example, energy independence) by forgoing her preferred policy on smaller goals (for example, by allowing offshore oil drilling in specific areas).

Our arguments are in line other work in political economy arguing that specific political

institutions may be useful in conveying information. This may explain complex procedures, for example, standing committees and restrictive amendment procedures, as in Gilligan and Krehbiel (1987). As in the case of pork, information transmission may be important in an otherwise reviled practice, for example, special interest lobbies who have superior information about the effect of policies.

What should a reader take away from the paper? We think the general message is three-fold. First, in analyzing how legislatures operate, assuming homogeneous legislators may be reasonable for some questions but not others. This is more than the argument that heterogeneity is the *sine qua non* of political economy (Drazen, 2000); this is well recognized. It is the argument that the nature of heterogeneity may be crucial in analyzing political phenomena and especially how legislatures operate. Second, and more specifically, since coalition-building among legislators with different preferences is crucial to passing legislation, the allocation of pork or "favors" will play a role in the process. This too is recognized. Our addition is to show that this role may be for better-informed legislative leaders to convince less-informed legislators of the need for policy changes. Third, and most generally, our paper presents yet another example of pitfalls in using representative agent models.

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APPENDICES

A   Analysis of full-information equilibrium

We outline the subgame equilibrium of the amendment round in this appendix. As noted in the text, the equilibrium of the legislative game under full information is identical to the outcome of the amendment round.

Let λ be the multiplier on the budget constraint (8b) and ϕ^F the multiplier on the formateur's participation constraint (8a) in the amendment round. ξ^C and ξ^F are the non-negativity constraints on s^C and s^F, respectively. Then the first order conditions of the full-information problem, described in (7) to (8d) are

$$\left[z + \phi^F \left(z + \alpha \right) \right] v_g \left(g \right) = \lambda$$
$$\left(1 + \phi^F \right) \mu \left(\tau \right) = \lambda$$
$$1 + \xi^C = \lambda$$
$$\phi^F + \xi^F = \lambda.$$

We have four possible regimes, depending on the values of ξ^F and ξ^C, i.e. whether both the formateur and the centrist, only one of the two, or neither receives pork.

The first regime is Complete BAU where $\xi^F = \xi^C = 0$ and $\lambda = \phi^C = 1$, so that

$$2\mu \left(\tau \right) = \left(2z + \alpha \right) v_g \left(g \right) = 1.$$

s^F is found through (8a) and s^C via (8b), both holding with equality.

A second possible regime is RPM, where $s^F = s^C = 0$. It is easy to show that when $z = \underline{z}$, RPM equilibrium is at the status quo: $\tau = \tau^q$ and $g = g^q$. When $z = \bar{z}$, equilibrium is at $\tau = \tau^* \left(\bar{z}, X \right)$ and $g = R \left(\tau^* \left(\bar{z}, X \right) \right) - X$. Both are the best no-pork policies that the centrist can propose, subject to the formateur's participation.

The final two regimes are partial BAU which differ from one another according to which legislator receives pork. When $z = \bar{z}$, only the centrist obtains pork in partial BAU. When $z = \underline{z}$ the legislator who obtains pork is uniquely determined by the value z^e. If $z^e < \bar{z} + \frac{\alpha}{2}$ (which is always the case if $p < \frac{1}{2}$, because $z^e = \left(1 - p \right) \underline{z} + p\bar{z}$ and $\alpha > \bar{z} - \underline{z}$), only the centrist obtains pork in PBAU. This is because the status quo $\tau^q = \tau^* \left(z^e, X \right)$ is closer to the preferred no-pork policy of centrist $\tau^* \left(\underline{z}, X \right)$ than that of the agenda center $\tau^* \left(\underline{z} + \alpha, X \right)$. As both legislators place the same value on pork, efficient compromise requires a shift in policy $\{ \tau, g \}$ that favors the formateur, with the centrist compensated with pork. The opposite is true when $z^e > \bar{z} + \frac{\alpha}{2}$; the formateur then obtains pork in PBAU.[24]

When the centrist obtains pork in PBAU, $\lambda = 1$ and the first order conditions above imply that g, τ, and s^C are given jointly by (8a) and (8b) both holding with equality with s^F set

---

[24]If $z^e = \bar{z} + \frac{\alpha}{2}$, PBAU does not arise in equilibrium and RPM and CBAU are the only possible regimes.

to zero, combined with

$$\frac{(z + \alpha) v_g (g)}{1 - z v_g (g)} = \frac{\mu (\tau)}{1 - \mu (\tau)}. \qquad (26)$$

When $z = \bar{z}$, There is a special case where this system of equations leads to $\mu (\tau) > 1$. This cannot be equilibrium, because the centrist prefers cutting taxes at the expense of his own pork. This is a case where the formateur's participation constraint is not binding, $\phi^F = 0$ and equilibrium satisfies

$$\mu (\tau) = \bar{z} v_g (g) = 1$$

and s^C is given by the budget constraint (8b) holding with equality.

When the formateur obtains pork in PBAU, the first order conditions above imply that g, τ, and s^F are given jointly by (8a) and (8b) holding with equality with s^C set to zero in the latter, combined with

$$\frac{z v_g (g)}{1 - (z + \alpha) v_g (g)} = \frac{\mu (\tau)}{1 - \mu (\tau)}. \qquad (27)$$

B   Asymmetric Information Equilibrium

We characterize the solution to the amendment subgame under asymmetric information. Appendix D then shows that the policy that results from this subgame is indeed the legislative outcome. The amendment round will have been reached only if no information was revealed in the first round. The centrist then makes a take-it-or-leave-it offer to the formateur.

There are two candidate equilibria: pooling or separating. We focus on separating equilibrium. Appendix C provides an analysis of the candidate pooling equilibrium and the proof of proposition 5, showing that a pooling equilibrium does not exist when (23) holds.

In a separating equilibrium, the centrist makes two proposed amendments, one which would be accepted when $z = \underline{z}$, the other when $z = \bar{z}$. We denote with upper and lower bars the policies in these two proposals, respectively. The two amendments jointly maximize

$$\max_{\substack{\bar{\tau}, \bar{g}, \bar{s}^C, \bar{s}^F, \\ \underline{\tau}, \underline{g}, \underline{s}^C, \underline{s}^F}} \left\{ \begin{array}{c} p \left[\hat{u} (\bar{\tau}) + \bar{z} v (\bar{g}) + \bar{s}^C \right] \\ + (1 - p) \left[\hat{u} (\underline{\tau}) + \bar{z} v (\underline{g}) + \underline{s}^C \right] \end{array} \right\}$$

subject to the budget constraints for $z = \bar{z}$ and $z = \underline{z}$:

$$R (\bar{\tau}) \geq \bar{g} + X + \bar{s}^C + \bar{s}^F$$
$$R (\underline{\tau}) \geq \underline{g} + X + \underline{s}^C + \underline{s}^F,$$

the participation constraints $z = \bar{z}$ and $z = \underline{z}$:

$$\hat{u} (\bar{\tau}) + (\bar{z} + \alpha) v (\bar{g}) + \bar{s}^F \geq \hat{u} (\tau^q) + (\bar{z} + \alpha) v (g^q) \qquad (28)$$
$$\hat{u} (\underline{\tau}) + (\underline{z} + \alpha) v (\underline{g}) + \underline{s}^F \geq \hat{u} (\tau^q) + (\underline{z} + \alpha) v (g^q), \qquad (29)$$

the incentive-compatibility (IC) constraints for $z = \bar{z}$ and $z = \underline{z}$:

$$\hat{u}\left(\bar{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F \geq \hat{u}\left(\underline{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F \tag{30}$$

$$\hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F \geq \hat{u}\left(\bar{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F, \tag{31}$$

and the regular non-negativity constraints on pork.

B.1 Which constraints are binding?

There are several cases depending on which of the constraints (the two participation constraints and two IC constraints) are binding. We start by asking when the full information equilibrium is incentive compatible in itself, i.e. both the IC constraints are slack. We then consider cases when costly screening is necessary, i.e. one of the IC constraints is binding.

B.1.1 Case 1: Full information equilibrium is incentive compatible

We begin by assessing when the full-information policy is incentive compatible, and therefore is a separating equilibrium. In the full information equilibrium, the IC constraints are slack and the two participation constraints are binding so that

$$
\begin{aligned}
\hat{u}\left(\bar{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F &= \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v\left(g^q\right) \\
&= \hat{u}\left(\tau^q\right) + \left(\underline{z} + \alpha\right) v\left(g^q\right) + \left(\bar{z} - \underline{z}\right) v\left(g^q\right) \\
&= \hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F + \left(\bar{z} - \underline{z}\right) v\left(g^q\right).
\end{aligned}
$$

Then (30) is equivalent to $g^q \geq \underline{g}$. Similarly,

$$
\begin{aligned}
\hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F &= \hat{u}\left(\tau^q\right) + \left(\underline{z} + \alpha\right) v\left(g^q\right) \\
&= \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v\left(g^q\right) - \left(\bar{z} - \underline{z}\right) v\left(g^q\right) \\
&= \hat{u}\left(\bar{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F - \left(\bar{z} - \underline{z}\right) v\left(g^q\right),
\end{aligned}
$$

and (31) is equivalent to $\bar{g} \geq g^q$. Thus the full-information equilibrium screens for z if and only if

$$\bar{g}^{FI} \geq g^q \geq \underline{g}^{FI},$$

where $\bar{g}^{FI}$ and $\underline{g}^{FI}$ are the levels of public spending arising in the full-information equilibrium when $z = \bar{z}$ and $z = \underline{z}$, respectively. If $\tau^q = \tau^*\left(z^e, X\right)$ then $\underline{g}^{FI} \geq g^q$ in PBAU and in RPM. Then $g^q \geq \underline{g}^{FI}$ requires that $\underline{g}^{FI}$ be the full-information CBAU policy, and this last set of inequalities is equivalent to

$$\bar{g}^{FI} \geq g^q \geq \underline{g}^{BAU}.$$

B.1.2 Case 2: Costly screening

In the remainder of the state space (for the remaining values of X) costly screening is necessary and one of the incentive-compatibility constraints must be binding.

First we show that one of the two participation constraints is slack when $g^q \notin \left[\underline{g}, \bar{g}\right]$. If $g^q > \bar{g}$ then the $z = \underline{z}$ participation (29) is not binding as

$$
\begin{aligned}
\hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F &\geq \hat{u}\left(\bar{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F \qquad\qquad (32)\\
&= \hat{u}\left(\bar{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F - \left(\bar{z} - \underline{z}\right) v\left(\bar{g}\right)\\
&\geq \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v\left(g^q\right) - \left(\bar{z} - \underline{z}\right) v\left(\bar{g}\right)\\
&= \hat{u}\left(\tau^q\right) + \left(\underline{z} + \alpha\right) v\left(g^q\right) + \left(\bar{z} - \underline{z}\right)\left[v\left(g^q\right) - v\left(\bar{g}\right)\right],
\end{aligned}
$$

with the first inequality following from the $z = \underline{z}$ IC constraint (31) and the second from the participation constraint when $z = \bar{z}$ (28). Comparing the first term with the last, if $g^q > \bar{g}$, (29) is slack.

Similarly, if $g^q < \underline{g}$ then (28) is slack, because

$$
\begin{aligned}
\hat{u}\left(\bar{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F &\geq \hat{u}\left(\underline{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F\\
&= \hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F + \left(\bar{z} - \underline{z}\right) v\left(\underline{g}\right)\\
&\geq \hat{u}\left(\tau^q\right) + \left(\underline{z} + \alpha\right) v\left(g^q\right) + \left(\bar{z} - \underline{z}\right) v\left(\underline{g}\right)\\
&= \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v\left(g^q\right) + \left(\bar{z} - \underline{z}\right)\left[v\left(\underline{g}\right) - v\left(g^q\right)\right],
\end{aligned}
$$

where the first inequality follows from the $z = \bar{z}$ IC constraint (30) and the second from the $z = \underline{z}$ participation constraint (29). Comparing the first and last terms we see that (28) is slack if $g^q < \underline{g}$.

Next, we show that at least one incentive compatibility constraint must be slack. Writing (30) as

$$
\hat{u}\left(\bar{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F + \left(\bar{z} - \underline{z}\right)\left[v\left(\bar{g}\right) - v\left(\underline{g}\right)\right] \geq \hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F
$$

and combining with (31) gives

$$
\begin{aligned}
&\hat{u}\left(\bar{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F + \left(\bar{z} - \underline{z}\right)\left[v\left(\bar{g}\right) - v\left(\underline{g}\right)\right]\\
&\geq \hat{u}\left(\underline{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\underline{g}\right) + \underline{s}^F\\
&\geq \hat{u}\left(\bar{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\bar{g}\right) + \bar{s}^F.
\end{aligned}
$$

As $\bar{g} > \underline{g}$ in a separating equilibrium, at least one of the two incentive-compatibility constraints must be slack. (We have already considered the case when both are slack in the previous section.)

B.2 Characterizing equilibrium

As in the full-information case, the state space can be partitioned into three regions, with increasing values of X. For the lowest values of X, equilibrium is CBAU, regardless of the value of z. Screening is then achieved by cutting the formateur's pork in favor of public goods (relative to the full-information equilibrium) to screen for $z = \bar{z}$ or cutting public goods in favor of pork to the formateur to screen for $z = \underline{z}$. For intermediate values of X, equilibrium is PBAU for at least one value of z. Finally, for the highest levels of X, such that (23) no longer holds, equilibrium is RPM (pooling at the status quo).

Given the large number of cases that might arise, we do not provide a full characterization of the separating equilibrium. Such analysis is available upon request. Section 6.1 analyzes a particularly interesting case that arises for the highest values of X at which (23) still holds. There the equilibrium is RPM when $z = \underline{z}$, but PBAU when $z = \bar{z}$. For the sake of further illustration, we analyze the opposite extreme, when X is low enough that equilibrium is CBAU for both values of z.

B.3 Analysis of CBAU

When X is sufficiently low, equilibrium is CBAU regardless of the value of z. Within this regime, three cases can emerge. For the lowest values of X, the formateur when $z = \underline{z}$ is tempted to accept the full-information policy for the $z = \bar{z}$ state. $z = \bar{z}$ policy must therefore be altered to screen for the state, while the full-information levels of public goods and taxation arise when $z = \underline{z}$. For intermediate values of X, the full-information equilibrium is information revealing, as discussed above in Section B.1.1. For higher values of X, screening requires distorting the $z = \underline{z}$ full-information policy, as it is now in the state $z = \bar{z}$ that the formateur is tempted by the full-information policy of the other state.

B.3.1 Low X

When X is sufficiently low (implying that g^q, which is strictly decreasing in X, is high) $g^q > \bar{g}^{BAU}$ and we concluded in Section B.1.2 that that the $z = \underline{z}$ participation constraint and the $z = \bar{z}$ IC constraint are both slack. The $z = \underline{z}$ IC constraint (31) and the $z = \bar{z}$ participation constraint are both binding. The first order conditions of the centrist's maximization problem then give $\underline{\tau} = \tau^{BAU}$ and $\underline{g} = g^{BAU}$.

When $z = \bar{z}$, policy is distorted due to screening. The first order conditions of the centrist's maximization problem are

$$\left(p + \bar{\phi} - \underline{\psi} \right) \mu \left(\bar{\tau} \right) = \bar{\lambda}$$

and

$$\left[p\bar{z} + \bar{\phi} \left(\bar{z} + \alpha \right) - \underline{\psi} \left(\underline{z} + \alpha \right) \right] v_g \left(\bar{g} \right) = \bar{\lambda},$$

where $\bar{\lambda}$, $\bar{\phi}$ and $\underline{\psi}$ are the Lagrange multipliers on the budget constraint when $z = \bar{z}$, the $z = \bar{z}$ participation constraint, and the $z = \underline{z}$ incentive-compatibility constraint, respectively.

As we are in CBAU, the first order conditions for pork give $\underline{\psi} = 1-p$, $\bar{\lambda} = p$ and $\bar{\phi} = \bar{\lambda}+\underline{\psi} = 1$. Together these give $\bar{\tau} = \tau^{BAU}$ and

$$\left[\bar{z} + \underline{z} + \alpha + \frac{\bar{z} - \underline{z}}{p}\right] v_g\left(\bar{g}\right) = 1. \tag{33}$$

As

$$\bar{z} + \underline{z} + \alpha + \frac{\bar{z} - \underline{z}}{p} > 2\bar{z} + \alpha,$$

this reflects higher public good provision than would be the case under full information.

To summarize, when $g^q > \bar{g}$, the formateur when $z = \underline{z}$ is tempted to accept the full information CBAU policy proposed for the $z = \bar{z}$ state. The centrist screens by increasing public spending to $g = \bar{g}$ as defined in (33), financed by the formateur's pork.

B.3.2   High X

We have seen in section B.1.1 that for intermediate values of X, where $g^q \in \left[\underline{g}^{BAU}, \bar{g}^{FI}\right]$, the full information equilibrium is separating. We now turn to the case when $g^q < \underline{g}^{BAU}$, but continue to consider the region where CBAU emerges as equilibrium for both values of z. As shown in section B.1.2, the $z = \bar{z}$ participation constraint (28) and the $z = \underline{z}$ IC constraint must be slack in this region. The two binding constraints are therefore the participation constraint for $z = \underline{z}$ (29) and the IC constraint for $z = \bar{z}$ (30).

With these two remaining constraints, equilibrium when $z = \bar{z}$ is characterized as in the full information case, with $\bar{\tau} = \tau^{BAU}$ and $\bar{g} = \bar{g}^{BAU}$. The $z = \underline{z}$ policy is distorted by the need to ensure that the $z = \bar{z}$ formateur does not prefer the $z = \underline{z}$ policy. The following first order conditions characterize the $z = \underline{z}$ policy:

$$\left(1 - p + \underline{\phi} - \bar{\psi}\right) \mu\left(\underline{\tau}\right) = \underline{\lambda} \tag{34}$$

and

$$\left[(1 - p)\underline{z} + \underline{\phi}\left(\underline{z} + \alpha\right) - \bar{\psi}\left(\bar{z} + \alpha\right)\right] v_g\left(\underline{g}\right) = \underline{\lambda}, \tag{35}$$

where $\underline{\lambda}$, $\underline{\phi}$ and $\bar{\psi}$ are the Lagrange multipliers on the budget constraint when $z = \underline{z}$, the $z = \underline{z}$ participation constraint, and the $z = \bar{z}$ IC constraint, respectively.

In CBAU, the first order conditions for pork give $\bar{\psi} = p$, $\underline{\lambda} = 1 - p$ and $\underline{\phi} = 1$. Using these values, the first order condition (34) gives $\underline{\tau} = \tau^{BAU}$ and (35) gives

$$\left[\bar{z} + \underline{z} + \alpha - \frac{\bar{z} - \underline{z}}{1 - p}\right] v_g\left(\underline{g}\right) = 1. \tag{36}$$

Noting that

$$\bar{z} + \underline{z} + \alpha - \frac{\bar{z} - \underline{z}}{1 - p} < 2\underline{z} + \alpha,$$

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this gives $\underline{g} < \underline{g}^{BAU}$.

This equilibrium is summarized as follows. In this region of the state space, the formateur when $z = \bar{z}$ is tempted by the full-information proposal for $z = \underline{z}$. Screening for $z = \underline{z}$ requires financing pork by cutting public expenditures to $g = \underline{g} < \underline{g}^{BAU}$: a level, which the formateur would not accept when $z = \bar{z}$.

C   Characterizing a candidate pooling equilibrium

We analyze a candidate pooling equilibrium in the amendment round, under the assumption that no information was revealed in the proposal round. The proof of proposition 5 then shows that even if the centrist arrived at the amendment round uninformed about the state z, the pooling subgame equilibrium analyzed here does not exist for most values of X. A pooling equilibrium for the amendment subgame exists only if the condition (23) does not hold, in which case the pooling equilibrium is the status quo. Appendix D then shows that the PBE of the legislative game is identical to the outcome of the amendment subgame.

In a pooling equilibrium the centrist does not attempt to screen for z, so that $\tilde{z} = z^e$. Accordingly, the centrist maximizes

$$\max_{\breve{\tau},\breve{g},\breve{s}^C,\breve{s}^F} \hat{u}\left(\breve{\tau}\right) + z^e v\left(\breve{g}\right) + \breve{s}^C,$$

(where we denote with "$\smile$" variables in a pooling equilibrium) subject to the budget constraint

$$R\left(\breve{\tau}\right) \geq \breve{g} + X + \breve{s}^C + \breve{s}^F; \tag{37}$$

two participation constraints, ensuring that the proposal is accepted by the formateur in either state of the world,

$$\begin{aligned} \hat{u}\left(\breve{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\breve{g}\right) + \breve{s}^F &\geq \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v\left(g^q\right) \\ \hat{u}\left(\breve{\tau}\right) + \left(\underline{z} + \alpha\right) v\left(\breve{g}\right) + \breve{s}^F &\geq \hat{u}\left(\tau^q\right) + \left(\underline{z} + \alpha\right) v\left(g^q\right); \end{aligned} \tag{38}$$

and the regular non-negativity constraints on $\breve{s}^C$ and $\breve{s}^F$. Notice that the two participation constraints cannot both hold with equality unless $\breve{g} = g^q$. The first constraint (for $z = \bar{z}$) is binding if $\breve{g} \leq g^q$, while the latter (for $z = \underline{z}$) is binding if $\breve{g} \geq g^q$. There are three possible regions of the state space, depending on which legislators obtain pork: CBAU, PBAU and RPM, arising for increasing levels of X. We analyze them in turn.

C.1   CBAU

For the lowest values of X, we are in complete BAU and the first order conditions of the pooling problem imply $\breve{\tau} = \tau^{BAU}$ and $\breve{g} = \breve{g}^{high}$ with

$$\left(z^e + \bar{z} + \alpha\right) v_g\left(\breve{g}^{high}\right) = 1, \tag{39}$$

if the $\bar{z}$ participation constraint is binding; or $\breve{\tau} = \tau^{BAU}$ and $\breve{g} = \breve{g}^{low}$ where

$$\left(z^e + \underline{z} + \alpha\right) v_g \left(\breve{g}^{low}\right) = 1, \tag{40}$$

if the $\underline{z}$ participation constraint is binding.

Noting that (a) $\breve{g}^{high} > \breve{g}^{low}$ are both dependent only on parameter values other than X and (b) g^q is decreasing in X, we can partition the CBAU state space into three regions based on increasing values of X.

- For the lowest values of X, $g^q > \breve{g}^{high} > \breve{g}^{low}$ and accordingly the $\bar{z}$ participation constraint is binding and $\breve{g} = \breve{g}^{high}$.

- For intermediate values of X, $\breve{g}^{high} > g^q > \breve{g}^{low}$ and the two participation constraints cannot jointly hold for either value of $\breve{g}$. No pooling equilibrium exists. (In this region, the full information CBAU equilibrium is information-revealing and constitutes the unique, separating, equilibrium.)

- For lower values of X, $\breve{g}^{high} > \breve{g}^{low} > g^q$ and the $\underline{z}$ participation constraint is binding and $\breve{g} = \breve{g}^{low}$.

C.2   PBAU

In PBAU, only the centrist obtains pork if $\tau^q = \tau^*\left(z^e, X\right)$. The status quo is closer (identical, in fact) to the no-pork policy most preferred by the centrist than that preferred by the formateur. A PBAU equilibrium constitutes a increase in public spending, desired by the formateur, in return for pork to the centrist.

As we have seen, with $\breve{g} > g^q$, the $\underline{z}$ participation constraint is binding so that the PBAU equilibrium $\left\{\breve{\tau}, \breve{g}, \breve{s}^C\right\}$ solves (37),

$$\hat{u}\left(\breve{\tau}\right) + \left(\bar{z} + \alpha\right) v\left(\breve{g}\right) = \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v\left(g^q\right)$$

and

$$\frac{1 - z^e v_g\left(\breve{g}\right)}{\left(\underline{z} + \alpha\right) v_g\left(\breve{g}\right)} = \frac{1 - \mu\left(\breve{\tau}\right)}{\mu\left(\breve{\tau}\right)}. \tag{41}$$

C.3   RPM

In RPM, the pooling equilibrium is trivially $\breve{\tau} = \tau^q$ and $\breve{g} = g^q$, with $\breve{s}^F = \breve{s}^C = 0$.

D   Analyzing the proposal round

Taking into account the subgame equilibrium of the amendment round as analyzed in Appendix B, we now move back to the proposal round. We show that the Markov Perfect

Equilibrium of the entire legislative game is identical to the outcome of the amendment sub-game. This occurs either because the game proceeds to the amendment round, or because a proposal identical to the amendment round subgame equilibrium is proposed and accepted in the proposal round.

The formateur's proposal-round problem is described in Definition 1. She maximizes her own utility, subject to the budget constraint; the centrist's participation constraint–making him no worse off than he would be if the game proceeded to the amendment round–given the centrist's information set; and non-negativity constraints on pork. The participation constraint requires the centrist to be no worse off than his expected value in the amendment sub-game. There are two candidate equilibria to the proposal subgame: pooling and separating (signalling).

When (23) holds, the equilibrium of the amendment subgame is separating as shown in the proof of Proposition 5. In this case, we now show there is no way for the formateur to satisfy the centrist's participation constraint in the proposal round, without proposing the exact same legislation that would result in the amendment round. When (23) does not hold, the equilibrium of the amendment subgame is (pooling at) the status quo. We will show that in this second case, the status quo is also the best that the formateur can achieve in the proposal round as well. In both cases, the outcome of the game is identical to the outcome of the amendment round as analyzed earlier.

First, let (23) hold. Equilibrium in the proposal round cannot be pooling. A pooling equilibrium in the proposal round would maximize the formateur's utility, subject to the same constraints faced by the centrist in the candidate pooling equilibrium described in Appendix C, with the added constraint that the centrist must obtain utility of at least U_{amend}^C: the centrist's actual expected utility in the amendment round. But this constraint cannot be satisfied. The equilibrium of the amendment subgame is separating, so that the centrist derives a higher expected utility (U_{amend}^C) from screening than he could in the candidate pooling equilibrium of the amendment subgame. Thus the constraint that the centrist obtain at least U_{amend}^C in the proposal round cannot be satisfied without making the formateur worse off than in the status quo.

We now show that any separating proposal the formateur might offer in the proposal subgame will also be rejected by the centrist (without loss of generality). Assume via contradiction that the proposal subgame is separating, so that the formateur's proposal reveals the state z and the centrist accepts this proposal. This cannot be equilibrium as a profitable deviation can be found for the centrist, if the formateur's proposal is sufficient to reveal the state z. The centrist can reject the proposal and use his knowledge of the state z to offer the undistorted full-information proposal for the revealed value of z. This is better than accepting the formateur's proposal, because costly signalling requires a distorted policy that destroys surplus relative to the full information proposal. (Of course, such a sequence of events cannot occur in equilibrium. If the centrist rejects the formateur's proposal, no information could have been revealed in the first place.) Thus without loss of generality, we can think of the centrist rejecting the proposal, not updating his beliefs $\tilde{z} = z^e$, and proceeding to the

amendment stage.[25]

If (23) does not hold, on the other hand, pooling at the status quo is the subgame equilibrium of the amendment round. In the proposal round, the formateur can do no better than the status quo for the same reason that the status quo arises as the outcome of the amendment round. As in the proof of Proposition 5, there is no deviation from the status quo that makes the centrist and the formateur better off when $z = \bar{z}$, while making the formateur worse off when $z = \underline{z}$, so as to reveal the state. (A similar argument shows that signalling $z = \underline{z}$ is also impossible.) With no information revealed, pooling at the status quo is the unique equilibrium. We conclude that the outcome of the amendment subgame is the Markov Perfect Equilibrium of the legislative game.

E   Proof of Propositions

E.1   Proposition 1

The non-negativity constraints on pork (8c) and (8d) govern the nature of equilibrium. If neither is binding, we are in Complete BAU. If both are binding, we are in RPM. If only one of the two is binding we are in Partial BAU, with the binding constraint governing who receives pork in PBAU.

We characterize the subgame equilibrium in the amendment legislative round. As discussed in the text, this same policy is the PBE of the entire game. We refer occasionally to the first order conditions of the centrist's maximization problem in the amendment round. These are summarized in Appendix A.

If equilibrium is CBAU, policy is $\{\tau, g\} = \left\{\tau^{BAU}, \bar{g}^{BAU}\right\}$, as described in Appendix A, where $\bar{g}^{BAU}$ is defined in the proposition. Pork is allocated to the formateur to satisfy her participation constraint

$$s^F = \hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v_g\left(g^q\right) - \left[\hat{u}\left(\tau^{BAU}\right) + \left(\bar{z} + \alpha\right) v_g\left(\bar{g}^{BAU}\right)\right] \geq 0.$$

The centrist obtains all remaining budgetary resources as pork

$$
\begin{aligned}
s^C &= R\left(\tau^{BAU}\right) - \bar{g}^{BAU} - X - s^F \\
&= R\left(\tau^{BAU}\right) - \bar{g}^{BAU} - X - \left[\hat{u}\left(\tau^q\right) + \left(\bar{z} + \alpha\right) v_g\left(g^q\right)\right] + \hat{u}\left(\tau^{BAU}\right) + \left(\bar{z} + \alpha\right) v_g\left(\bar{g}^{BAU}\right) \geq 0.
\end{aligned}
$$

The two inequalities above are required to satisfy the non-negativity constraints on pork. These hold if and only if equilibrium is CBAU and are identical to those in (12) and (13).

---

[25]We qualify statements in this paragraph with "without loss of generality" because there are scenarios where the full-information policy *is* the subgame equilibrium of the amendment round. In these cases costly signalling/screening is not necessary. In these cases the agenda setter could make a proposal that is as good for the centrist as proceeding to the amendment round. But in this case too, the centrist is no worse off rejecting the agenda setter's proposal and proceeding to the amendment round, where he makes an identical counterproposal.

The cutoff between PBAU and RPM is determined as follows. Think of the centrist as shifting policy from the status quo to equilibrium in two steps. First, he shifts tax and public good policy alone to the extent that he desires and that is feasible, without allocating pork. Second, pork may be allocated. In the first stage, the centrist's preferred no-pork policy $\{\tau, g\} = \{\tau^*(\bar{z}, X), R(\tau^*(\bar{z}, X)) - X\}$ is feasible and leaves the formateur's participation constraint slack. At this point, the centrist does not wish to change the mix of public goods and taxes, and with the formateur's participation constraint slack, has no reason to allocate pork to the formateur. Thus $\{\tau^*(\bar{z}, X), R(\tau^*(\bar{z}, X)) - X\}$ is equilibrium if and only if $\mu(\tau^*(\bar{z}, X)) = \bar{z}v_g(R(\tau^*(\bar{z}, X)) - X) < 1$.

To see this last point, if $\mu(\tau^*(\bar{z}, X)) < 1$, the formateur is willing (and able, due to the slack in the formateur's participation constraint,) to increase taxes and forgo public goods in favor of pork. If, on the other hand $\mu(\tau^*(\bar{z}, X)) = \bar{z}v_g(R(\tau^*(\bar{z}, X)) - X) > 1$, the centrist is not willing to increase taxes or forgo public goods in favor of pork, even if he is the sole recipient, and the no-pork policy is equilibrium.

If equilibrium is PBAU, it is only the centrist that obtains pork. Once the preferred no-pork policy of the centrist is reached (in the first step) the participation constraint of the formateur is slack and the centrist will never allocate pork to the formateur before this slack is exhausted by extracting pork for his own district.

E.2   Proposition 2

We focus again on the subgame equilibrium of the amendment stage. As discussed in the text, the PBE equilibrium of the entire legislative game will be the same. The non-negativity constraints on pork (8c) and (8d) govern the nature of equilibrium. If neither is binding, we are in Complete BAU. If both are binding, we are in RPM. If only one of the two is binding we are in Partial BAU, with the binding constraint governing who receives pork in PBAU. Our proof is in three steps, corresponding to the three possible regimes. We refer occasionally to the first order conditions of the centrist's maximization problem in the amendment round. These are summarized in Appendix A.

Step 1: Complete BAU   If neither of the non-negativity constraints is binding, the first order conditions arising from the centrist's maximization problem imply that taxes and public expenditures are set at $\{\tau^{BAU}, \underline{g}^{BAU}\}$, as defined in the proposition. Pork to the formateur follows from her participation constraint:

$$s^F = \hat{u}(\tau^q) + (\underline{z} + \alpha)v(g^q) - [\hat{u}(\tau^{BAU}) + (\underline{z} + \alpha)v(\underline{g}^{BAU})] \geq 0,$$

while all residual resources are devoted to pork to the centrist, given by the budget constraint:

$$\begin{aligned} s^C &= R(\tau^{BAU}) - \underline{g}^{BAU} - X - s^F \\ &= R(\tau^{BAU}) - \underline{g}^{BAU} - X - [\hat{u}(\tau^q) + (\underline{z} + \alpha)v(g^q)] + \hat{u}(\tau^{BAU}) + (\underline{z} + \alpha)v(\underline{g}^{BAU}) \geq 0. \end{aligned}$$

The inequalities in the two last equations are the non-negativity constraints on pork. If they are not binding, equilibrium is unconstrained by the non-negativity constraints on pork and is CBAU. If either of the constraints if binding, CBAU is not feasible. These two conditions are identical to those in (16).

Step 2: Partial BAU   Now consider cases when CBAU is not feasible and explore conditions for a partial BAU. Note that the centrist obtains pork in PBAU if $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$, while formateur obtains pork if $\tau^q > \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$. A policy shift towards higher taxes and public goods increases the coalition's surplus by more than a decrease in taxes and public goods if and only if $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$. The centrist must be compensated (with pork) for these higher taxes, even if these are used to finance public goods, as the centrist prefers a policy mix with lower taxes and public spending. This yields PBAU with pork to the centrist. Similarly if $\tau^q > \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$, shifting to lower taxes and public goods is more beneficial for the coalitions surplus. The formateur is compensated for this with pork and is the recipient of pork in PBAU.

Consider first the possibility that the centrist obtains pork in equilibrium. i.e. $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$. If the formateur does not receive pork, her participation constraint requires that she prefer the equilibrium mix of tax and public good policy to the status quo. This necessary condition for PBAU with pork to the centrist is equivalent to

$$\frac{(\underline{z} + \alpha) v_g (g^q)}{1 - \underline{z} v_g (g^q)} > \frac{\mu (\tau^q)}{1 - \mu (\tau^q)},$$

as the left hand size of the PBAU equilibrium condition (26) is decreasing in g and its right hand side is increasing in τ.

Having found a necessary condition for PBAU with the centrist receiving pork, we now show that this condition and $\mu (\tau^q) < 1$ are together sufficient to ensure that the economy is not in RPM. RPM equilibrium is at the status quo, from which a profitable deviation exists, if these conditions hold. An example of such a deviation entails an increase in taxation by one unit of revenues used to finance the minimal amount of public spending that the formateur would accept

$$\Delta g = \frac{\mu (\tau^q)}{(\underline{z} + \alpha) v_g (g^q)} < 1,$$

and the remaining $1 - \Delta g$ in revenues finance pork to the centrist. This increases the centrist's utility by

$$\underline{z} v_g (g^q) \Delta g - \mu (\tau^q) + 1 - \Delta g = 1 - \mu (\tau^q) - \mu (\tau^q) \frac{1 - \underline{z} v_g (g^q)}{(\underline{z} + \alpha) v_g (g^q)}.$$

This is positive whenever the above sufficient conditions hold, which are precisely the conditions described in the proposition.

Whenever $\tau^q < \tau^* \left(\underline{z} + \frac{\alpha}{2}, X \right)$, PBAU entails pork to the formateur only. A similar necessary

condition for PBAU is then

$$\frac{\underline{z}v_g\left(g\right)}{1-\left(\underline{z}+\alpha\right)v_g\left(g\right)} > \frac{\mu\left(\tau^q\right)}{1-\mu\left(\tau^q\right)},$$

which follows the same logic. If the centrist obtains no pork in equilibrium, policy must have shifted to a lower mix of taxes and public goods. This last inequality then follows from the equilibrium condition (27).

Again, we can show that this condition, together with $\mu\left(\tau^q\right) < 1$, is sufficient to ensure that we are not in RPM. When these sufficient conditions hold a profitable deviation from the status quo exists wherein taxes are cut–by one unit of revenues, for example–financed by the smallest cut in public expenditures Δg that would leave the formateur indifferent, if all remaining resources $1 - \Delta g$ are used to finance pork to the formateur alone. This gives

$$\mu\left(\tau^q\right) + \Delta g - 1 = \left(\underline{z} + \alpha\right)v_g\left(g^q\right)$$

or

$$\Delta g = \frac{1 - \mu\left(\tau^q\right)}{1 - \left(\underline{z} + \alpha\right)v_g\left(g^q\right)}.$$

This makes the centrist better off if

$$\mu\left(\tau^q\right) - \frac{1 - \mu\left(\tau^q\right)}{1 - \left(\underline{z} + \alpha\right)v_g\left(g^q\right)}\underline{z}v_g\left(g^q\right) > 0,$$

which is equivalent to the sufficient condition described above that is precisely the condition in the proposition.

Step 3: RPM If none of the conditions for CBAU or PBAU hold, we are in RPM.

E.3 Proposition 3

We divide the proof into two parts, depending on the value of z. As a preliminary, notice that the welfare function is $\hat{u}\left(\tau\right) + zv\left(g\right) + \frac{s^C + s^F}{3}$. The average district has the same policy preferences as the centrist, and values aggregate per-capita pork, regardless of the recipient.

z=$\underline{z}$ First, consider RPM. Here the status quo is adopted both with or without pork, so that welfare is no better with pork. Now consider either PBAU or CBAU. If $\tau^q < \tau^*\left(\underline{z} + \frac{\alpha}{2}, X\right)$, the equilibrium policy mix $\{\tau, g\}$ is a movement in favor of the formateur relative to the status quo. This means that the $\{\tau, g\}$ policy mix makes social welfare worse, relative to the status quo, which is equivalent to the no-pork equilibrium. In addition, equilibrium policy involves pork, which is welfare reducing, because $\mu\left(\tau^q\right) > \frac{1}{3}$ (pork is not socially desirable). Thus in all three regimes pork (weakly) reduces welfare.

If, however, $\tau^q > \tau^*\left(\underline{z} + \frac{\alpha}{2}, X\right)$, pork always increases welfare in PBAU (and may increase

welfare in CBAU). To see this, consider the PBAU regime. The centrist is better off in equilibrium than at the status quo, with no pork allocated to his district, so that in equilibrium $\hat{u}(\tau) + \underline{z}v(g) \geq \hat{u}(\tau^q) + \underline{z}v(g^q)$. But as welfare is given by $\hat{u}(\tau) + \underline{z}v(g) + \frac{s^F}{3}$, this must exceed welfare in an equilibrium with no pork, $\hat{u}(\tau^q) + \underline{z}v(g^q)$. By continuity, welfare must be higher with than without pork for the highest levels of X that are still consistent with the CBAU regime.

z=z̄ Without pork, equilibrium when $z = \bar{z}$ is $\tau = \tau^*(\bar{z}, X)$. As $\mu(\tau^q) > \frac{1}{3}$, this policy is welfare-maximizing even when pork is available as an instrument. Thus the pork equilibrium can be no better for social welfare.

E.4 Proposition 5

We show that a pooling equilibrium exists for the amendment subgame, only if condition (23) does not hold. We do so by constructing a profitable deviation from the candidate pooling equilibrium. Appendix D then demonstrates that PBE is the same as the equilibrium of the amendment round subgame.

Appendix C solves for a candidate pooling equilibrium and shows that the centrist receives pork unless the regime is RPM. Consider first CBAU or PBAU, where the centrist obtains pork and consider the following deviation from a candidate pooling equilibrium. The deviation entails a (one-unit) cut in tax revenues, financed by a cut in public spending of the largest amount that is acceptable to the formateur when $z = \underline{z}$:

$$\Delta g = \frac{\mu(\breve{\tau})}{(\underline{z} + \alpha) v_g(\breve{g})} < 1, \tag{42}$$

and the remaining $1 - \Delta g$ is financed by cuts in pork to the centrist's district. We denote with "⌣" variables for the candidate pooling equilibrium. This deviation is unacceptable to the formateur when $z = \bar{z}$ because

$$\mu(\breve{\tau}) - \Delta g(\bar{z} + \alpha) v_g(\breve{g}) = \mu(\breve{\tau}) \left[1 - \frac{\bar{z} + \alpha}{\underline{z} + \alpha}\right] < 0.$$

The deviation is profitable for the centrist when $z = \underline{z}$ if

$$\mu(\breve{\tau}) - \Delta g \underline{z} v_g(\breve{g}) - (1 - \Delta g) \geq 0 \iff$$
$$\frac{1 - \underline{z} v_g(\breve{g})}{(\underline{z} + \alpha) v_g(\breve{g})} \geq \frac{1 - \mu(\breve{\tau})}{\mu(\breve{\tau})}.$$

We show in Appendix C that $\mu(\breve{\tau}) = \frac{1}{2}$ and $\tilde{g} \in \{\breve{g}^{low}, \breve{g}^{high}\}$ in CBAU, where $\breve{g}^{high}$ and $\breve{g}^{low}$ are defined by (39) and (40), respectively. With $\mu(\breve{\tau}) = \frac{1}{2}$ this last inequality becomes

$$(2\underline{z} + \alpha) v_g(\breve{g}) \leq 1,$$

which holds for $\breve{g} \in \left\{\breve{g}^{low}, \breve{g}^{high}\right\}$. When the candidate pooling equilibrium is CBAU, the suggested deviation is therefore profitable.

This is also the case in PBAU, as in this regime

$$\frac{1 - \mu\left(\breve{\tau}\right)}{\mu\left(\breve{\tau}\right)} = \frac{1 - z^e v_g\left(\breve{g}\right)}{\left(\underline{z} + \alpha\right) v_g\left(\breve{g}\right)} \leq \frac{1 - \underline{z} v_g\left(\breve{g}\right)}{\left(\underline{z} + \alpha\right) v_g\left(\breve{g}\right)}.$$

The first equality is an equilibrium condition for the candidate pooling equilibrium given in (41). The inequality follows from $z^e > \underline{z}$ and confirms that the proposed deviation is profitable for the centrist.

It remains to determine whether pooling at RPM could be arise as an equilibrium outcome. Consider a deviation from pooling at the status quo wherein tax revenues are increased by one unit in order to finance an increase in public spending just below the smallest increase that the $z = \underline{z}$ formateur would accept. This increase in public spending is as defined in (42) above, with $\breve{\tau} = \tau^q$ and $\breve{g} = g^q$, which are values in the candidate pooling RPM equilibrium. Remaining revenues go as pork to the centrist. This is acceptable to formateur when $z = \bar{z}$ because

$$\Delta g\left(\bar{z} + \alpha\right) v_g\left(g^q\right) - \mu\left(\tau^q\right) = \mu\left(\tau^q\right)\left[\frac{\bar{z} + \alpha}{\underline{z} + \alpha} - 1\right] > 0.$$

This deviation is profitable to the centrist if

$$\begin{aligned}
\Delta g \bar{z} v_g\left(g^q\right) - \mu\left(\tau^q\right) + 1 - \Delta g \;\; &\geq \;\; 0 \iff \\
\frac{1 - \bar{z} v_g\left(g^q\right)}{\left(\underline{z} + \alpha\right) v_g\left(g^q\right)} \;\; &\leq \;\; \frac{1 - \mu\left(\tau^q\right)}{\mu\left(\tau^q\right)}.
\end{aligned} \tag{43}$$

As $\left(\underline{z} + \alpha\right) v_g\left(g^q\right) > z^e v_g\left(g^q\right) = \mu\left(\tau^q\right)$ in the denominator and $\bar{z} v_g\left(g^q\right) > \mu\left(\tau^q\right)$ in the numerator, this holds whenever $\mu\left(\tau^q\right) \leq 1$, including debt levels where the full information equilibrium is RPM.

Using $\mu\left(\tau^q\right) = z^e v_g\left(g^q\right)$ (43) can be rewritten as (23):

$$\mu\left(\tau^q\right) \leq \frac{\underline{z} + \alpha - z^e}{\underline{z} + \alpha - \bar{z}},$$

the condition for a separating equilibrium in the proposition.

When (23) holds, no pooling equilibrium satisfies the centrist's maximization problem in the amendment subgame. As this maximization problem has a unique solution, we conclude that the equilibrium of the amendment subgame is separating. Appendix B characterizes this separating equilibrium.