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Essays in Special Interest Politics

By

Vikram Maheshri

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requirements for the degree of

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of the

University of California, Berkeley

Committee in charge:

Professor Gerard Roland, Chair

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Abstract

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by

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Doctor of Philosophy in Economics

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In the following three essays, I explore how organized political interests behave, interact with each other, and affect public policies. As special interest groups in the United States have proliferated both in number and size over the past several decades, policy-makers have responded with a mixture of public consternation and private acceptance. American voters overwhelmingly disapprove of the activities of special interest groups, but observers have been unable to articulate convincingly the effects of these activities on legislative practices and social welfare. I fill in this gap.

In my first essay, I consider the effects in Congress of competition between interest groups over public policy. I model the interactions of rival interest groups and legislators as a dual form of competition over both the substance of legislation – that is, the legislative agenda – and legislators’ votes on legislation. This is, at its heart, a model of congressional committee behavior. The unique prediction of this model is that interest groups may intentionally spend money to have legislation introduced that is known to have no prospect of being passed. Such interest groups are motivated by the inability to shape policy in a more favorable direction and the desire to protect a sufficiently palatable status quo. This result is attractive in light of the fact that roughly 90% of legislation fails passage. I then go on to provide empirical evidence in support of this prediction using an original, large and highly detailed dataset consisting of all pieces of legislation introduced into Congress over a twenty year period. I estimate that interest groups attempt to suppress roughly 56% of legislation that is introduced in the House of Representatives and 69% of legislation that is introduced into the Senate. Furthermore, I provide evidence that groups may suppress legislation by obfuscating the linguistic content of bills.

In my second essay, I consider the effects of competition *within* interest groups on the direction of redistributive policies. Individuals and firms form interest groups as a means of pooling resources and overcoming free riding in order to shape favorable public policies. However, the objectives of interest groups and their constituents do not perfectly align. In particular, interest groups tend to be more farsighted than their constituents. This asymmetry of objectives generates an agency problem that may manifest itself in the persistence of inefficient public policies. That is, interest groups may be directed by their relatively shortsighted constituents to oppose efficient policy reforms. In the long run, this agency problem is exacerbated by the responses of interest groups to free riding.

I provide suggestive econometric evidence from the United States in support of this argument.

In my third essay, I consider the implications of the very function of an interest groups: providing a means to aggregate the preferences of a motivated but potentially heterogeneous constituency. I begin by noting a very strong empirical regularity in lobbying activity in the United States. In nearly every industry, the distribution of lobbying expenditures follows a power law. This regularity is not predicted by standard models of interest group behavior. Instead, I provide a heuristic explanation for the empirical finding. If interest group expenditure decisions are made in response to periodic signals and are determined by a constituency that continuously updates its preferences according to a simple heuristic, then we should expect to see the distribution of lobbying expenditures follow a power law. I provide additional simulation evidence in support of this claim.

1. Buying the Legislative Agenda

1.1. Introduction

Any attempt to explain the legislative process in the United States must contend with three inescapable facts. First, legislators continue to attract substantial expenditures — roughly \$4 billion in 2008 — from private agents (firms, groups and individuals) in the form of campaign contributions and lobbying expenditures. Second, a strong systematic relationship has not been found between the money that legislators receive and their votes on legislation brought before the full chamber (Parker (1996), Ansolabehere, deFigueiredo and Snyder (2003)). Third, the vast majority — over ninety percent — of proposed legislation fails at some point along the arduous route to passage. These facts raise two critical questions. Why do private agents continue to contribute substantial funds to legislators if those funds have no discernible effect on the legislator’s voting behavior? And why do members incur the costs of drafting legislation if failure rates are so high?

These questions lie at the heart of the intersection of economics and politics. Firms engage in competition for economic profits while interest groups that represent firms and individuals simultaneously compete for political rents. The economic implications of profit-driven competition are well known; the economic implications of politically-driven competition are less well-known but of great importance. In the short run, interest group competition may distort the efficiency of public policies, while the tradeoffs that private agents make between rent seeking and productive activities may impact economic welfare in the long run. Understanding the impact of political expenditures on policy is a necessary first step toward understanding the relationship between political competition and social welfare, and should guide constructive and efficient political finance reforms. The realities of legislative performance suggest that this relationship must be understood in the context of bill failure.

In this chapter, I show that when interest groups play an active role in both the process of drafting legislation and in building support for or opposition to a given policy agenda, bills may be strategically blocked. That is, interest groups who find that the status quo is sufficiently palatable may choose to maintain it by intentionally targeting expenditures to draft legislation designed to fail. I indicate the specific conditions whereby policies will be promoted or blocked, and argue that in equilibrium, successive policy proposals will either fail, which leaves welfare unchanged, or will pass, which weakly improves a crude measure of aggregate welfare. Hence, the determination of the actual relationship between political expenditures and legislative success is an empirical question.

I provide evidence that is broadly consistent with the formal implications of this model using a novel dataset that combines detailed information over time on both legislation and political expenditures. I distill the contents of every bill introduced in both houses of Congress during the twenty year period from 1989-2008 with the use of a self-designed, automated script. For each bill, I extract key information about the sponsors, cosponsors and legislative activity. I also compute objective measures of the textual complexity of each bill—that is, the ease with which legislators who must vote on a bill are able to understand it—drawing on methods from linguistics and educational psychology. With this legislative data in hand, I assess every distinct campaign contribution made by political action committees to a federal candidate and match those expenditures with individual bills, paying close attention to both timing and institutional considerations. My analysis of the linguistic components of bill texts allows me to investigate directly a potential mechanism for the predicted and observed legislative behavior. I find that if a legislator wishes to design a bill intentionally to fail, then obfuscating the language of the proposal is an effective method of achieving his

or her goal. To my knowledge, this is the first use of these particular objective tools for analyzing general linguistic complexity in economics.

I find that political spending does in fact affect policy, though not by influencing floor-voting behavior. Instead, political spending alters the actual substance of legislation that politicians consider — that is, it affects the legislative agenda. Specifically, the effects of money on legislation are most pronounced when bills are being considered in committee rather than when they are on the floors of their respective chambers. Political expenditures may have positive or negative effects on legislative success depending on the motives of the groups involved. I argue that the direction of this effect is predictable and present evidence supporting this claim. Increasing campaign contributions to sponsors of bills with less general support in committee (as indicated by having few or no cosponsors) decrease the probability of legislative success, while these same payments increase the probability of legislative success for bills with broad committee support (as indicated by having many cosponsors). While I am able to identify both effects for certain bills in each chamber, bills are more effectively killed by interest groups in the House and more effectively pushed through by interest groups in the Senate. In addition I estimate that in committee, interest groups actively suppress 56% of bills in the House and 69% of bills in the Senate.

My findings appear to explain why researchers have been unable to uncover a systematic relationship between lobbying and floor voting and they suggest a richer explanation of why private agents contribute funds to policymakers. Though well developed, the theoretical literature on interest group behavior and competition starting with Olson (1965) has thus far been inadequate in explaining the facts outlined above. In well-known papers, Peltzman (1976) and Becker (1983) formalize the work of Stigler (1971) to argue that competition among interest groups generally leads to policies that are as efficient as possible, given the existence of vested political interests. However, these treatments focus primarily on characterizing redistributive efficiency and hence place the entire legislative and political process in a “black-box,” taking the relationship between interest group spending and favorable policies as given. Grossman and Helpman (1996) view lobbying in a common agency framework which has been applied elsewhere in legislative bargaining (Helpman and Persson (2001)), taxation (Dixit, Grossman and Helpman (1997)) and elections (Grossman and Helpman (2002)). A general implication of these models is that failed legislation is exceptional — policies will almost always be crafted in such a way that they will be implemented, standing at odds with the observation that the vast majority of legislation fails to be signed into law. Groseclose and Snyder (1996) propose a model of vote buying in which dominant groups bribe supermajorities of voters to push forth their legislation but do not pursue the issue of agenda setting. In what is perhaps the closest model in spirit to the one provided in this paper, Snyder (1990) jointly considers both vote buying and agenda setting by lobbyists but does not explore such matters in the context of competing interest groups. By going into greater depth about the interactions between interest groups and legislators, my legislative model bridges the theoretical and empirical literature on lobbying and agenda setting.

1.2. Background on the US Legislative Process

The legislative process of the federal government is broadly defined in Article 1 of the United States Constitution. The actual rules of the legislature are largely established by the respective chambers and standing precedent. Any member of Congress may propose a piece of legislation.¹

¹There are four main types of legislation: bills, joint resolutions, simple resolutions and concurrent resolutions. The first two require approval of both chambers of Congress before the president can sign them into law. The latter

This bill is allocated to the appropriate committee of jurisdiction for review. While in committee, the legislation can be sent to subcommittees or to other committees, and hearings may be held to collect information. Changes, or amendments, to the text of the bill may also be made. At this point, the chairman of the committee may bring the bill to a vote in committee or leave it to die. If brought to vote in committee and the bill passes, it then moves to the floor of the appropriate chamber where it is debated and then brought to vote. After clearing one chamber of Congress, it moves to the floor of the next chamber. If after debate, the bill passes a second vote, then it is sent to the desk of the President who may either veto the bill or sign it into law.

The first stylized fact is that legislators have been collecting and continue to collect substantial sums of money from private interests. Generally speaking, money in the political process can be broken down into one of three categories: campaign contributions from individuals, campaign contributions from Political Action Committees (PACs), and general lobbying expenditures from private firms and interest groups. Individuals can contribute money to political candidates' campaigns; since 1990, the Federal Election Commission (FEC) has documented these expenditures in detail. Individual contributions had been limited to \$1000 per candidate per election until the end of the 2002 Federal election when the Bipartisan Campaign Finance Reform Act (BCFRA, or McCain-Feingold colloquially) came into effect. This bill raised the limit on individual contributions immediately to \$2000, and thereafter increased the limit by \$100 per electoral cycle.² Individuals may also contribute to national parties and PACs. Firms and labor organizations cannot make direct contributions to candidates, but they may establish PACs to act as proxies. These committees can raise money from employees, stockholders, and union members and their families. These funds can then be directly contributed to candidates. Multicandidate PACs may contribute up to \$5000 per candidate per election. This limit was unchanged by BCFRA. Finally, firms and interest groups may also lobby their representatives for favorable legislation. While this money cannot be directly transferred to politicians, it potentially serves to inform legislators on relevant issues, signal interest group preferences and influence actual policy (Grossman and Helpman (2002)).

Each of these three types of political spending has been increasing in real terms within the past twenty years for which this data is available. In figure 1, I plot real campaign contributions to Congressional candidates over the past ten federal electoral cycles broken down by source.³ In this time period, contributions from individuals have increased roughly by a factor of two and a half to \$1 billion in 2008, while contributions from PACs have nearly doubled to \$400 million.⁴ The number of PACs has increased by roughly 80% in the last decade to nearly five thousand today. As shown in figure 2, lobbying expenditures have nearly doubled to over \$3.2 billion annually in the past decade. Note that this corresponds to roughly six times as much as individual campaign contributions, as those are aggregated over two year cycles. Private money is a large and growing component of the political process.

two address internal matters to one or both chambers respectively and are never signed into law. Accordingly, I consider only the first two and hereafter use the terms "bill" and "legislation" interchangeably to describe both bills and joint resolutions.

²While limits on individual contributions *increased* with the passage of BCFRA, soft money contributions were eliminated altogether. Before, individuals and PACs could contribute unlimited amounts of "soft" money to national parties which could then be redistributed at the party's discretion.

³All monetary variables hereafter are inflated to real 2008 dollars using the US Bureau of Labor Statistics consumer price index for all urban consumers.

⁴In a broader historical context, the total amount raised by all congressional candidates from all sources in the 1951-1952 race, adjusted for inflation, was estimated to be a mere \$45 million by the Congressional Quarterly Almanac 1953 (Ornstein, Mann and Malbin (2008)).

Figure 1: Federal Campaign Contributions from Individuals and PACs, 1990-2008

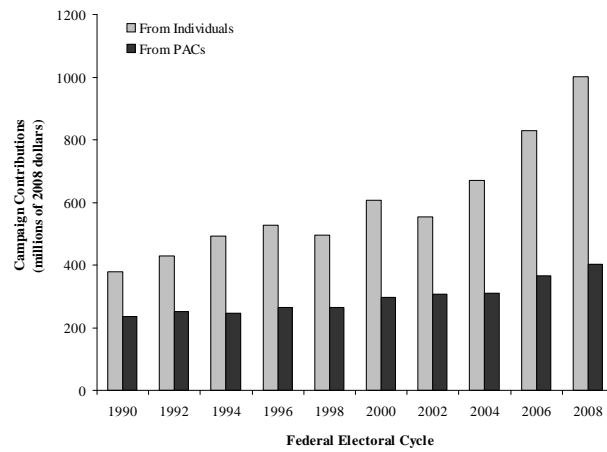
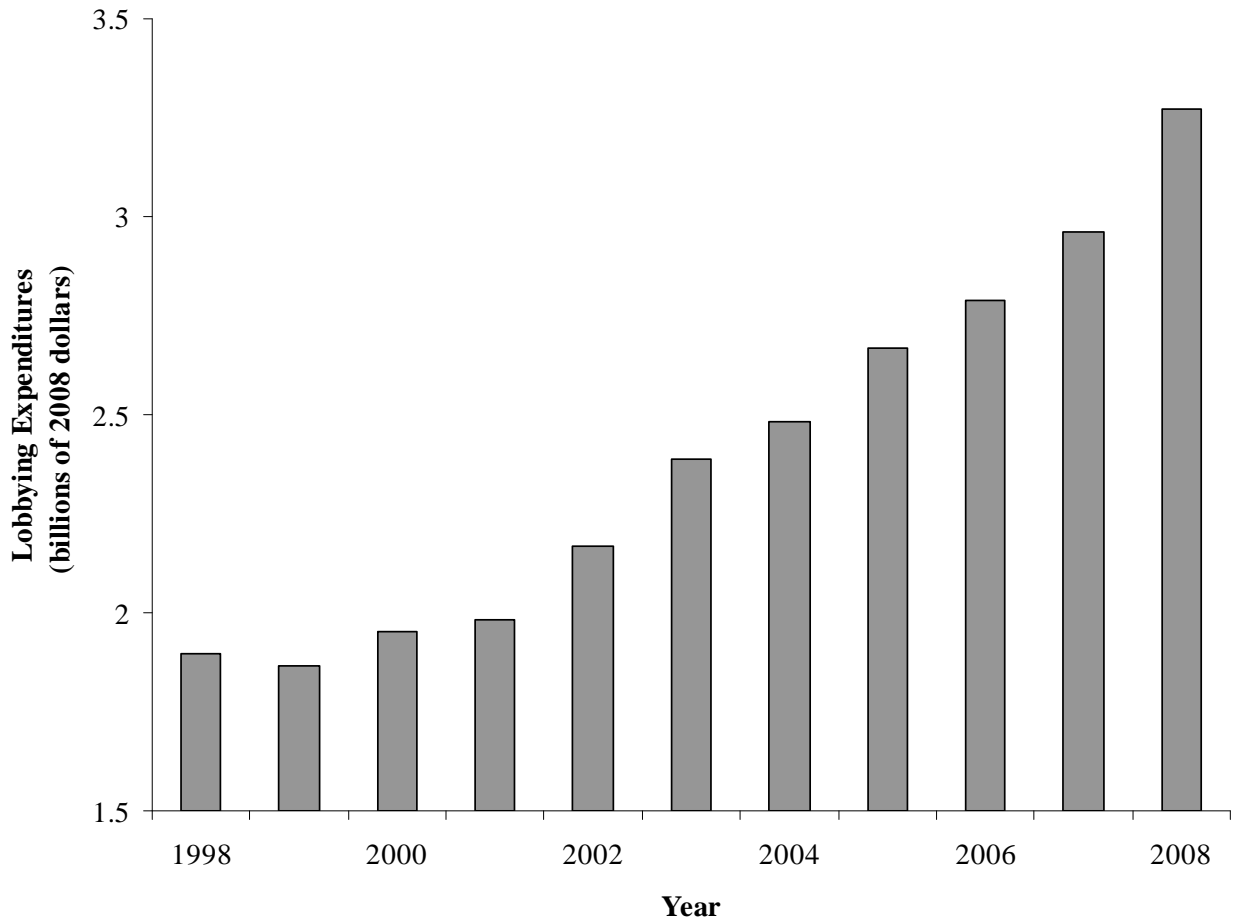


Figure 2: Federal Lobbying Expenditures, 1998-2008



The second stylized fact stands in some contrast to the observation that more and more money is entering the political arena: the evidence linking political expenditures and legislative voting behavior is, at best, ambiguous. Ansolabehere, deFigueiredo and Snyder (2003) provide a careful summary of nearly forty studies attempting to link PAC contributions with some form of roll call voting behavior, either direct votes or voting score indexes developed by various third parties. Their ultimate finding is that PAC contributions have relatively few effects on voting behavior. In particular, three of four studies failed to report statistically significant positive effects of PAC contributions on roll call votes. Ansolabehere, deFigueiredo and Snyder also provide some original regression results of their own supporting this finding.

To be sure, some studies do find connections between campaign contributions and public policy in the United States. For example, deFigueiredo and Edwards (2007) show that campaign contributions by the telecommunications industry affected the regulatory decisions of state public utility commissions. Similarly, Gordon and Hafer (2005) argue that corporations use political expenditures to signal their willingness to contest regulatory decisions, which results in measurably less oversight. Hoffman (2007) explores the connection between campaign contributions from businesses and labor and voting behavior in state legislatures. And Mian, Sufi and Trebbi (2008) find that campaign contributions are correlated with voting patterns on two specific pieces of financial legislation. However, to my knowledge, no broad and conclusive evidence exists to link spending at the federal level to congressional voting behavior.

The dramatically simplified explanation of the legislative process given above lends itself to the third stylized fact, as there are several opportunities for legislation to fail. I summarize the final destination of every bill considered by the House of Representatives and Senate for a twenty year period spanning the 101st Congress to the 110th Congress (roughly 1989-2008) in table 1. In total, a mere 6% of all bills introduced in the House of Representatives and 4% of bills introduced in the Senate are signed into law. The bulk of bill failure takes place in committee – approximately nine out of every ten bills never see the chamber floor. Roughly half of the bills that reach the chamber floor make it out of Congress. Bills are more likely to die on the Senate floor than the House floor, which is consistent with the perception that individual Senators are more autonomous than their counterparts in the House. On the whole, Presidential veto rarely disrupts legislation.⁵

1.3. A Model of Agenda Setting With Lobbying

Politicians write legislation for a number of reasons. In addition to promoting their policy ideals in hopes of changing the law, legislators may sponsor bills to signal effort, competence and preferences to their constituents and fellow legislators, to curry favor with special interest groups or to focus legislative resources and attention upon their policy positions at the expense of other legislators (see, for example, Fenno 1978).⁶ This list is by no means exhaustive. Interest groups develop

⁵In light of the low passage rate, it is worth mentioning that crafting and sponsoring a bill can be a rather costly endeavor. The full costs of bill sponsorship are difficult to enumerate; however there is evidence that they are a substantial constraint on legislative activity. The initial costs of sponsorship come in the form of specialization, or the acquisition of the relevant background knowledge to draft the text of a bill. For example, Gilligan and Krehbiel (1997) show that a politician's level of specialization, as measured by their probability of legislative co-sponsorship, decreases in various costs to the politician of acquiring bill-specific expertise. Further costs of legislative sponsorship include the devotion of legislative staff and other resources to the task of crafting a bill and shepherding it along.

⁶In his classic treatment of Congressional motives for action, Fenno (1978) explores the value and importance of various legislative activities, especially the sponsoring of legislation, based upon hundreds of interviews of

Table 1: Legislative Failure Rates, 101st-110th Congress

| | House | | Senate | |
|----------------------------|--------|---------------------------------------|--------|---------------------------------------|
| | Number | Conditional Failure Rate [†] | Number | Conditional Failure Rate [†] |
| All introduced bills | 59894 | | 31764 | |
| Bills that leave committee | 5777 | 0.90 | 3510 | 0.89 |
| Bills that leave Congress | 3346 | 0.42 | 1476 | 0.58 |
| Bills that become law | 3307 | 0.01 | 1306 | 0.12 |
| Total Failure Rate | | 0.94 | | 0.96 |

Includes all bills and joint resolutions except those promoted by discharge petition.

[†] Conditional Failure Rate is the probability that a bill fails conditional on reaching the previous stage.

relationships with and access to politicians to provide specialized information and ultimately to influence relevant policies. Interest groups may leverage their financial resources, access and know-how to shape the actual text and substance of legislation. They may also utilize their position to directly influence coalition building, voting and other legislative behavior.

More formally, there is a status quo policy of s in a potentially multi-dimensional policy space.⁷ A legislative sponsor possesses a quasi-linear, separable utility function over policy, s , and consumption, C , given by $\bar{U}(y, C) = U(y) + C$, and two interest groups each possess similarly defined utility functions over policy and consumption given by $\bar{V}(y, C) = V(y) + C$.⁸ For simplicity then, all utilities over policy can be measured as pure consumption. All preferences over policy are single peaked, and the interest groups have opposing views. That is, their bliss points lie on either side of the status quo policy, or

$$d\left(\arg \max_y V_i(y), \arg \max_y V(y)\right) > d\left(\arg \max_y V_i(y), s\right), \quad (1)$$

for all i, j where d is some metric defined on the policy space.

I model the legislative process as a two stage game. Each stage captures a different aspect of the interaction between political expenditure and legislation. In the first stage, interest groups exploit their political access to shape legislation, and in the second stage, interest groups may explicitly utilize their influence to alter a legislative vote. Following Baron and Ferejohn's (1989) canonical model of legislative bargaining, I assume that the legislative sponsor is exogenously determined. In the first stage, the policy agenda is set.⁹ Interest groups may submit take it or leave it bids to the

Representatives and congressional staff conducted over an eight year period.

⁷The policy space need not be continuous. In reality, the set of potential policy agendas is likely to be discrete.

⁸The forthcoming argument generalizes to any number of interest groups greater than or equal to two. With multiple groups, the "losing group" described in the argument below should simply be replaced by the second strongest group (the group that would otherwise have been the dominant group had the "winning group" been removed from contention.)

⁹For simplicity, I model the agenda setting process as a closed rule with no possibility for amendment. Approximately 97% of bills introduced in the House and 96% of bills introduced in the Senate are not amended, and over 99%

sponsor consisting of a transfer in return for a specific policy agenda.¹⁰ The sponsor then chooses at most one of these bids, and the agenda is set. In the second stage, interest groups may offer payments to members of the legislature in return for favorable votes. A summary of these stages follows:

1. Each interest group submits a bid i to the sponsor. This bid consists of a policy, y_i , and a payment, $X_i(y_i)$, to the sponsor conditional on acceptance.¹¹ The sponsor selects their favored bid, and a single payment is made. If the two bids generate equal utility for the sponsor, the sponsor chooses the bid of the group with higher net valuation for their policy.¹²
2. The sponsor proposes legislation to the relevant committee. Interest groups may make payments to legislators for votes. Payment offers are made sequentially, if at all. The group (if any) in favor of the bill makes payments first. The group defending the status quo then has an opportunity to make payments second. The bill's sponsor may not receive any payments.

The second stage of this game is adapted from Groseclose and Snyder's (1996) vote-buying game in which interest groups are free to offer legislators payments conditional on their votes, and pivotal legislators are willing to vote for a given policy if their utility over that policy is not less than their utility over an alternative policy by the amount of their payment.¹³ My formulation is one of complete information, and there is no uncertainty in any stage of the game. Though unrealistic, this is an appropriate modeling choice as my goal is to show that even in the absence of uncertainty, failing legislation can be an equilibrium outcome. I now consider the subgame perfect Nash equilibria (SPNE) of this game in pure strategies. Proofs can be found in the mathematical appendix A.

Proposition 1.1. There exists a SPNE in pure strategies in the game described above.

The existence of equilibrium hinges upon two features of the game. The first stage can be thought of as a common knowledge auction where interest groups are vying for control of the sponsor. The tiebreaking rule ensures a unique winner. Sequential vote-buying payments ensure the existence of a Nash equilibrium in pure strategies within the second stage.¹⁴

The equilibrium decisions of the three participants in the game — the group that wins the first stage auction, W , the losing group, L , and the legislative sponsor — can be described in three

of bills introduced in both houses are amended fewer than four times. To be sure, with an open rule, amendment might be largely an out of equilibrium action, so the threat of amendment might potentially impact the legislative agenda. This admittedly merits further investigation.

¹⁰This stands in contrast to models of influence where payments are made conditional upon outcomes or votes being pivotal (e.g., Dal Bo (2007)).

¹¹The first stage payment is not conditional upon the final outcome of the bill, only the text of the introduced bill.

¹²This tiebreaking rule is merely a technical condition. It is substantively equivalent to modeling the bidding space as discrete.

¹³The sequential timing of payments generates equilibrium strategies that are equivalent to the equilibrium strategies in a simultaneous vote buying game with minimal structure. Suppose groups simultaneously decide whether to initiate the vote buying game and then play proceeds as above. If both groups opt to initiate, then the initiator is determined by random assignment, and if neither group opts to initiate, then no roll call vote is taken. Then the group in favor of the status quo will never initiate payments as they have the luxury of waiting to respond to the group opposed to the status quo (Groseclose and Snyder (1996)).

¹⁴The first stage of the game could also be thought of as a menu auction where interest groups offer payment schedules to the legislative sponsor consisting of payments conditional upon the final agenda. With the additional assumption of strict concavity of interest groups' utility over policy (and the relaxing of the assumption of opposing views), a Nash equilibrium exists in such an auction and possesses the efficiency property described in proposition 2 (Bernheim and Whinston (1986b)).

inequalities.¹⁵ Let P_i indicate the expenditures that group i must make to other legislators to promote their legislation in the second stage of the game. In any subgame perfect Nash equilibrium, the following individual rationality constraint for W must hold:

$$X_W(y_W) + P_W(y_W) \leq V_W(y_W) - V_W(y_L). \quad (2)$$

The full costs of implementing W 's policy, y_W , which are given on the left side of (2) as the sum of the first stage payment to the sponsor and second stage payments to other legislators, must not exceed the benefits W would enjoy from their policy relative to the alternative losing policy L .

Similarly, the legislative sponsor also faces an individual rationality constraint, namely

$$X_W(y_W) + U(y_W) \geq X_L(y_L) - U(y_L). \quad (3)$$

This inequality simply describes the condition for which the sponsor writes W 's bill over L 's bill – the sponsor's utility from the winner's bid plus their legislation must exceed the sponsor's utility from the loser's bid plus their legislation. While L does not face an individual rationality constraint, strictly speaking, the full costs of implementing their policy must exceed the benefits that they derive from their policy relative to the W 's policy alternative. Otherwise, L would face an opportunity to manipulate their first stage bid to the sponsor which would result in a beneficial deviation and the policy, , being implemented. Formally,

$$X_L(y_L) + P_L(y_L) \geq V_L(y_L) - V_L(y_W). \quad (4)$$

These inequalities can be combined to form the following result.

Proposition 1.2. In any subgame perfect Nash equilibrium (SPNE) in pure strategies, the aggregate utilities of all groups and the sponsor must not decrease either when the winning policy is adopted over the status quo, or when the status quo is defended over a losing policy. That is,

$$V_W(y_W) - V_W(y_L) - P(y_W) + V_L(y_W) + P_L(y_L) - V_L(y_L) + U(y_W) - U(y_L) \geq 0. \quad (5)$$

It is important to note that each player's surplus is weighted equally. This is also a feature of the noncooperative menu action model of Bernheim and Whinston (1986a) and the truthful equilibria of the common agency model in Dixit, Grossman and Helpman (1997). This result can also be viewed in a somewhat different perspective as an analog of Becker's (1974) "Rotten Kid Theorem."¹⁶ In spite of the lack of altruism in the model, the bidding stage links groups' incentives in such a way that their actions would be consistent with explicitly modeled altruism, which only leads to outcomes that increase total welfare.

This proposition constitutes a weak claim on the efficiency of lobbying in setting policy agendas. If all members of society were represented by one of the two groups, and the legislative sponsor's

¹⁵Hereafter, I only consider pure strategies.

¹⁶In a familiar formulation of the "Rotten Kid Theorem," a parent has two children, one of whose utility is based strictly upon their consumption (the rotten kid), and the other of whose utility is based upon some combination of their consumption and their sibling's consumption (the prodigal kid). Children take actions that affect their private consumption and their parent's income. If the parent commits to redistributing household wealth in an equitable manner, then Becker shows that both the rotten kid and the prodigal kid take the same actions because their incentives are linked through the parent.

utility was representative of social utility, then lobbying would necessarily push policies in the direction of improving social welfare. Inasmuch as weaker interests are disorganized and legislators are unrepresentative, lobbying distorts policies in the direction of stronger interests' and legislative sponsors' blisspoints.

Proposition 1.2 does not ensure that the alternative policy proposed will defeat the status quo policy. Note the weak inequality in (5). In fact, the key result of the model is that there is a specific condition under which a new policy will replace the status quo (and conversely, a condition under which the status quo will persist). Interest groups may spend to move the policy towards their blisspoint. However, if faced with sufficient opposition – some combination of the legislative sponsor demanding a greater payment in the first stage and the opposing interest group forcing them to spend a greater amount buying legislator's votes in the second stage – that the dominant interest group is unable to move the policy towards their blisspoint, then they may decide to spend money to set an agenda in the first stage that is known to fail in the second stage as a way of preventing the equilibrium policy from moving further from their own blisspoint. This condition is described in the following statement:

Proposition 1.3. Legislation will be promoted if and only if the total surplus that W , L and the legislative sponsor derive from versus the status quo policy is positive. That is, legislation will be promoted if and only if

$$V_W(y_W) - V_W(s) - P(y_W) + V_L(y_W) - V_L(s) + U(y_W) - U(s) > 0 \quad (6)$$

holds. Otherwise W will play a blocking strategy intentionally introducing legislation to fail.

The key takeaway from proposition 1.3 is that the determination of whether interest groups spend to buy favorable legislation or to suppress unfavorable legislation is an empirical one. There exist certain conditions under which money will be spent to increase the probability of legislative success, but there also exist conditions under which interest groups will spend to decrease the probability of legislative success. In particular, if no feasible policy exists that will increase the aggregate welfare of the groups and the sponsor, then *the status quo must necessarily prevail*. Sometimes interest groups will pay legislative sponsors to kill their own bills.

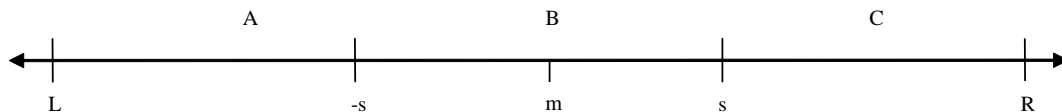
How often might such conditions for blocked policy present themselves? In reality, the policy space is often discrete, perhaps even binary. There are only a small number of potential policies that could be written into bills. Hence, if alternatives to the status quo are sufficiently unpalatable to one of the interest groups or the legislative sponsor, then blocked policy will be the norm. In addition, the policy space is often multidimensional. If the component policies of a particular piece of legislation are highly substitutable for each other, then potential policy improvements are less likely to exist, and accordingly, groups will spend to block legislation.

Legislation may be continually introduced into the chamber. While this reduces the likelihood that W pays the sponsor to block and maintain the status quo, it does not eliminate it altogether. In the one-shot formulation of the game group W pays to pass legislation if and only if

$$P_W(y_W) < V_W(y_W) - V_W(s) - (X_W^i(y_W) - X_W^i(s)), \quad (7)$$

where $X_W^i(y)$ is the first stage cost to W to induce sponsor i to write bill y . This is simply a less simplified form of the statement of proposition 3. Define $X_W^0(y) = E_i[X_W^i(y_W)]$, that is, the

Figure 3: A Stylized Unidimensional Policy Space



expected value of the first stage cost to induce a randomly chosen sponsor to write bill y . Then, if there is a common discount rate of δ between each bill introduction, it can be shown that W will pay to pass legislation if and only if

$$P_W(y_W) < \frac{V_W(y_W) - V_W(s)}{1 - \delta} - \left(X_W^i(y_W) - \frac{X_W^i(s)}{1 - \delta} \right), \quad (8)$$

where i is the current sponsor. The quantity on the right hand side of inequality (8) is simply the expected cost to W of passing legislation today and protecting the future status quo of y_W indefinitely relative to the cost of maintaining the current status quo of s indefinitely. While (8) is a looser inequality than (7) is (that is, repeated interactions make it more likely that W will choose to pass rather than to block legislation), the thrust of proposition 1.3 remains. There still exist certain conditions under which interest groups will pay sponsors to introduce intentionally failing legislation, and hence, the determination of the effects of expenditures on legislative success is ultimately an empirical question.

In summary, there are two forces acting on the policy agenda. The “stronger” group would like to spend money to move the agenda towards their blisspoint, while the “weaker” group wields the threat of payment in order to keep the agenda from moving too far away from their blisspoint. The costs of policy implementation in the second stage (through vote buying) potentially keep the stronger group from moving policy, thus maintaining the status quo. In effect, the cost of building broader support for policy in the second stage serves as a wedge which keeps policy fixed at the status quo.

For simplicity, consider the representation of the continuous, uni-dimensional policy space in figure 3. The blisspoints of the two interest groups are given by L and R respectively, and I refer to the groups by their blisspoints. The status quo policy is at s and the median voting politician’s blisspoint is at m . The second stage is summarized as follows. Policies in intervals A and C would fail without vote buying (i.e., $B_i(y) = 0$ and $P_i(y) > 0$), and policies in interval B would pass on their own without vote buying (i.e., $B_i(y) > 0$ and $P_i(y) = 0$).

For example, assume that R is the winning group and $P_R(y)$ and $V_R(y)$ are differentiable at the point $y = s$. Then R would prefer to keep the policy at s instead of moving it to the right if the marginal cost of moving to the right (which is comprised of the first stage marginal cost of buying the agenda plus the second stage marginal cost of buying votes) exceeds the marginal benefit of

moving to the right, or $X'_r(s) + P'_r(s) > V'_r(s)$. Similarly, R would prefer to keep the policy at s instead of allowing it to shift leftward if the marginal utility loss from moving left exceeded the money saved from allowing the policy to move left (the marginal cost of buying the agenda in the first stage), or $V'_r(s) \geq X'_r(s)$. Combining these conditions, a blocking strategy is an SPNE if

$$X'_r(s) + P'_r(s) > V'_r(s) \geq X'_r(s). \quad (9)$$

In the simple case described, the marginal costs of building support in the second stage to overturn the status quo, $P'_r(s)$, define the “width” of the range of interest group preferences which would lead such a group to pursue a blocking strategy. As the costs of building broader support in the second stage increase, the potential for intentionally failing policies to be introduced increases as well.

If L has very strong distaste for s relative to R (that is, L would be willing to pay relatively large amounts to change the policy) then the proposed policy will pass and the status quo will move to the left. Conversely, if R has very strong relative distaste for s , then the proposed policy will pass and the status quo will move to the right. Now suppose R only has moderately more distaste for s than L . Being the “stronger” group, R will certainly not allow the policy to move leftward. However, the strength of L ’s preferences still keep the policy from moving rightward. As a result, R will pay for the power of proposal, and the policy will fail.

Legislation will be promoted, on average, when the dominant group greatly dislikes the status quo and will be suppressed otherwise, and groups hoping to change policy are more likely to assert themselves when a particular legislative sponsor dislikes the status quo. However, when opposing groups have very strong policy preferences, it is likely that the status quo will be maintained. This could come at cost to the more dominant group, as they may be induced to set the agenda intentionally to be blocked by the threat of the opposing group’s actions. In general, groups will propose legislation that takes into account the preferences of all players. This serves to moderate policy. After moving to a new status quo policy, a change in the aggregate utilities of both groups and the legislative sponsor will be required to move to a new policy alternative. Though sponsors may vary, the policy effects of differences in their preferences will be dampened by the stability of the preferences of the two interest groups.

1.4. Empirical Strategy

The main testable implication of this model is that money can potentially distort the policy *agenda* that legislators vote on. These distortions are likely to take place when bills are in committee, as this is the time when the agenda is shaped. Hence, the inability of earlier studies to correlate campaign contributions with voting behavior is simply a case of looking in the wrong place – or rather wrong time. Instead of focusing on bills which have left committee in a more or less refined form, I focus on bills at their nascent stages. The two basic empirical questions left by the theory concern the legislative motives of interest groups and the legislative effects of interest groups. In particular, it is ambiguous whether groups will spend to pass or to block legislation. I begin by exploring the effects of PAC expenditures on overall legislative success. I then directly and parametrically estimate the probability that a given bill is intentionally blocked by an interest group to shed light on the prevalence of different group motives.

1.4.1. Effects of Contributions

For a given bill i that is introduced, I define π_i equal to 1 if it emerges successfully from committee and equal to 0 if it fails passage. Let $X_i = X_W(y_i)$, the first stage payments to the legislative sponsor, and let $P_i = P_W(y_i)$, the second stage payments to the entire committee membership. Then the overall effect of PAC expenditures on legislative success is captured by the parameters β_X and β_P in the regression

$$\pi_i = 1 (X_i\beta_X + P_i\beta_P + W_i'\beta_W + \varepsilon_i > 0), \quad (10)$$

where $1()$ is the indicator function, W_i is a vector of bill, sponsor and committee specific characteristics, and ε_i is an i.i.d. normally distributed error term consisting of unobserved determinants of bill i 's success.

Proposition 1.3 implies that the effects of PAC expenditures on legislative success will vary with the motive of the dominant interest group. When groups are motivated to block legislation, β_X is expected to be negative and β_P is expected to be zero as there should be no second stage payments related to the bill. When groups are motivated to pass legislation, both β_X and β_P are expected to be positive. These motives are determined by the cost of building the broad support in the second stage required to implement the policy y_i and by the relative preferences for y_i to the status quo, which are unobserved. The former determinant of interest group motives has implications for the specification of equation (10), while the latter determinant of interest group motives has implications for the identification strategy. I consider these both.

Theory suggests that interest groups are more likely to attempt to pass legislation when P_i is low, and they are more likely to block legislation when P_i is high. Even if PAC expenditures are highly effective influences on legislative success, a regression of the form given in equation (10) on a full sample of bills including ones with both low and high values for P_i could generate estimates of β_X and β_P that are indistinguishable from zero. This is due to the fact that the positive influence of expenditures on legislative success for bills with low P_i may be offset by the negative influence of expenditures on legislative success for bills with high P_i . For this reason, an estimate of the average β_X and β_P for the entire sample of bills may be misleading. As such, I attempt to separate the two subsamples of bills with differing expected effects.

The cosponsorship of a bill confers two distinct and important pieces of information. First, legislators signal their support for the substance of a bill by signing on as cosponsors. A bill with a large number of cosponsors will be met with broader positive support before the full committee than a bill with a smaller number of cosponsors, and interest groups pursuing passage of the bill will not need to buy the support of listed cosponsors. Other things equal, P_i should decrease with the number of cosponsors. Second, the sponsor signals their personal value for the substance of their bill by gathering cosponsors. Wawro (2000) argues that legislative entrepreneurship, or the careful building of support for legislation, is a costly endeavor. Furthermore, the number of cosponsors on a bill reflects to some extent the level of entrepreneurship that has gone into such a bill. Hence, the sponsor's relative preference of the policy to the status quo ($U(y_i) - U(s)$) is increasing in the number of cosponsors on their bill.

The combination of these two pieces of information suggests that for bills with few cosponsors, interest groups are motivated to block legislation, and for bills with several cosponsors, interest groups are motivated to pass legislation. Separation of the sample of bills into two groups accordingly allows me to differentiate the two effects of PAC expenditures on legislation.

The relative preferences for policy, though unobserved, have implications for the identification of the parameters β_X and β_P . Defining $v_i = V_W(y_i) - V_W(s)$ and $u_i = U(y_i) - U(s)$, the error term in equation (10) can be decomposed into

$$\varepsilon_i = u_i + v_i + e_i, \quad (11)$$

where e_i is assumed to be uncorrelated with all of the observed variables. Under the assumptions that $E[X \cdot (u + v + e) | W] = 0$ and $E[P \cdot (u + v + e) | W] = 0$, β_X and β_P could be estimated by straightforward methods. However, these assumptions are unlikely to hold.

If the interest group is trying to pass legislation, I expect v_i to be negatively correlated with X_i and P_i , and I expect u_i to be positively correlated with X_i and P_i . As the winning interest group's surplus utility over the agenda relative to the status quo increases, the level of the payment they would be willing to make to the sponsor might also increase. And as the legislative sponsor's utility over the agenda relative to the status quo increases, the level of payment they would require to craft that particular agenda might decrease. On the other hand, if the interest group is trying to block legislation, I expect v_i to be positively correlated with X_i and P_i , and I expect u_i to be uncorrelated with X_i and P_i . I deal with the problem of endogeneity in two ways. First, I include a number of bill specific and legislator specific explanatory variables in my estimation. This should absorb some of the explanatory power of the problematic unobserved variables. Second, I utilize instruments which are not likely correlated with the unobserved variables to identify the potentially biased parameter.

The additional explanatory variables I include in the regression fall into two categories – bill specific determinants of legislative success and sponsor specific determinants of legislative success. Bill specific variables include the number of cosponsors on a bill, the number of times the particular bill has been amended, and the amount of time the bill spends in committee. Bills with more cosponsors are more likely to be successful, as this is a signal of broader legislative support and policy importance. Bills with more amendments are also more likely to be successful, as the extra attention given to the legislation may also reflect greater policy importance. More time spent in committee may reflect increased attention paid to the issue, or it may reflect low scheduling priority. I also include dummies for the committee in which the bill was introduced to account for any committee specific precedents and idiosyncrasies that might influence legislative success.

Sponsor specific variables include measures of sponsor ideology, a measure of the electoral strength of the sponsor, and a dummy for the majority status of the sponsor's party. Bills sponsored by more moderate members are more likely to be successful, as these politicians might be more skilled at building consensus. Bills sponsored by members who were elected with a greater share of the vote are also more likely to be successful, as these members are more representative of their constituents. Bills sponsored by members in the majority party are also more likely to be successful due to the substantial gatekeeping power afforded to committee chairpersons. I also include sponsor fixed effects which should account for any unobserved sponsor specific attributes. In addition, I include measures of the total amounts of contributions from interested PACs that committee members of the sponsor's party and members of opposing parties raise during the period of committee consideration. These variables are likely to appear in the vector P_i . Finally, I include ten fixed effects for each two year congressional period and twenty four seasonal fixed effects defined for the month of bill introduction in the House (two year terms) and seventy two season fixed effects defined for the month of bill introduction in the Senate (six year terms). The former should account for broader historical trends in legislative behavior, while the latter should account for variation in intra-annual

legislative sessions and due to vacations.

Using standard maximum likelihood techniques, I employ a vector of instruments Z_i which are uncorrelated with the unobservable variables to identify the coefficients of the endogenous variables β_X and β_P . The Z_i include four measures of PAC contribution activity that are intended to predict the endogenous variables without directly affecting the legislative prospects of bill i . In particular, I compute aggregate contributions from relevant PACs to legislators both of the sponsor's party and of opposing parties who are not members of the committee where bill i is being considered, and I compute aggregate contributions from relevant PACs to legislators both of the sponsor's party and of opposing parties who are members of the legislative chamber where bill i is *not* being considered.

The key maintained assumption behind this identification strategy is that these PAC contributions do not directly affect the chance that bill i emerges from committee. This is defensible upon institutional grounds, as committees in both the House and Senate possess a great deal of autonomy regarding the proceedings within their purview. As such, pressure applied by interest groups to members who do not sit upon the committee of jurisdiction for a particular bill is unlikely to affect that bill's prospects. These members can neither participate fully in committee and subcommittee hearings nor cast committee votes. This autonomy is even more pronounced between chambers. Pressure applied by interest groups to Senators is unlikely to affect the proceedings in a House committee and vice versa.

However, the instruments are valid predictors of the endogenous variables for a number of reasons. Inasmuch as there are broad national political and economic determinants of campaign contributions, these four instruments should capture these trends. For example, concerted political fund raising efforts or scandals might result in short run increases or decreases in overall campaign contributions. And general macroeconomic trends might result in medium run increases or decreases in overall campaign contributions. The instruments may also capture determinants of campaign contributions that are more narrowly defined for a particular piece of legislation. For example, if agricultural PACs are contributing heavily in a particular period, then they may not be able to contribute as much for a particular piece of legislation as they face both self imposed budget constraints and exogenous constraints on contributions defined by federal election statutes.

1.4.2. Motives for Contribution

The motives of interest groups – whether to promote or suppress legislation – are unobserved. Let σ_i be a variable equal to 1 if the dominant interest group's motive is to pass bill i , and 0 if the dominant interest group's motive is to block bill i . In a world of no uncertainty and perfect information, interest group motives should be perfectly correlated with actual legislative outcomes. If a group made efforts to pass a bill, then that bill would necessarily pass committee. Hence, π_i , an observed variable, would be identically equal to σ_i , an unobserved variable. Based on the data, this suggests that groups intend to kill roughly 90% of all federal legislation.

While I assume no uncertainty and perfect information in the formulation of the model, I fully admit that these are unrealistic assumptions. Obviously if these assumptions did not hold, then ambiguous outcomes would be unsurprising. Nevertheless I predict them in a full information setting. To the extent that uncertainty and imperfect information are salient features of the legislative process, π_i is likely to overstate the true motives of interest groups. In a deviation from the model, suppose that in the second stage of the game, there is uncertainty in vote buying. Payments to committee members do not guarantee favorable votes, though they are certainly correlated (i.e., $\pi_i \neq \sigma_i$). I can flexibly model this uncertainty with two parameters capturing the two types of error

in correlating unobserved motives and observed bill success. Define the following parameters

$$\alpha_0 = \Pr[\sigma = 0 | \pi = 1], \quad (12)$$

$$\alpha_1 = \Pr[\sigma = 1 | \pi = 0]. \quad (13)$$

The parameter in (12) is the probability that an interest group attempting to block legislation was unsuccessful, and the parameter in (13) is the probability that an interest group attempting to pass legislation was unsuccessful. With knowledge of these parameters, the share of bills that interest groups intentionally suppress is therefore simply given by

$$1 - E(\sigma) = \alpha_0 E(\pi) + (1 - \alpha_1) E(1 - \pi). \quad (14)$$

According to proposition 3, the probability that an interest group plays to pass a bill is a function of the utilities of the winning and losing groups and the sponsor, and the cost of implementing the policy in the second stage. I proxy for these probabilities using the bill and legislator specific explanatory variables described above, specifying

$$\sigma_i = 1 (W_i' \beta + e_i > 0), \quad (15)$$

where e_i is an i.i.d. error term with cumulative distribution F that is assumed to be uncorrelated with the vector of explanatory variables W_i . The parameters in (15) cannot be estimated since the variable on the left hand side is unobserved. However, the parameters α_0 and α_1 link the unobserved dependent variables with the observed variable π_i by capturing the extent to which the observed variable is “misclassifying” the true value of the unobserved variable. The probability that a bill is successful is given by

$$\Pr[\pi_i = 1] = \alpha_0 + (1 - \alpha_0 - \alpha_1) F(W_i' \beta). \quad (16)$$

If F is a symmetric distribution (e.g., normal) and $\alpha_0 + \alpha_1 < 1$ (i.e., the information contained in W_i is of some predictive value for the unobserved σ_i), then Hausman, Abrevaya and Scott-Morton (1998) show that the parameters in (16) can be consistently estimated by nonlinear least squares based on minimizing the moment condition

$$\{\widehat{\alpha}_0, \widehat{\alpha}_1, \widehat{\beta}\} = \arg \min \sum_i (\pi_i - \alpha_0 - (1 - \alpha_0 - \alpha_1) F(W_i' \beta))^2. \quad (17)$$

The misclassification parameters are identified by the nonlinearity of the functional form of F . If some elements in W_i are endogenous, then unbiased estimates of the parameters can be obtained using standard nonlinear instrumental variables techniques along with their standard errors (Murphy and Topel 2002).

1.5. Description of the Data

The theoretical argument above has two key implications for the understanding of interest group behavior. That is, there should be heterogeneity in both the motives of interest groups and the effects of their spending on the legislative processes. Some expenditures should further legislation along, while others should suppress it. To identify these two aspects of interest group behavior, I employ federal data from the United States spanning the most recent two decades. This dataset combines a wealth of legislative data with detailed information on the type, source and target of

interest group funding. Using these two sources, I construct a number of variables describing various features of bills and political contributions. To my knowledge, this is the first time such detailed data at the level of individual bills has been constructed and used to analyze the role that interest group spending plays in all phases of the legislative process.

The key variables in the model are the agenda and the payments made by relevant interest groups. Accordingly, the analysis is conducted at the bill level. I consider all bills and joint resolutions introduced in both the House of Representatives and the Senate from the 101st Congress (beginning January 3rd, 1989)¹⁷ to the 110th Congress (ending January 3rd 2009). The text and relevant information of each bill is available in the Thomas Legislative Database which is maintained by the Library of Congress. For each bill, I locate the primary sponsor, cosponsors and amendments made to the bill. I also identify the dates in which major legislative actions occurred. This allows me to construct the time frame that a bill spent in committee and in the chamber, if applicable. Some four percent of bills do not pass on their own but are rolled into other bills that do end up being written into law. In these cases, I omit the intermediate bills and consider only the final legislation.

For political expenditure data, I use bulk data from the Federal Elections Committee collated by the Center for Responsive Politics (opensecrets.org), a non-partisan watchdog group that monitors various manifestations of money in politics. Of the three main types of political expenditures outlined in the introduction, I choose to focus on PAC contributions as a proxy for policy influential payments. PACs are organized by specific political interests, hence their contributions are more likely to be associated with influence peddling as opposed to individual campaign contributions which may be as little as twenty dollars and have greater potential to be associated with simple political consumption. Lobbying expenditures by firms and interest groups are also likely associated with influence peddling; however, the information required by the Internal Revenue Service in accordance with the Lobbying Disclosure Act of 1995 does not include the legislative targets of lobbying spending. In other words, lobbying expenditure data suffer from the fact that their recipient is unspecified.

Each campaign contribution made by a PAC contains information linking the donor PAC, the recipient candidate, and the date it was made. I first identify the primary policy interest of every PAC using the following objective algorithm. In every congress, I locate every contribution that a particular PAC made. For each recipient of these contributions, I identify which committees they sit upon using committee membership data from Nelson (2009) and Stewart and Woon (2009) and tally the contributions accordingly. I can then identify the committee membership that a particular PAC most actively contributed to, which allows me to classify PACs by committee level interest. For each bill in my sample, I can use this information to construct the total contributions that a bill's sponsor received from interested PACs during the period that the bill was in committee consideration, and the total contributions that a bill's sponsor received during the period that the bill was under floor consideration. I can also construct the total contributions from relevant PACs that all members of a given committee or party received during the relevant periods of time for a particular piece

¹⁷I omit bills and joint resolutions promoted by discharge petition, a technique that allows legislators to circumvent the committee stage and bring bills directly to the chamber floor, provided an absolute majority of members agrees. As the usual agenda setting process takes place in committee, it is reasonable to omit these rare bills which account for no more than 0.15% of all legislative activity in any Congress. I also omit a small number (less than 0.2%) of bills introduced by members of jurisdictions that lack voting rights in the House (representing Puerto Rico, Guam, American Samoa and the US Virgin Islands) since not all variables can be constructed for these bills.

of legislation. In contrast to the two year aggregate expenditure variables used in most studies attempting to link money and voting, these finely tuned proxies for political contributions vary by time, committee, and legislative sponsor. Automation of the data collection process allows a much larger sample to be obtained than would have been feasible otherwise.

I define the period that a bill is in committee consideration as seven days before and after the date of introduction. There is an inherent tradeoff in this arbitrary definition of this legislative period. If the window is too narrow, then the chance of not accounting for expenditures that are germane to the drafting of the particular bill increases. However, if the window is too wide, then the chance of accounting for expenditures that are not germane to the particular bill increases as well. This latter concern might introduce the possibility that error terms in regressions featuring legislative expenditures as an independent variable are not independently distributed. The fourteen day window mitigates this, as fewer than 1.5% of all bills are introduced by the member within seven days of another bill that is introduced in the same committee by the same member.¹⁸ I define the period that a bill is under floor consideration similarly.

Finally, I use DW-NOMINATE (dynamic, weighted, nominal three step estimation) scores developed by Keith Poole and Howard Rosenthal to proxy for the multidimensional ideology of each congressman and senator during the sample (Carroll et. al., (2009)). These scores aggregate the information contained in every floor vote cast by legislators during their time in Congress by evaluating voting decisions under the framework of a random utility choice model along two dimensions. The first score captures politicians' differing views on government intervention in the economy. The second score captures North-South conflict on slavery and civil rights, though the realignment of the South from the Democratic party to the Republican party since 1980 has reduced the importance of this dimension. These ideology measures vary by both politician and Congress and assume values between -1 and 1 with a median of zero. Summary statistics for the data can be found in table 2.

On average, legislative sponsors in the House of Representatives receive approximately four hundred dollars in campaign contributions from PACs of interest for the periods in which their bills are under committee consideration. This is roughly one twentieth of the total amount of contributions that all members on the committee receive during the same period. Since committees have many more than twenty members on average, this means that money disproportionately flows to authors of legislation while bills are under committee consideration. Bear in mind that multiple members of a committee may be sponsoring bills. In the Senate, legislative sponsors receive roughly two thousand dollars in campaign contributions from PACs of interest for the periods in which their bills are under committee consideration, which is a similarly approximately one twentieth of total committee contributions in the same period.¹⁹ Bills stay in committee roughly fifty days in the house and thirty five days in the Senate, though there is tremendous variance in this time period.

Both of the average bill sponsor's ideology scores are close to zero. This suggests that sponsors of legislation don't tend to be disproportionately left or right leaning. This does not, however, suggest that legislators are largely moderates, as evidenced by the sizable standard deviations of

¹⁸I begin the period of committee consideration a week prior to the introduction of the bill because that is when much of the drafting of the bill takes place. As a robustness check, I tried specifying the periods beginning 3 days and 2 weeks prior to the date of introduction. The econometric results remained qualitatively unchanged, and ending either at the date at which the bill moved to the floor or for failed bills, the date of the final major legislative action on the bill. I also extended the period of committee consideration to the date of final major committee actions on a bill, but again, the results were qualitatively unchanged.

¹⁹Over half of bills generate few or no contributions for their sponsor. As a result, bills that receive over \$250 in nominal contributions attract an average of roughly \$4,500 in the House of Representatives and \$10,000 in the Senate for their sponsors.

Table 2: Summary Statistics of the Data, 101st-110th Congress

| Variable | House | | Senate | | Source |
|---|--------------|-----------|--------------|-----------|--|
| | Mean | Std. Dev. | Mean | Std. Dev. | |
| While bill is under committee consideration: | | | | | |
| Money raised by sponsor | 376.8 | 4840 | 1995 | 87321 | Center for Responsive Politics |
| Money raised by Republicans in committee | 4938 | 13948 | 18081 | 85481 | Center for Responsive Politics |
| Money raised by Democrats in committee | 4404 | 15595 | 19948 | 155876 | Center for Responsive Politics |
| Days bill is in committee | 47.27 | 97.04 | 34.73 | 92.31 | Author's Calculation |
| Sponsor's 1 st dimension DW-NOMINATE score | 0.004 | 0.46 | -0.07 | 0.41 | www.voteview.com |
| Sponsor's 2 nd dimension DW-NOMINATE score | -0.090 | 0.40 | -0.06 | 0.44 | www.voteview.com |
| Sponsor's election winning percentage | 0.671 | 0.139 | 0.597 | 0.108 | Clerks of the House of Rep. and Senate |
| Number of cosponsors on the bill | 18.11 | 39.47 | 5.57 | 11.05 | Thomas Legislative Database |
| Number of times bill is amended | 0.31 | 4.22 | 0.40 | 5.62 | Thomas Legislative Database |
| Textual complexity of bill: | | | | | |
| Flesch Reading Ease | 56.65 | 10.00 | 51.66 | 12.64 | Author's Calculation |
| Automated Readability Index | 10.52 | 3.55 | 11.06 | 3.21 | Author's Calculation |
| Gunning-FOG Index | 12.82 | 2.72 | 13.03 | 2.47 | Author's Calculation |
| SMOG Index | 12.09 | 1.90 | 12.12 | 1.75 | Author's Calculation |
| Number of Bills | 59894 | | 31764 | | |

these variables. Sponsors in both houses tend to have won their electoral races with substantial majorities. Bills have on average eighteen cosponsors. However, the standard deviation of this variable is quite high. In fact, the modal bill has zero cosponsors. Bills are amended less than once on average, and roughly ninety five percent of bills are not amended at all. Again there is great heterogeneity in this variable, as some bills contain well over one hundred amendments.

1.6. Empirical Results and Analysis

I present various tests of the efficacy of political spending in table 3. All coefficients are estimated efficiently by maximum likelihood in instrumental variables probit regressions. The coefficients in the first four columns are estimated by using bills introduced in the House of Representatives, and the coefficients in the last four columns are estimated using bills introduced in the Senate. In the first two columns of each set, I present regression results based on the full sample of bills in each house. Columns 1 and 4 represent the average determinants of legislative success in each house.

Columns 2 and 5 include the PAC money raised by the sponsor interacted with $\log(1+\text{number of cosponsors})$. The general idea behind these estimates is that if legislative sponsors know they are writing their bill to intentionally fail, then they will be less likely to expend resources to build the support of cosponsors. On the other hand, if sponsors are aiming to pass legislation, they will seek to attract a large number of cosponsors. For bills intended to fail, PAC money should diminish their legislative prospects, and for bills intended to pass, PAC money should improve their legislative prospects. Hence, I expect the base coefficient in the first row to be negative and the interacted coefficient in the second row to be positive. I take logarithms of the number of cosponsors because I expect the effect to increase at a diminishing rate as the number of cosponsors grows. In the third and fourth columns of each set, I present regression results based on subsamples of bills defined by cosponsorship of bills.

The key coefficient of interest, interested PAC contributions to the legislative sponsor, can be found in the first row of the table. In the House, the average effect of contributions to the sponsor found in first column is negative. As bills attract more and more cosponsors (column 2), contributions start to help bills out of committee. This finding motivates the regressions in the third and fourth columns. For those bills with few cosponsors (column 3), this effect is more strongly negative and more precisely estimated, as suggested by theory. An additional \$1000 in campaign contributions to a legislator sponsoring a bill with at most one cosponsor is estimated to decrease the prospects of that bill passing committee by eight percent. For bills with many cosponsors (column 4), payments to the sponsor have a small and imprecisely measured effect. In the Senate, the average effect of contributions to the sponsor found in column 5 is positive, but statistically indistinguishable from zero. As in the House, as bills attract more cosponsors (column 6) contributions have a greater positive effect on legislative success. For bills with few cosponsors (column 7), I find that an additional \$10,000 in campaign contributions results in a 0.4% decrease in legislative success. For those bills with many cosponsors (column 8), an additional \$10,000 in campaign contributions to the sponsor will result in a roughly seven percent increase in legislative success.

PAC money raised by other committee members has a positive effect on average in both the House and Senate. In accordance with the theoretical result that groups do not buy votes when blocking legislation, the effect of this variable on legislative success is statistically indistinguishable from zero in both chambers when bills have few cosponsors (columns 3 and 7). However, when bills are heavily cosponsored, an additional million dollars to committee members results in a twenty three percent increase in legislative success in the House and an additional hundred thousand dollars

Table 3: Campaign Contribution Effects on Legislative Success in Committee, 101st-110th Congress

| Variable | House | | | | Senate | | | | |
|--|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-----|
| | All Obs. | 0, 1 | 3+ | All Obs. | 0, 1 | 3+ | All Obs. | 0, 1 | 3+ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Interested PAC money raised by sponsor † | -0.063** (0.026) | -0.061** (0.026) | -0.098** (0.010) | -0.031* (0.017) | 3.45 (3.62) | 2.27 (2.16) | -0.356** (0.063) | 8.48** (3.57) | |
| Interested PAC money raised by sponsor * | | 0.015** (0.006) | | | | 2.31* (1.21) | | | |
| ln(1+cosponsors) †† | | | | | | | | | |
| Interested PAC money raised by comm. members † | 0.346** (0.154) | 0.140 (0.098) | 0.225 (0.278) | 0.260** (0.129) | 1.45** (0.374) | 0.705** (0.226) | -0.727 (0.467) | 2.12** (0.704) | |
| Sponsor's economic ideology score (DW ₁) ² | -0.244** (0.058) | -0.230** (0.056) | -0.119 (0.094) | -0.293** (0.074) | -0.235** (0.085) | -0.257** (0.085) | -0.417** (0.126) | -0.052 (0.135) | |
| Sponsor's North-South ideology score (DW ₂) ² | -0.065* (0.037) | -0.071* (0.037) | -0.096 (0.062) | -0.021 (0.047) | -0.031 (0.041) | -0.033 (0.041) | -0.157** (0.060) | 0.100 (0.065) | |
| Majority party dummy | 0.678** (0.021) | 0.673** (0.021) | 0.675** (0.036) | 0.649** (0.027) | 0.416** (0.023) | 0.414 (0.023) | 0.381** (0.034) | 0.422** (0.037) | |
| Number of cosponsors (x10) | 0.021** (0.002) | 0.019** (0.002) | 3.344** (0.033) | 0.019** (0.002) | 0.202** (0.008) | 0.210** (0.001) | 2.03** (0.321) | 0.172** (0.011) | |
| Number of amendments | 0.056** (0.003) | 0.056** (0.003) | 0.029** (0.003) | 0.096** (0.006) | 0.026** (0.002) | 0.026** (0.002) | 0.035** (0.004) | 0.020** (0.003) | |
| Sponsor winning percentage in previous election | 0.557** (0.064) | 0.560** (0.063) | 0.664** (0.106) | 0.460** (0.082) | 0.651** (0.102) | 0.649** (0.102) | 0.846** (0.143) | 0.582** (0.171) | |
| Days in committee (x10) | 0.040** (0.001) | 0.040** (0.001) | 0.043** (0.001) | 0.040** (0.001) | -0.060** (0.001) | -0.060** (0.001) | -0.090** (0.001) | -0.050** (0.001) | |
| Committee, congress, month fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | |
| Number of Observations | 59642 | 59642 | 24500 | 32401 | 31371 | 31371 | 16977 | 11944 | |

Dep. variable is 1 if bill passed committee and 0 otherwise. Huber-White robust standard errors in parentheses.

Significance level indicated by: *=10%, **=5%.

† Endogenous variable, †† Endogenous variable, instruments are also multiplied by ln(1+cosponsors)

All monetary variables are denominated in millions of 2008 dollars except PAC money raised by sponsor is in thousands of dollars for the House.

to committee members results in a twenty percent increase in legislative success in the Senate.²⁰ Overall, these results are consistent with the idea that money is given to legislative sponsors and committee members for differing reasons, and hence has different ultimate effects on legislative success depending on the type of bill.

Other explanatory variables tend to be statistically significant and of the expected sign. Other things equal, bills sponsored by more ideologically extreme politicians are more likely to fail. The strongest determinants of legislative success are the party and the relative electoral strength of the sponsor. Bills written by politicians in the majority party have a substantially greater chance of passage than bills written by politicians in the minority party, likely due to the considerable gatekeeping power of the committee chairperson and the availability of more favorable votes. Bills with more cosponsors and bills that are more often amended enjoy greater chances of legislative success as expected. In the house, the longer a bill remains in committee, the more successful it is, although this effect is reversed in the Senate. This could be a result of the fact that scheduling rules are more rigidly defined in the House.

I explore interest group spending motives by directly estimating the misclassification parameters described in the previous section by nonlinear least squares. Regression results for the House and the Senate assuming a normally distributed error term are shown in table 4. The key parameters of interest are in the first two rows. The probability that a group was trying to suppress a bill that was ultimately observed to have passed is given by $\widehat{\alpha}_0$. As expected, this probability is low. The small number of successful bills is not overstated. The probability that a group was trying to promote a bill that ultimately failed is given by $\widehat{\alpha}_1$. This parameter is very precisely estimated and roughly 0.37 in the House and 0.22 in the Senate. Utilizing equation (14), I compute²¹

$$1 - E(\sigma_{HR}) = 0.56, \quad (18)$$

$$1 - E(\sigma_S) = 0.69. \quad (19)$$

In other words, interest groups spend to suppress legislation on 56% of bills introduced in the House and 69% of bills introduced in the Senate. Other coefficients are of expected sign.

1.7. Extensions

1.7.1. Linguistic Complexity

I now attempt to shed light on a potential mechanism that sponsors might employ to affect the potential success of their legislation. By increasing the linguistic complexity of the text of a bill, the obfuscation of policy could enable politicians to sponsor bills intended to fail at the behest of

²⁰Estimates of the effects of interested PAC contributions on legislative success are qualitatively similar, though less precisely measured when restricted to the subset of bills that attract over \$250 in contributions to their sponsor. In the House, for bills with zero or one cosponsors, an additional ten thousand dollars to the sponsor decreases the probability of legislative success by 5%, and for bills with three or more sponsors, it increases the probability of passage by 4%. In the Senate, for bills with zero or one cosponsors, an additional hundred thousand dollars to the sponsor decreases the probability of legislative success by 25%, and for bills with three or more cosponsors, it increases the probability of legislative success by 27%. All estimates are statistically significant from zero at the 15% significance level with the exception of House bills with over three cosponsors.

²¹These estimates are robust to alternative functional form assumptions on the error distribution F. For example, if the error term is extreme value type 1, then $1 - E(\sigma_{HR}) = 0.59$ and $1 - E(\sigma_S) = 0.70$.

Table 4: Campaign Contributions and Interest Group Motives, 101st-110th Congress

| Variable | House (1) | Senate (2) |
|---|---------------------|---------------------|
| $\widehat{\alpha}_0$ | 0.026** (0.008) | 0.045** (0.002) |
| $\widehat{\alpha}_1$ | 0.373** (0.007) | 0.217** (0.015) |
| Interested PAC money raised by committee members† | 0.213** (0.056) | -1.19* (0.562) |
| Sponsor's economic ideology score (DW ₁) ² | -0.762** (0.196) | -1.57** (0.414) |
| Sponsor's North-South ideology score (DW ₂) ² | -0.393 (1.02) | -0.077** (0.005) |
| Majority party dummy | 0.949** (0.242) | 1.12** (0.140) |
| Number of cosponsors (x10) | 0.043** (0.012) | 0.771** (0.006) |
| Number of amendments | 1.50 (1.19) | 4.65** (0.341) |
| Sponsor winning percentage in previous election | 1.11* (0.788) | 1.91** (0.386) |
| Days in committee (x10) | 0.026** (0.006) | -0.249** (0.022) |
| Committee, congress, month fixed effects | Yes | Yes |
| Number of Observations | 56942 | 31372 |

Dependent variable is equal to 1 if the bill passed committee and zero otherwise. Murphy-Topel robust standard errors are in parentheses.

Significance level indicated by: *=10%, **=5%.

† Endogenous variable

All monetary variables are denominated in millions of 2008 dollars.

special interest groups, as legislators are given an excuse for voting “no” without signaling their policy preferences.²² This could be advantageous to legislators. Alesina and Holden (2008) argue that in the context of elections, politicians may prefer to remain ambiguous over their policy positions in an effort to balance campaign contributions and electoral pressure from the median voter.

Linguistic complexity and the parsing of public statements has been shown to be a mechanism for the intentional manipulation of signals in central banking. For example, Romer and Romer (2000) go through central bank statements by hand, scoring complexity by the presence of particular phrases, while Lucca and Trebbi (2008) refine and automate this method for a similar application, keying in on specific words and phrases. I also summarize the content and complexity of legislation using general, automated, linguistic procedures. This allows me to investigate the connection of PAC contributions with legislative outcomes in two steps. First, I explore the extent to which PAC contributions affect the textual complexity of particular types of legislation. I then consider the link between legislative complexity and legislative outcomes.

The full, final text of each bill is available in the Thomas Legislative Database. From this, I construct four well established measures of textual complexity. *FRE*, the Flesch reading ease score (Flesch (1948)), *ARI*, the automated readability index (Kincaid, et. al. (1975)), *FOG*, the Gunning-FOG index (Gunning (1952)) and the *SMOG* index can all be computed from primitive corporal variables related to the number of syllables, words, and sentences in the text. Detailed formulas for these measures appear in Appendix B. The general idea underlying the textual analysis is that complexity is an increasing function of the number of words per sentences and of the number of syllables per word. Larger values of these measures reflect greater textual complexity (except for the aptly named Flesch reading ease score, which I multiply by negative 1 to make larger values correspond to greater complexity). To be sure, these measures were all developed using large corpora based on broad samples of English literature and prose. Legislative language is hardly representative of standard prose, as it is rife with jargon and complex, multi-clause sentences. This renders an absolute interpretation of these measures – each measure is calibrated to correspond to the reading comprehension ability of an American student at that grade level – somewhat suspect. Nevertheless, relative interpretation between bills is still of value. Summary statistics of these measures for the sample of bills are provided in table 2.

In table 5, I regress the four measures of linguistic complexity on the amount of PAC contributions the legislative sponsor collects. I instrument the PAC contributions with the same set of instruments as before. The first set of four columns contains results that are estimated using the full sample. In both the House and the Senate, bills tend to be more complex when their sponsor receives more campaign contributions. The second set of four columns contains results that are estimated using the subsample of bills that are likely to be blocked. In this subsample, campaign contributions appear to obscure legislation more than in the entire sample. The third set of four columns contains results that are estimated using the subsample of bills that are unlikely to be blocked. Here, there appears to be no precise relationship between campaign contributions and legislative complexity. The qualitative results are largely robust to the various metrics of linguistic complexity. Overall, these estimates are strongly suggestive that that the text of bills that attract large amounts of PAC contributions for their sponsor tends to be far more complicated than the text of bills that attract small amounts of PAC contributions for their sponsor. As argued above, the magnitude of these

²²For example, Rep. John Boozeman (R-AR) justified his prospective “no” vote on H.R. 3200 (America’s Affordable Health Choices Act of 2009) with the following statement: “This is not light reading. It’s difficult reading, it involves policy and things. Right now, because of those things, I will probably vote against it.”

coefficients is of little interpretive value, but their uniformly positive values are consistent with the notion that these contributions induce legislators to obfuscate the content of their bills.

Moreover, I robustly find that the obfuscation of legislation is detrimental to its success. In table 6, I present probit estimates of legislative success on the four measures of linguistic complexity along with previously used control variables. The dependent variable is equal to one if the bill passes committee and zero otherwise. In both chambers, the more semantically complex a piece of legislation is (as measured by all metrics), the more likely it is to fail. Other control variables have coefficients of similar sign and significance to their counterparts in table 3. This is evidence that textual complexity affects legislative success through a similar channel as PAC contributions to the sponsor (and consistent with the idea that the obfuscation of legislation *is* one of the very channels through which PAC contributions induce intentionally failing legislation).

1.7.2. Floor Voting

For the sake of comparison with the existing literature attempting to link campaign contributions and legislative behavior, it is worth investigating what happens to bills once they've passed committee and made it to the floor for debate. The overwhelming majority of studies conduct their empirical analysis at the politician level. That is to say, each observation is a politician in a given congress, the dependent variable is some voting score derived from an aggregation of all floor votes the individual politician cast, and the independent variable of interest is the total amount of campaign contributions the politician raised in the same time period. My analysis presented here is unique because the dataset allows analysis at the level of the individual bill, and campaign contributions vary within congresses.²³ In addition, most studies restrict their attention to the House of Representatives, whereas I consider both legislative houses.

In table 7, I present results from instrumental variables probit regressions of legislative success on various covariates conducted on the subsample of bills which have emerged from committee successfully. At this point in the legislative process, the agenda has largely been set, so the two relevant groups of legislators are the entire chamber delegation of the party of the legislative sponsor, and all other legislators. I aggregate the PAC contributions raised by these two groups of legislators during the period that the particular bill is under floor consideration, and instrument these two variables by the contribution totals for the two analogous groups in the opposite chamber. I include committee, congress and monthly fixed effects.

Money to legislators does not seem to have much of an effect on bill success in either chamber – there is little evidence of vote buying on the floor of the House or the Senate. In general, bills sponsored by more ideologically extreme legislators are less likely to pass a floor vote. Interestingly, conditional on seeing the floor of the House, bills from the majority have a lower probability of passage than bills from the minority. This is likely an artifact of the tremendous power delegated to the committee (see, for example, Cox and McCubbins (2007)), as House committees may promote lower quality bills if they are introduced by the majority party rather than the minority party. Bills with heavy cosponsorship are predictably more likely to see favorable results on the chamber floor, and the longer time a bill is under floor considered, the more successful it is.

²³Some studies (e.g., Wawro (2001)) do conduct their analysis at the level of individual legislation; however, they only consider a very small subset of total legislation considered. In contrast, I consider all pieces of legislation that make it to the floor of the relevant chamber.

Table 5: Campaign Contributions and Linguistic Complexity of Legislation, 101st-110th Congress

| House | | | | | | | | | | | | |
|---|------------------|------------------|------------------|------------------|------------------|-----------------|------------------|------------------|----------------|----------------|----------------|----------------|
| Dependent Variable: Variable | Full Sample | | | | 0-3 Cosponsors | | | | 4+ Cosponsors | | | |
| | -FRE (1) | ARI (2) | FOG (3) | SMG (4) | -FRE (5) | ARI (6) | FOG (7) | SMG (8) | -FRE (9) | ARI (10) | FOG (11) | SMG (12) |
| Interested PAC money raised by sponsor† | 0.16** (0.06) | 0.01 (0.01) | 0.02** (0.01) | 0.02** (0.01) | 0.35** (0.12) | 0.04* (0.02) | 0.06** (0.02) | 0.05** (0.02) | 0.06 (0.04) | 0.01 (0.01) | 0.01 (0.01) | 0.01 (0.01) |
| Number of Observations | 57203 | | | | 29804 | | | | 27399 | | | |
| Senate | | | | | | | | | | | | |
| Interested PAC money raised by sponsor† | Full Sample | | | | 0-3 Cosponsors | | | | 4+ Cosponsors | | | |
| | -FRE (1) | ARI (2) | FOG (3) | SMG (4) | -FRE (5) | ARI (6) | FOG (7) | SMG (8) | -FRE (9) | ARI (10) | FOG (11) | SMG (12) |
| Interested PAC money raised by sponsor† | 17.6* (8.65) | 2.67** (1.26) | 1.25** (0.57) | 0.54** (0.24) | 21.6** (13.0) | 3.56 (2.06) | 1.88* (1.06) | 0.91* (0.47) | 9.04 (7.24) | 1.05 (0.77) | 0.21 (0.22) | 0.03 (0.22) |
| Number of Observations | 31679 | | | | 21497 | | | | 10182 | | | |

Significance level indicated by: * =10%, ** =5%.

† Endogenous variable

Monetary variable is denominated in thousands of 2008 dollars for the House and millions of dollars for the Senate

Table 6: Linguistic Complexity of Legislation and Legislative Success, 101st-110th Congress

| Variable | House | | | Senate | | | | |
|--------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| -FRE | -0.008** (0.001) | | | | | | | |
| ARI | | -0.016** (0.004) | | | | | | |
| FOG | | | -0.040** (0.003) | | | | | |
| SMOG | | | | -0.079** (0.005) | | | | |
| Sponsor's econ. ideology score | -0.201** (0.051) | -0.211** (0.050) | -0.218** (0.050) | -0.222** (0.050) | -0.226** (0.083) | -0.229** (0.083) | -0.230** (0.083) | -0.232 (0.083) |
| Sponsor's N-S ideology score | -0.070* (0.036) | -0.072** (0.036) | -0.071** (0.036) | -0.070* (0.036) | -0.027 (0.039) | -0.027 (0.039) | -0.026 (0.039) | -0.026 (0.039) |
| Majority party dummy | 0.673** (0.020) | 0.680** (0.020) | 0.688** (0.020) | 0.693** (0.020) | 0.420** (0.022) | 0.420** (0.022) | 0.421** (0.022) | 0.422** (0.022) |
| Number of cosponsors (x10) | 0.020** (0.002) | 0.021** (0.002) | 0.021** (0.002) | 0.022** (0.002) | 0.192** (0.008) | 0.198** (0.008) | 0.198** (0.008) | 0.199** (0.008) |
| Number of amendments | 0.056** (0.010) | 0.057** (0.010) | 0.057** (0.010) | 0.058** (0.011) | 0.026** (0.004) | 0.026** (0.004) | 0.026** (0.004) | 0.026** (0.004) |
| Sponsor's winning percentage | 0.553** (0.062) | 0.568** (0.062) | 0.576** (0.062) | 0.582** (0.062) | 0.674** (0.100) | 0.677** (0.100) | 0.675** (0.100) | 0.674** (0.099) |
| Days in committee (x10) | 0.041** (0.001) | 0.040** (0.001) | 0.040** (0.001) | 0.040** (0.001) | -0.006** (0.001) | -0.006** (0.001) | -0.006** (0.001) | -0.006** (0.001) |
| Comm., cong, mon. dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 56497 | 56497 | 56497 | 56496 | 31293 | 31293 | 31293 | 31292 |
| Pseudo R ² | 0.29 | 0.29 | 0.29 | 0.29 | 0.19 | 0.19 | 0.19 | 0.19 |

Dependent variable is 1 if bill passed committee, 0 otherwise. Huber-White robust std. errors in parentheses.

Significance level indicated by: *—10%, **—5%.

Table 7: Campaign Contributions and Legislative Success on the Floor, 101st-110th Congress

| Variable | House (1) | Senate (2) |
|--|---------------------|---------------------|
| Interested PAC money raised by members of sponsor's party† | 0.424 (0.710) | 0.237 (0.511) |
| Interested PAC money raised by members not of sponsor's party† | 0.819 (0.838) | 0.489 (0.389) |
| Sponsor's economic ideology score (DW ₁) ² | -0.555** (0.289) | -0.382* (0.214) |
| Sponsor's North-South ideology score (DW ₂) ² | -0.114 (0.182) | -0.242** (0.092) |
| Majority party dummy | -0.544** (0.143) | -0.088 (0.059) |
| Number of cosponsors (x10) | 0.030** (0.007) | 0.119** (0.017) |
| Number of amendments | 0.002 (0.003) | 0.004** (0.002) |
| Sponsor winning percentage in previous election | 0.175 (0.304) | 0.478** (0.239) |
| Days in committee (x10) | 0.042** (0.006) | 0.022** (0.001) |
| Committee, congress, month fixed effects | Yes | Yes |
| Number of Observations | 5473 | 3466 |

Dependent variable is equal to 1 if the bill made it off the floor conditional on emerging from committee and zero otherwise. Huber-White robust standard errors are in parentheses.

Significance level indicated by: *=10%, **=5%.

† Endogenous variable

All monetary variables are denominated in millions of 2008 dollars.

1.8. Conclusion

Legislative observers have long described the development of “political access” as a primary motive of interest group expenditures. This ill defined construct has been often used as a catchall justification for the persistent and increasing levels of money in politics. In a very real sense, political access enables special interests to influence legislation by shaping the very policy up for debate. In a presidential primary campaign speech, Barack Obama proclaimed his intent to, “tell the corporate lobbyists that their days of setting the agenda in Washington are over.”²⁴ It was as widely apparent to him as it is to practitioners of legislative politics that interest groups play a prominent role in agenda setting. In my formal description of this role, I have provided an explanation for the observation that legislative failure is the norm.

By empirically testing a key proposition of my model, I have provided robust evidence that political spending affects the legislative process in a measurable way. The relationship between spending and legislative success emerges when analysis is conducted at a disaggregated level. (This should come as little surprise since the majority of legislative models consider the decision making process at the level of individual bills.) Furthermore, the utilization of basic linguistic analysis sheds light on a potential mechanism for this relationship. I do not claim to explain completely why interest groups spend so much and why so many bills fail; mine is by no means a comprehensive answer. That said, I hope to emphasize the value of disaggregated legislative data in future empirical investigations.

²⁴Said on December 12, 2007 in Exeter, New Hampshire.

2. Interest Group Behavior and the Persistent Inefficiencies of Public Policy

2.1. Introduction

Why do inefficient policies exist? The deceptively simple answer is that society has other goals besides efficiency, namely redistribution. But it is still appropriate to ask whether redistribution policies are as efficient as possible, especially if one shares Stigler's view that the primary intention of government interventions is to redistribute income.²⁵

The political economy literature has analyzed whether interest groups give certain individuals a disproportionately greater—and possibly distorting—impact on public policies and has debated whether competition between interest groups is conducive to a “second-best” method of redistribution, given the political process (e.g., Becker (1983), Coate and Morris (1995), Grossman and Helpman (1996a), Rajan and Zingales (2000), and Persson and Tabellini (2000)). However, to the best of my knowledge, no one has looked at competition within interest groups—that is, at the interactions between constituents and the organizations that they form and the implications of these interactions for redistributive policies.

In this chapter, I argue that interest groups value and accumulate political capital to obtain subsidies in the long run, where political capital is defined as the stock of political influence an individual or group builds up through repeated investments (i.e., lobbying and campaign contributions) in particular policies or politicians.²⁶ The behavior of interest groups is governed by their constituents, who value more immediate political rents. For instance, U.S. airlines are often preoccupied with short-term profitability, whereas the interest group to which they belong, the Air Transport Association (ATA), is concerned not only with short-term industry profitability but also with accumulating influence over policymakers to ensure the future financial health of the industry.

Interest groups make investments in political capital at the expense of immediate consumption, which does not necessarily raise the welfare of their more myopic constituents who exert control over them. The resulting agency problem leads certain constituencies to maintain and expand their preferential treatment by favoring inefficient redistributive policies. Inefficiencies persist and grow as influential groups seek to maximize rents per member by limiting their size. Expanding on the previous example, the ATA limits its membership to the “principal U.S. airlines,” which does not include commuter carriers and general aviation. In the aftermath of September 11, the ATA lobbied the government to provide lump sum grants and low interest loans to the airline industry instead of taking a longer view and calling for more efficient policies such as reducing the airline ticket tax to reduce the marginal cost of flying and increase the demand for air travel.

I conduct basic econometric tests and confirm that the model's assumptions and predictions are consistent with interest group behavior during recent decades; namely, greater political contributions by interest groups result in more inefficient policies, and limits by interest groups on their membership exacerbate inefficiencies. In contrast to previous models, this model leads to a focus on

²⁵Stigler's view is reiterated in his final papers that are summarized by Friedland (2002).

²⁶Cohen and Noll (1991) provide a striking example of the effects of a stock of political capital in their discussion of the Clinch River Breeder Project. Appropriation for the project began in 1974. About two years later, it became clear that the project was a failure. Nonetheless, appropriations for it continued until 1984, in large part because of the accumulated political influence of districts that benefited from project funds. A more recent example is a repository for nuclear waste that is being constructed in Yucca Mountain, Nevada in response to the entrenched interests of nuclear plants. Despite near unanimous, widespread predictions by the scientific community that it will be a technological, ecological, and financial failure, appropriations for the project continue to increase.

barriers to intra-group competition. An implication of this analysis is that regulation of firm entry, licensing, membership fees, and the like may be a substantial impediment to efficient redistribution.

2.2. Formulation of the Model

Citizens and firms with common policy goals are likely to increase their political power by forming interest groups. Constituents of an interest group and the interest groups themselves seek to influence the formation and enactment of public policies that increase their utility as measured by future consumption streams. Federal public policies are enacted by Congress and implemented by executive branch institutions such as regulatory agencies and cabinet-level departments. Feasible policy change is defined by the stability that institutions provide and by the long-run interaction of those institutions with interest groups. Interest groups target specific policymakers for subsidies and do not necessarily compete with each other in a zero-sum game, as evidenced by a plethora of bills, such as transportation and agriculture appropriations, and regulations, such as textile quotas, that subsidize well-defined interests at different times, in different intervals, and under different votes or executive orders. To the extent that interest groups do compete, their constituencies guide their actions.

I develop a basic model of special interests that captures two important features of the political environment that have not been incorporated into previous models of special interest politics. First, I identify and analyze a potential agency problem that arises between interest groups and their constituents because they may have different objectives. Second, I explicitly account for the fact that interest groups' repeated interactions with policymakers imply that their behavior reflects dynamic considerations.

Interest groups (agents) position themselves to engage with policymakers and to pursue their objectives by leveraging influence into preferential treatment in the near term and the long run. Constituents (principals) exert control over their interest group by directing it to support policies aligned with their most immediate or individual objectives. For example, the AARP uses its financial resources to ensure both current and future access to politicians while its constituents collectively throw their political weight at the ballot box behind policies that benefit them in the near term. Agricultural groups and trade unions have long legacies of political activism and explicit goals of maintaining their favored status in the future while farmers and labor repeatedly direct their interests to pursue protectionist goals that yield immediate benefits. This departure from standard models of interest groups (e.g., Grossman and Helpman (1996b)) is analogous to models of firms that feature separation of ownership and control. Such models indicate that agents (managers) who control the firm may pursue objectives that are not always in the interest of the principals (stockholders) who own the firm.

The analytical goal is to provide the simplest formulation of interest group behavior that, among other things, accounts for the preceding phenomena. To this end, I model interest groups and their constituents separately, with distinct objectives, allowing interest groups to accumulate political capital, or influence, over time. I abstract from other possible functions of interest groups discussed in the literature, such as actors in elections and disseminators of information, and from possible inter-group competition because they are not essential for this purpose.

I make the following assumptions to develop our model:

Assumption 2.1. Agents (interest groups) maximize their instantaneous long-run utility

given by the present value of their finite future stream of consumption up to period τ .²⁷ In particular, in period t , agents maximize

$$\max U_t = C_t + \sum_{j=t+1}^{\tau} \rho^{j-t} C_j \quad (20)$$

where C_j is consumption in period j and ρ is an agent specific discount rate. Similarly, principals (constituents) support policies that maximize their utility given by

$$\max V_t = C_t + \sum_{j=t+1}^{\tau} \sigma^{j-t} C_j \quad (21)$$

where σ is their distinct discount rate.

Discount rates reflect interest groups' and constituents' rate of time preferences and attitudes toward risk. As noted, interest groups tend to be more farsighted than the constituents that they represent because they seek to cultivate and maintain political access in the long run. Indeed, an interest group is likely to exist long after certain constituents have expired (e.g., firms that have gone out of business or individuals no longer in the group, as in the AARP). As predicted by the Arrow-Lind (1970) theorem, interest groups are also likely to be less risk averse than the constituents they represent. The theorem states that if organization is desirable, full insurance is unavailable, and the transaction of benefits between members and the organization is costly, then it is appropriate to distinguish between private and common discount rates, treating the latter as lower because risk is shared among a larger group of agents. Applying the theorem to the case at hand, the proliferation of special interests suggests that the organization of individuals and firms into interest groups is desirable, insurance is not offered for political outcomes, and redistributing benefits entails costs. Accordingly, I make the following assumption:

Assumption 2.2. Constituents discount future consumption more heavily than interest groups who represent them discount future consumption. Formally, $\sigma < \rho$.²⁸

Consumption levels are determined by agents' wealth and the economic rents that they obtain through the political process. I formally define consumption at time t as:

$$C_t = Y_t + n_t R_t(a_t) - n_t a_t \quad (22)$$

where Y_t represents wealth, n_t is the number of members in the agent's constituency, and R_t is the net benefit (or loss) from subsidy (or taxation) per member which is a function of a_t , the net expenditure on political capital per member. Net expenditures could include lobbying and campaign contributions.

²⁷de Figueiredo (2004) argues that a finite time horizon is appropriate for modeling political processes because policies have well-defined "windows" of opportunity. This is appropriate because institutional characteristics of the political system such as term limits, the electoral process, and shifts in the public's ideology create an environment where agents will be dealing with particular policymakers up to a particular point in time.

²⁸We could explicitly consider that uncertainty has different effects on interest groups and constituents by including a stochastic component to future period consumption (for instance, in the form of income flows), but this would not alter any of the implications of our model.

Assumption 2.3. Agents' political capital, or influence, I_t , is a stock variable and does not completely depreciate over time. In particular, it is related to the total benefits received by the group by the following equation:

$$I_t = n_t D(R_t) + \delta I_{t-1} \quad (23)$$

where δ is the rate of depreciation of influence, and the function D captures the transaction costs and other efficiency distortions associated with redistribution.

I summarize here a few important properties of the redistribution function D . When an agent is a net taxpayer (i.e., $R < 0$) then $D(R) \leq R$, $D' \leq 1$ and $D'' \leq 0$, as costs tend to increase slightly as the rate of taxation increases. Analogously, when an agent is a net recipient of subsidy (i.e., $R > 0$) then $D(R) \geq R$, $D' \geq 1$ and $D'' \geq 0$.²⁹ Preference distortions and transaction costs cause the cost of providing a subsidy to exceed the subsidy itself, thus reversing the inequalities from those in the taxation function. If lump sum taxes (subsidies) are used and there are no transaction costs, then behavior is not distorted, i.e., D is the identity function, so the preceding properties hold with equality for taxpayers (subsidized agents). To obtain comparative statics, we assume that D is an invertible function, simply implying that any given level of influence generates a unique level of benefits.

Finally, I analyze interest group behavior under different assumptions about the ability of an interest group to manage the size of its constituency.

Assumption 2.4. Interest group size, n , is fixed in the short run and variable in the long run.

2.2.1. Short-Run Analysis

In the short run, constituents provide guidelines to their interest group on the forms of redistribution to pursue: namely, those that generate the greatest utility given in equation (21). Interest groups of fixed size, n , take the method of redistribution as given and choose a level of political expenditure per member to maximize their utility given in equation (20). I do not explicitly model the process of converting political expenditures into benefits, but note the existence of diminishing marginal returns to political expenditures per member (i.e., $\frac{\partial^2 R_t}{\partial a_t^2} < 0$, otherwise interest group spending would approach infinity, which clearly does not occur).

I use a two-period model (i.e., $\tau = 2$) to analyze the interaction between interest groups and their constituents with the timing of events as follows: Two different redistributive policies are under consideration, one of which is more efficient than the other. In period 1, constituents of the interest group direct it to pursue a redistributive policy that maximizes first period utility V_1 . The interest group then chooses the level of expenditures per member, a_1 , that maximizes its utility U_1 . Similarly, in period 2, the interest group chooses a_2 to maximize U_2 . Constituents take no action in this period because they have governed interest group policy in period 1. Without loss of generality, $I_0 = 0$ and $\sigma = 0$. This choice of makes the algebra significantly more tractable but does not change the qualitative findings.

I derive the equilibrium results of this interaction using backwards induction. In period 2, the

²⁹This specification of influence and the redistribution function, D , follows from Becker (1983, 1985).

problem faced by the interest group is

$$\max_{a_2} C_2 = Y_2 + nR_2 - na_2 \quad (24)$$

given the influence accumulation equation (23). The first order condition for the optimal level of expenditures per member can be expressed either in terms of benefits or the influence function as³⁰

$$\frac{\partial R_2}{\partial a_2} = \frac{1}{nD'(R_2)} \frac{\partial I_2}{\partial a_2} = 1 \quad (25)$$

Thus interest groups will invest to the point that a marginal dollar of political expenditure per member, a , generates a marginal dollar of political benefits per member, R . Because the incentives of the interest group and its constituents are perfectly aligned in the final period, there is no agency problem.

I now turn to period 1. Interest groups select the level of expenditures that maximizes U_1 taking second period expenditures as fixed. Hence, the first order condition is

$$\frac{\partial R_1}{\partial a_1} + \rho \frac{\partial R_2}{\partial a_2} = 1 \quad (26)$$

Rewriting the first order condition in terms of influence yields

$$\left(\frac{1}{nD'(R_1)} + \frac{\rho\delta}{nD'(R_2)} \right) \frac{\partial I_1}{\partial a_1} = 1 \quad (27)$$

Note that in the contrast to the second period, an extra term appears because interest groups do not simply maximize instantaneous consumption but account for the effect of current period political capital (influence) on future benefits from the government. The term $\frac{\rho\delta}{nD'(R_2)}$ is nonzero because a positive ρ captures the relatively greater farsightedness of interest groups compared with their constituents, and because a positive δ captures the durable nature of political influence.

As noted, interest groups pursue policies as directed by their constituents. Thus the critical question is whether constituents would be better off if policies employed efficient methods of redistribution. I argue that they may not because such policies encourage interest groups to engage in behavior, namely investing in political influence, which may compromise constituents' near-term consumption. Such behavior would not be an option if interest groups could not accumulate influence.

Consider two different redistributive policies that the government proposes: D_E , an efficient policy, and D_I , an inefficient policy. For subsidized groups, the efficient policy requires less influence to obtain a marginal dollar of subsidy, hence $1 \leq D'_E < D'_I$. The efficient policy will therefore encourage the interest group to increase its investments in influence because the "return" on political capital is likely to be greater. Examining equation (27), the first factor is larger for efficient policies, thus $\frac{\partial I_2}{\partial a_1}$ must fall, implying that political expenditures increase. Similarly, Becker and Mulligan (2003) argue that subsidies with lower marginal deadweight costs lead to greater pressure by subsidized groups and elevate overall government spending.

By substituting away from immediate consumption towards influence that increases future con-

³⁰To obtain the first equality, note that D is invertible, and for any monotonic, differentiable, and invertible function f , $(f^{-1})'(x) = f'(f^{-1}(x))^{-1}$.

sumption, constituents' first period utility, V_1 , decreases. Hence, fully myopic constituents will direct their interest group to support inefficient policies to avoid the loss in utility. Of course, very farsighted constituents will direct their interest group to support efficient policies, but as they increasingly discount the future, it becomes more likely that interest groups would be pressed to support inefficient policies.

For taxpayers, the analysis proceeds in a similar manner. Now, $D'_I < D'_E \leq 1$, so efficient policy generates fewer investments in influence, interest groups substitute towards first period consumption, and taxed constituencies will in all likelihood direct their agents to pursue more efficient policies.³¹ I distill the preceding argument in the following statement:

Proposition 2.1. All else equal, subsidized interest groups will respond to improvements in redistributive efficiency by shifting away from consumption to expenditures on political influence while taxed constituents will shift towards consumption. In the process, interest groups with greater foresight than their constituents will favor increased investments in influence, which may leave their constituents worse off. Thus, interest groups, especially those composed of subsidized constituents, do not necessarily pursue efficient public policies.

Although this proposition was derived from a two period model of political influence because it is the simplest specification that retains the salient features of the political environment, I stress that the qualitative results easily generalize to a model of political influence with finitely many periods.³² Specifying additional periods would enable interest groups to accumulate more political influence and to find it less costly to shift from consumption to expenditures on influence. Such behavior would harden their constituents' opposition to efficient policies because they prefer to reap the benefits of greater influence through additional consumption. The two-period analysis was conducted under the simplifying assumption that agents are perfectly myopic and fully discount the future. Again, proposition 2.1 holds even if agents are forward looking, provided they abide by assumption 2.3 and discount the future more than interest groups discount the future. I provide an implicit econometric test of this assumption later.

Finally, this model focuses on the behavior of interest groups who pursue benefits that are not likely to be affected by the existence of other interest groups (e.g., the size of agricultural subsidies is not affected by protection provided to steel workers, and quotas on steel imports are not likely to be affected by farmers who seek subsidies). Previous research has obtained conflicting results on whether interest group competition involving taxed and subsidized interests yields efficient policy outcomes. Becker (1983, 1985) initially concluded that it did, but Becker and Mulligan (2003) subsequently pointed out that taxpayers might prefer inefficient subsidies because an increasingly efficient system of redistribution would increase the resources that are available to subsidized constituents and encourage them to intensify their political pressure to obtain additional subsidies. In addition, Dixit, Grossman, and Helpman (1997) develop a model where interest groups compete for government subsidies, and argue that such competition could generate a political equilibrium with inefficient redistribution. I do not explicitly consider these effects, but simply note that the existence of interest group competition may actually exacerbate inefficiencies because the actions

³¹Subsidized constituents are more likely than taxpayers to prefer inefficient policies because the interest groups they form place greater priority on political capital. That is, subsidized constituents could prefer inefficient to efficient policies because current consumption may fall if interest groups invest in influence in response to efficient policies.

³²In fact, the qualitative results generalize to a model with infinitely many periods as well, although this is less obvious because we can no longer solve for equilibrium behavior by backwards induction.

of competitors could introduce more uncertainty into particular interest groups' optimization problems. Relatively risk averse constituents may then become even more myopic and direct their interest groups to take stronger measures to pursue consumption at the expense of influence.

2.2.2. Long-Run Analysis

In the long run, subsidized interest groups make additional investments in political influence to maintain and expand their subsidies while their group size n is no longer fixed and exogenous. As shown in equation (23), additional investments and greater membership expand a stock of influence. However, as pointed out by Olson (1965), membership growth is likely to be curtailed because of the "free rider" problem. That is, as groups expand, the cost per member of producing political pressure may actually *increase* because members assume other members will exert pressure on their behalf. In response, subsidized groups seek to maximize benefits per member by requiring some type of license, membership fee, and so on that limits their size. Membership of a subsidized group may also be restricted by laws that are supported by interest groups (e.g., states require doctors and lawyers to obtain a license to practice).

What are the implications for the efficiency of public policy if we allow interest groups to adjust their size? Because the effect of membership on political influence is the relevant margin to consider and is completely determined by the interest group, the analysis can be simplified to a representative period during which interest groups choose their membership levels and political expenditures. In any given period, the interest group's objective can be written as

$$\max_{a,n} C + Y + nR - na \quad (28)$$

where the time subscripts have been omitted. This yields two first order conditions with respect to the control variables a and n . The former remains unchanged from the short run analysis and is reproduced as

$$\frac{\partial R}{\partial a} = \frac{1}{nD'(R)} \frac{\partial I}{\partial a} = 1 \quad (29)$$

The latter is obtained by differentiating the objective function with respect to group size, yielding

$$R - a + n \frac{\partial R}{\partial n} = 0 \quad (30)$$

Implicitly differentiating the influence accumulation equation (23), we can express the first order condition as

$$R - a = \frac{1}{nD'(R)} \left(D(R) - \frac{\partial I}{\partial n} \right) \quad (31)$$

Finally, noting from the first order condition in (29) that $\frac{\partial I}{\partial a} = nD'(R)$, I substitute this result into equation (31) and obtain

$$R - a = \left(\frac{\partial I}{\partial a} \right)^{-1} \left(D(R) - \frac{\partial I}{\partial n} \right) \quad (32)$$

The left hand side of this equation gives the net subsidy (or gross tax) that the interest group obtains per member—that is, the difference between what the member receives from the political process and what the member pays for in political influence. The second factor on the right hand side has the intuitive interpretation of the influence generated by the average member, $D(R)$,

minus the influence generated by the marginal member, $\frac{\partial I}{\partial n}$, while the coefficient, $(\frac{\partial I}{\partial a})^{-1}$, captures the “dollar cost” of additional influence. In other words, net benefits (or gross costs) per member are proportional to the difference between the average and marginal member’s contribution to influence.

Naturally, subsidized groups prefer a large difference and limit group size to ensure that the average member’s contribution to influence is high. Taxed groups prefer a small difference because the value of the difference is negative; hence, they favor an increase in group size so that the marginal member’s contribution to influence approaches the average member’s contribution to influence.

To put this finding a different way, the accumulation of influence over time manifests itself through a combination of increases in group size, n , and benefits per member, R (which are generated by political expenditures, a). If the average member contributes less influence than the marginal member (a gap which exists for a taxpaying group) then gains in influence, which are associated with closing this gap, will largely be due to increased membership instead of additional political expenditures. Conversely, if the average member contributes more influence than the marginal member (which we expect for a subsidized group) then gains in influence will largely be due to additional political expenditures instead of greater membership (because the “dollar cost” of influence is relatively low). In sum, I have derived a behavioral response by interest groups to the well-known “free rider” problem:

Proposition 2.2. Subsidized and taxpaying groups attribute growth in political capital both to direct investments in political influence and increases in membership. In the long run, taxed groups prefer to accrue influence by increasing group size, while subsidized groups obtain greater net benefits per member by increasing investments to accumulate influence and by restricting membership. Hence, in all likelihood, subsidized interest groups will be smaller than taxpayers.

This response to the free rider problem is similar to that found in Becker and Mulligan (2003), but it has important dynamic welfare implications that we pursue here. If an efficient and inefficient redistributive policy were under consideration, the interest group would, in the long run, strictly prefer the efficient policy.³³ However, constituents of the interest group would be even less likely in the long run to support the efficient policy because the lower cost of influence would imply further long term substitution from consumption to expenditures on political influence—which, as indicated, reduces constituents’ utility. The dynamic tendency of subsidized interest groups to increase and consolidate influence through investments *and* membership restrictions widens the gulf between principals’ and agents’ objectives. Hence, our conclusion that the agency problem leads to inefficient policies in the short run is likely to be more severe in the long run because interest groups are free to adjust their size. I summarize this idea in the following proposition:

Proposition 2.3. Subsidized interest groups’ responses to free riding further promote less efficient redistribution policies over time.

In sum, I have shown that subsidized interest groups, as dictated by their constituents who seek to maximize near term consumption per member, will provide persistent support for inefficient policies through their expenditures on political influence and limits on membership. I now turn to the data to test the validity of our predictions of interest groups’ behavior and the implication of this behavior for public policy.

³³The result follows from our short-run analysis, which found that an interest group would be strictly better off with more efficient redistribution if the value of n was fixed. Allowing interest groups to re-optimize by choosing a new n cannot decrease utility.

2.3. Econometric Tests of the Model's Predictions

A fundamental premise of the theoretical model is that special interests benefit from their expenditures on political influence; that is, $\frac{dR}{da} > 0$. Thus, before testing the main propositions, I verify that such investments result in policies that have a positive effect on subsidized interests.

Little empirical evidence on this relationship exists in the economics and political science literature (Persson and Tabellini (2000), Ansolabehere, de Figueiredo, and Snyder (2003), and Mann (2003)).³⁴ Given the limited data that are available, I take a crude approach here by defining policies that benefit subsidized interests as federal appropriations that “designate tax dollars for a specific purpose in circumvention of budget procedures”—referred to as pork-barrel spending by Citizens Against Government Waste.³⁵ Comprehensive data on lobbying expenditures are unavailable, so expenditures on political influence only include campaign contributions. Both variables are measured at the federal level and I assume that our basic unit of observation is generated every two years in accordance with the federal election cycle.

Campaign contributions could increase pork barrel spending because elected officials seek to raise money from a diverse set of interests, some of whom can be satisfied by earmarked legislation. Coefficient estimates of a regression of lagged political contributions on pork-barrel spending are presented in table 8. The first column reports ordinary least squares coefficients, while the second column reports coefficients from a second-order mixed autoregressive moving average regression (ARMA(2,2)).³⁶ Consistent with our analysis, political contributions have a positive effect on pork-barrel spending in the subsequent budget, and the effect is statistically significant and robust to the alternative specifications.

Turning to the main theoretical results, Proposition 2.1 indicates that an increase in redistributive efficiency will cause interest groups to exert greater political pressure by shifting from consumption to investments in influence. I test this proposition by examining the effect of changes in the efficiency of the tax code on political contributions. As noted by Becker and Mulligan (2003), commonly used measures of redistributive efficiency are constructed from the flatness of the income tax structure. I employ three different measures of tax code efficiency: the difference in Gini coefficients of the pre-tax and post-tax income distributions (a larger difference indicates less efficient redistribution), a measure which I call Becker-Mulligan A, which is the ratio of more efficiently collected tax revenue to less efficiently collected tax revenue (e.g., the ratio of revenue from the payroll tax and revenue from other taxes that are less distorting than income taxes to total tax revenue), and a measure I call Becker-Mulligan B, which is the ratio of the effective average tax rate to the effective tax rate of the top decile (a larger ratio implies a flatter tax structure). As shown by the regression results presented in table 9, an increase in taxation efficiency causes interest groups to increase political contributions.³⁷ Generally, the effect is statistically reliable and robust to alternative ways

³⁴ Ansolabehere, de Figueiredo, and Snyder summarize studies that tend to find that campaign contributions have little effect on roll call votes. But it is difficult to characterize such votes as supporting or opposing policies that may benefit subsidized groups. In addition, a major benefit of campaign contributions is they may prevent certain policies from ever being formulated and subjected to a vote.

³⁵ Of course, there are federal expenditures in the budget that subsidize particular interests. I include only pork-barrel spending in this estimation because I wish to avoid any ambiguity about which expenditures subsidize interests.

³⁶ I specify the model as a second-order process because consecutive elections—presidential and midterm—take on different importance. Extending the dependence to a third or fourth-order process did not significantly alter our findings.

³⁷ Due to limited observations, I estimated MA(2) coefficients (i.e., skipped an observation) in specifications (1) and (3) because it is more likely that errors will be correlated with previous errors of the same type of election, for example, presidential, than with errors of a different type of election. I was able to estimate MA(1) and MA(2)

Table 8: Political Contributions and Pork-Barrel Spending, 1952-2004

| Variable | OLS | ARMA(2,2) |
|----------------------------------|------------------|--------------------|
| Lagged political contributions † | 0.017 (0.004) | 0.0013 (0.0006) |
| Autoregressive coefficients | | |
| ϕ_1 | | 0.628 (0.154) |
| ϕ_2 | | 0.337 (0.156) |
| Moving average coefficients | | |
| θ_1 | | 1.566 (0.094) |
| θ_2 | | 1.00 (0.001) |
| Constant | -3.57 (1.83) | 2.30 (2.31) |
| Number of Observations | 26 | 26 |
| R^2 | 0.37 | 0.71 |

Dependent variable is amount of pork-barrel spending in the budget. Data on pork-barrel spending are compiled by Citizens Against Government Waste. For each year since 1991 CAGW has combed through the discretionary portion of the federal budget, and taken the sum of the value of appropriations that “designate tax dollars for a specific purpose in circumvention of budgetary procedures.” We estimated values for pork-barrel spending prior to 1991 by extrapolating from the CAGW data and confirming these figures with our estimates of pork-barrel spending from the discretionary portion of the federal budget. The data are available at http://www.cagw.org/site/PageServer?pagename=reports_pigbook2004.

† Disclosure of contributions to federal candidates or parties was required by law beginning in 1979. To extend our data series, we assumed that total campaign expenditures are roughly equivalent to total political contributions. Disclosure of campaign costs for federal elections to the Federal Election Commission was required by law beginning in 1971. But political scientist Alexander Heard made estimates of the costs of presidential campaigns of 1960, 1964, and 1968, based upon research and interviews with campaign managers. Heard's estimates for the presidential campaigns during the 1960s and data reported to the FEC up through 1996 are from John C. Green, ed., *Financing the 1996 Election* (Armonk, N.Y.: M. E. Sharpe, 1999), p. 19. Data reported to the FEC for the costs of presidential campaigns in 2000 and 2004 are from David B. Magleby et al., eds., *Financing the 2004 Election* (Washington, D.C.: Brookings Institution Press), p.71. Data for costs of congressional campaigns from 1972-2004 are from Magleby, p. 75. Values back to the 1950s were obtained by simple extrapolation of these data and were aligned with Heard's rough estimates for presidential campaigns during the 1950s.

Newey-White robust standard errors are in parentheses below coefficient estimates.

Table 9: Redistributive Efficiency and Political Contributions

| Variable | (1) | (2) | (3) |
|--|-----------------|-----------------|------------------|
| Difference in ginni coefficient of pre-tax and post-tax income † | -5.16 (2.32) | | |
| Becker-Mulligan A †† | | 4.42 (0.35) | |
| Becker Mulligan B †† | | | 33.18 (19.36) |
| Moving average coefficients | | | |
| θ_1 | | -1.99 (1.42) | |
| θ_2 | 1.54 (0.53) | 1.00 (0.01) | 1.00 (0.01) |
| Time trend | 0.06 (0.03) | 0.04 (0.002) | 0.08 (0.03) |
| Constant | 5.36 (0.92) | 2.39 (0.26) | 4.35 (0.64) |
| Number of Observations | 12 | 22 | 13 |
| Sample | 1980-2002 | 1964-2004 | 1980-2004 |

See note in table 8 for data on political contributions. The measures of tax efficiency are lagged by one period.

† We use pre- and post-tax Ginni coefficients for households, provided by the Bureau of the Census, available at <http://www.census.gov/hhes/www/income/histinc/rdi5.html>.

†† Becker and Mulligan (2003) develop alternative measures of redistributive efficiency. The first measure, which we call Becker-Mulligan A, is given by: (social security tax revenue + payroll tax revenue + sales tax revenue)/(total tax revenue). The historical tax revenue data come from the Congressional Budget office. One place to find them is in “The Budget and Economic Outlook: Fiscal Years 2007 to 2016,” p. 142, available at <http://www.cbo.gov/ftpdocs/70xx/doc7027/01-26-BudgetOutlook.pdf>. The second measure, which we call Becker-Mulligan B, is given by (effective average tax rate/effective tax rate of top decile).

Newey-White robust standard errors are in parentheses below coefficient estimates.

Table 10: Interest Group Growth, 1990-2006

| Variable | (1) | (2) | (3) | (4) |
|------------------------|-------------------|-------------------|---------------------|---------------------|
| Year † | -0.003 (0.001) | -0.003 (0.001) | 0.005 (0.004) | 0.005 (0.004) |
| Year ² † | | | -0.0004 (0.0002) | -0.0004 (0.0002) |
| Constant | No | -0.014 (0.015) | 0.010 (0.022) | 0.039 (0.021) |
| Group Fixed Effects | No | Yes | No | Yes |
| Number of Observations | 180 | 180 | 180 | 180 |
| R^2 | 0.03 | 0.32 | 0.04 | 0.33 |

Dependent variable is interest group growth rate. We measure interest group size with industry employment data from the Bureau of Labor Statistic's Current Employment Statistics surveys,

† 1990 has been rescaled to 1, 1991 to 2, etc.

Newey-White robust standard errors are in parentheses below coefficient estimates, clustered by industry.

of measuring the efficiency of the tax code.

As pointed out in the theoretical model, because interest groups' greater expenditures on influence in response to efficient policies may reduce constituents' current consumption, constituents tend to prefer inefficient policies. In this environment, I develop the idea in propositions 2.2 and 2.3 that inefficiencies associated with political pressure by interest groups are exacerbated by their efforts to curb free riding. Specifically, proposition 2.2 states that while subsidized interest group membership increases over time, its growth is restricted in response to concerns with free riding. To verify this empirically, I examine a panel of twelve major subsidized interest groups and characterize their membership growth over time. I include casinos, commercial banks, computer and internet services, health professionals, insurance, labor, lawyers, oil and gas, pharmaceuticals and health products, securities and investments, telecommunications, and tobacco because they are well-organized, lobby extensively at the federal level for policies that are favorable to them, and exhibit membership that is well-defined and measured by the US Commerce Department's Bureau of Labor Statistics.

Table 10 presents linear and quadratic projections of membership growth rates over time. In the first two columns, the linear growth rates clearly diminish, and the effect is statistically significant. But in the third and fourth columns, I observe an initial increase in growth rates, which is quickly overtaken by a larger, negative, quadratic term. All of the results persist when interest group specific fixed effects are included. By diminishing over time, the pattern of interest group growth rates is consistent with the second proposition. The pattern is also consistent with anecdotal evidence such as education unions restricting membership and extracting payments from nonmembers to punish free riding and industrial consolidation in agriculture effectively restricting free riding.³⁸

coefficients in specification (2). The inclusion of a time trend mitigates the necessity of including autoregressive terms and conserves degrees of freedom in estimation on such a small sample.

³⁸The U.S. Supreme Court has affirmed the action taken by education unions in *Lehnert v. Ferris Faculty Association* (1991), citing "government's vital policy interest in labor peace and avoiding 'free riders'." [500 U.S. 507,508] In agriculture, Cargill, the largest grain producer in the United States, recently purchased the second leading

Table 11: Political Contributions and Interest Group Size, 1990-2006

| Variable | (1) | (2) |
|------------------------------|-----------------|-----------------|
| Membership growth rate † | -20.6 (9.92) | -19.2 (11.1) |
| Presidential election dummy | | 8.16 (3.96) |
| Constant | 6.93 (0.23) | 2.30 (2.31) |
| Interest group fixed effects | Yes | Yes |
| Number of Observations | 84 | 84 |
| R^2 | 0.69 | 0.71 |

Dependent variable is political contributions in millions of dollars. Political contributions data by “interest group,” which are aligned with the occupational categories in the Bureau of Labor Statistics data noted in table 3, are compiled by the Center for Responsive Politics. The data originate from legally-required reports filed with the Federal Elections Commission. The data are available at <http://www.opensecrets.org/industries/index.asp>.

† See note to table 10 for data on interest group size.

Newey-White robust standard errors are in parentheses below coefficient estimates clustered by industry.

Proposition 2.3 states that by restricting membership, interest groups tend to exacerbate redistributive inefficiency. I have already found that political (campaign) contributions result in greater pork-barrel spending, which increases redistributive inefficiency. Unfortunately, pork-barrel spending on specific groups is difficult to measure, but campaign contributions by specific interest groups have been compiled by the Center for Responsive Politics since 1990. Thus, I test proposition 2.3 by running a regression of campaign contributions on membership growth rates for the twelve interest groups noted above. Recall, the basic unit of observation is generated every two years in accordance with the federal election cycle.

Estimation results for two specifications are reported in table 11. To be sure, endogeneity is an issue in the estimation of the coefficient on membership growth rate. I attempt to mitigate this bias by including interest group fixed effects in both specifications. In the second specification I include a dummy variable to identify years when a presidential election was held. Any remaining bias in the coefficient on membership growth rate must be derived from within group variation over time that is correlated with unobservable determinants of political contributions. I find that campaign contributions increase—thereby generating redistributive inefficiencies— as interest groups slow the growth of their membership and that the effect is statistically significant.

It is important to point out that if interest groups were able to act solely on their preference for efficient policies, then it is unlikely that constituents would be able to govern their actions to exacerbate inefficiencies. Thus the results in table 11 constitute an implicit test of Assumption

producer, Continental Grain. In addition, the four largest meat packing firms now account for 80 percent of cattle slaughter and 70 percent of sheep slaughter.

2.2—constituents discount the future more than interest groups discount the future—as well as circumstantial evidence that is consistent with the agency problem that underlies our model.³⁹

Turning to some specific policies, these findings are consistent with growing subsidies to an increasingly concentrated agriculture industry, which increases the welfare costs of inefficient redistribution, and with growing rents in law and medicine, which are created by a licensing requirement for practitioners in these professions and by the inefficient government policies that these professions support (Winston, Crandall and Maheshri (2010)).

2.4. Final Comments

I have developed a theoretical model that shows subsidized interest groups contribute to inefficient policies by making investments in political influence and by limiting the size of their membership. I have also obtained crude empirical evidence that is consistent with these propositions. This analysis indicates that the notion of incomplete contracts between constituents and their interest groups is an important feature of special interests politics that should be subject to further theoretical and empirical research.

There has been long standing interest in reforming federal campaign-finance law, in part to limit the influence of interest groups on public policy. This analysis suggests that redistributive inefficiencies may also be reduced by policies that spur competition within interest groups. For example, by eliminating entry restrictions, deregulation improved efficiency and reduced rents to interest groups such as labor and certain firms that were protected from competition. In all likelihood, eliminating barriers, such as licensing and certification, to work in certain professions would also produce efficiency gains by reducing the average benefits per member from expenditures on political influence, which would make inefficient policies less attractive to represented constituents. To be sure, the mechanisms that have enabled interest groups to limit their size are often thought to provide benefits (e.g., licensing may improve the quality of services provided by practitioners). It may be appropriate to reevaluate the social desirability of these mechanisms in light of their negative effects on interest group behavior.

³⁹As an additional test of Assumption 2.2, I allowed the effect of membership growth rates to vary by industry thus capturing the possibility that industries with more disparate constituencies and greater intrinsic risk—and hence greater differences between the constituents' discount rate σ and the interest group's discount rate ρ —would have the largest negative relationships between membership growth rates and inefficiency. I found this to be the case for industries with large average beta coefficients (a standard measure of risk in the finance literature), such as computers and internet, telecommunications and securities and investments, but the differences across industries were not statistically significant at conventional levels perhaps due to the limited sample size. In any case, the coefficients themselves provide some additional support for the plausibility of Assumption 2.2.

3. Political Expenditures and Power Laws

3.1. Introduction

Politicians and voters persistently bemoan the notion that, “There’s too much money in politics.” Whether that is indeed the case or not, money certainly plays a key role in the American political process, whether in the form of campaign contributions from special interest groups, campaign contributions from individuals or other lobbying expenditures by special interest groups. Furthermore, the amount of money explicitly tied into the political process through one of those three channels has been undoubtedly increasing up to the present. In the last presidential election cycle (2003-04) the Democratic and Republican parties raised a record setting \$1.5 billion in campaign contributions alone. Ironically, this was the first election cycle in which the Bipartisan Campaign Finance Reform Act of 2002 which restricted campaign contributions was in effect. Meanwhile special interest groups spent at least \$4 billion in various lobbying expenditures during the same two year period.⁴⁰ The message is quite clear: there is a substantial amount of money in politics, and voters and politicians on both sides of the aisle have felt compelled to reform the giving process.

Setting aside the issue of campaign finance, I concern myself with the other, larger component of money in politics, lobbying expenditures. As long as government policies and regulatory actions can be targeted to distinct groups, these interests will have incentives to lobby the government for preferential treatment. This is an inescapable feature of modern democracies, yet the public holds lobbyists in such a dim view that over nine out of ten Americans believe it should be illegal for lobbyists to give any item of value to politicians.⁴¹ Grossman and Helpman (2001) identify three basic motives for lobbying – gaining access to politicians, providing credibility for favored policy positions, and direct influence on policy. However, the effects of lobbying on policy (and ultimately social welfare) are ambiguous. Targeted transfers may or may not be inefficient, while competition among special interest groups could potentially produce more or less efficient redistributive policies. Given lobbyists’ key role in policymaking, their ever increasing expenditures, and the public’s poor opinion of them, political finance reform is an issue of central importance. Ideally, we would like to reform spending in politics in a way to maximize social welfare. If, however, our understanding of lobbying is flawed, then policy reforms may be inefficient at best, and socially detrimental at worst.

There is a very well developed theoretical literature on special interests and lobbying stretching back nearly a half century. Olson’s (1965) seminal work identifies obstacles to collective action and underscores the differences between individual and group interests, even among like-minded constituents. Stigler (1971) suggests that lobbying, particularly with respect to regulation and redistribution, is motivated by rent seeking behavior, and this line of thought has been more rigorously followed by Peltzman (1976) and Becker (1983). Besley and Coate (1998) consider the role of special interests in public goods provision, while Austen-Smith and Wright (1992) analyze the role of interest groups in influencing legislators. Maheshri and Winston (2008) model interest group behavior in a dynamic setting, where lobbying maintains a bias towards an inefficient status quo.

Broadly speaking, there have been two general theoretical approaches to describing special interest group (inter)action. Becker (1983, 1985) models interest group competition between representative

⁴⁰Campaign figures are from the Federal Election Commission. Lobbying expenditures come from the Lobbying Database maintained by the Center for Responsive Politics. The lobbying expenditures only count contributions over \$10,000, hence this is a lower bound. All monetary values hereafter are in 2006 dollars.

⁴¹In addition, two thirds of Americans believe that lobbyists should not be allowed to contribute to political campaigns. According to an ABC News/Washington Post poll conducted on January 5-8, 2006.

taxed and subsidized groups as a reduced form game. Special interests make expenditures on political pressure and in turn develop their political influence to generate rents from the government. Grossman and Helpman (1996, 2001) and Grossman, Helpman and Dixit (1998) have applied the common agency model of Bernheim and Whinston (1986) to a strategic game between interest groups and politicians involving political contributions contingent on actual policies drives lobbying behavior.

In both approaches, very little attention is given to the distribution of lobbying expenditures by interest groups. This is unfortunate because the distribution of lobbying expenditures (rather than simply the magnitude of these expenditures) is also a first order concern to policy makers. Broadening the base of political participation and dissuading or restricting one group from dominating all government interactions are priorities to political reformers.⁴² Becker simply assumes away the distribution through the use of aggregate representative agents, and the structure of the common-agency model of Grossman and Helpman has a tendency to yield knife-edge strategies in which groups do all or none of the giving in equilibrium. Neither of these theoretical results can be corroborated in lobbying data. In fact, they are directly refuted. The distribution of lobbying expenditures simply cannot be characterized by a single group taking full action, nor is it characterized by lumpy point masses of groups with different policy interests. Instead, I note a conspicuous empirical regularity, namely that the distribution of lobbying expenditures follows a power law. This casts serious doubt on the ability of bargaining models of lobbying to generate realistic predictions.

In general, the literature on this subject has relied heavily on stylized models of decision making to describe special interest behavior. In a recent survey on the state of political economy research, Timothy Besley (2004) notes that there is no clear correct theoretical framework for understanding special interest politics, and in fact “there is no reason to believe that any single theoretical approach will dominate.” Indeed, one of the goals of this chapter is to provide a substantively new and different approach to understanding decision making by special interest groups. I focus my attention on the distribution of lobbying expenditures by special interests in all sectors and industries. While the main contribution is a theoretical description of a general set of processes consistent with specific behavior, all of the analysis is empirically driven. That is, only after showing that lobbying expenditures follow a power law do I propose an alternative model of political decision-making that is driven by general, plausible assumptions on special interest groups, their constituencies, and the informational environment in which they act. The striking predictions of this model on the distribution of lobbying expenditures stand in stark contrast to the predictions of widely accepted strategic models in the style of Grossman and Helpman. That, along with simulation evidence, corroborates my approach and implies that only large scale modifications to the political process are likely to induce relative changes in lobbying. Furthermore, the analysis shares key similarities to models of widely disparate phenomena in the physical, biological and social sciences; this cross-disciplinary universality is intellectually satisfying in its own right.

3.2. Power Laws

The term power law is given to a general class of probability distributions with a unique feature: scale invariance. Consider some data generating process. It is said to be scale invariant if the

⁴²Senator John McCain, cosponsor of the McCain-Feingold Bipartisan Campaign Finance Reform Act himself stresses, “Our law was not designed to lower spending in elections. . . It was, however, designed to ensure that the money political groups spend in federal elections is limited to reasonable, small contributions from individuals.” (USA Today, November 4, 2004).

probability density of the data is similar at all scales. That is, if one observed the density over some domain of the process and compared it with the density of another domain of the process which was scaled up (or down) by a constant factor, then the densities on the two domains would always be proportional to one another. In simpler terms, the same fundamental forces generate the data at all scales even when the data are dispersed over many orders or magnitudes.

Power laws are of great scientific interest in large part due to their universality. They appear widely not only in physics, biology and earth sciences, but also in demography, economics, finance, and social networking (Newman 2006). This list is by no means exhaustive. Models of ferromagnetism and percolation (Hill 1987) and biological speciation (Yule 1925) imply power laws arising in substantively different settings by fundamentally different mechanisms. Data on the intensity of solar flares (Lu and Hamilton 1991) and armed conflict (Roberts and Turcotte 1998) follow power laws, as does city size (Gabaix 1999), firm size (Axtell 2001), stock market volatility (Gabaix et al. 2003) and telephone call frequency (Ebel et. al. 2002).

As mentioned, a variety of different environments give rise to power laws, which in some sense are limiting distributions of a general class of stochastic processes (those with scale invariance). Dynamic processes evolve over time and often contain some component of a random walk. For example, power laws can be deduced from stochastic accumulation or disintegration of different quantities (such as cities growing with random migration and biological genera fragmenting into new species through random mutation). Other processes need not be dynamic and are intimately related to fractals. The self similarity of fractals is broadly analogous to the scale invariance of power law distributions, and in several models, invariant behavior arises at particular critical points (related to the fractional dimension which a fractal occupies). Examples of these processes include percolation (as water boils, there is a point between the liquid and gaseous phase in which the sizes of bubbles are distributed according to power laws) and the evolution of forest fires (periodic, stochastic fires arrange smaller groups of trees in a specific manner until the entire forest is vulnerable to a single fire).⁴³

More formally, a probability density $\pi(x)$ is scale invariant if

$$\pi(bx) = g(b)\pi(x) \tag{33}$$

for all values of x and b , and some function g . This distribution follows a power law, because it is necessarily the case that we can write the density as

$$\pi(x) = Cx^{-\gamma} \tag{34}$$

for some exponent γ and constant C .⁴⁴ As seen in the functional form of equation (34), these distributions have a striking geometric property. When plotted on logarithmic axes, the graph of π will be a downward sloping straight line with slope $-\gamma$. A graph of $1 - \Pi$, where Π is the cumulative density of π , will be a downward sloping straight line with slope $-(\gamma - 1)$.⁴⁵ The constant (or invariant) slope at all scales of the variable on the x-axis reflects the notion of scale invariance.

Consider a log-log plot of the rank of a variable (as ordered from largest to smallest) on the

⁴³Stauffer (1985) gives a detailed treatment of discrete spatial power law processes, particularly those of percolation.

⁴⁴For a proof of this assertion, see Lemma 1 in the appendix.

⁴⁵Plotting the cumulative density is superior to plotting a histogram of the density itself since cumulative distributions do not discard any data that would have been lost in the binning process.

value of the variable. This rank-frequency plot is a simple representation of the function $1 - \prod$. Data from a power law process will uniquely have straight line rank frequency plots with exponent equal to the slope of the line (in absolute value) plus one. Efficient maximum likelihood estimates of power law exponents can also be performed. Details are given in appendix A. The efficiency gains from the maximum likelihood estimates come at the cost of a parametric assumption on (power law) functional form. The rank frequency plot is simply a representation of the data, and is fundamentally nonparametric. A natural test of power law behavior is then a (Kolmogorov-Smirnov type) comparison of the empirical distribution of a variable with the theoretical distribution of a power law random variable with the predicted maximum likelihood exponent. If the data is truly from a power law process, then these two distributions should be asymptotically indistinguishable.

3.3. General Empirical Findings

According to the Federal Lobbying Disclosure Act of 1995, all lobbyists with expenditures exceeding \$10,000 are required to file semi-annual reports with the Senate Office of Public Records. All of these filings can then be traced to individual clients (trade groups, unions, firms, etc.) The Center for Responsive Politics annually enumerates all lobbying expenditures by interest groups of over \$10,000 since 1998. I use these data to explore the distribution of lobbying expenditures and to statistically test for scale invariance.

Summary statistics for the lobbying data are provided in table 12. The dataset is large and comprehensive; the large number of observations allow for very precise distributional estimates. All monetary amounts are reported in 2006 dollars using the average CPI from the US Bureau of Labor Statistics. Of particular note is the wide range of values that lobbying expenditures for individual interest groups assumes (from \$10,000 to over \$30 million). The fact that these values span several orders of magnitude indicates that there is no “typical scale” of lobbying. This can be an important clue towards scale invariance. Furthermore, there is great heterogeneity in the number of contributors in each industry. If power law coefficients are similar across industries, then this could mean that the distribution of lobbying expenditures is unrelated to the underlying structure of who gives.

Expenditures follow a power law if a rank-frequency plot of the data resembles a straight line. More specifically, in a plot with log-rank of expenditures on the y-axis and log-expenditures on the x-axis, the data should fall along a straight line.⁴⁶ Hence, a simple “optical” test of whether data follow a power law can be done in two steps. First, the coefficient from an OLS regression of log-rank on log-expenditure should be significant and negative. Second, in an OLS regression of log-rank on log-expenditure and $(\log \text{ expenditure})^2$, the coefficient on the squared term should be zero.

If power law behavior is suspected, there are two traditional methods to estimate the exponent. The first is a maximum likelihood estimate of the power law coefficient as derived in appendix A. This is, by definition, the most efficient test. The second is the familiar OLS regression of log-rank of expenditures on log-expenditures. The slope coefficient (in absolute value) in this regression represents the power law exponent. Gabaix and Ibragimov (2007) derive a simple, optimal correction – simply subtracting 0.5 from the rank before taking logarithms – which reduces the bias of estimates in small samples to a leading order.

⁴⁶Instead of using log-expenditures on the right hand side, power law exponents are sometimes better estimated using log-share of expenditures as the independent variable. For a brief discussion, see Gabaix (1999).

Table 12: Lobbying Summary Statistics, 1998-2006

| Variable | Mean | Std. Dev. | Min. | Max. | Data Source |
|---|-------|-----------|------|---------|---|
| Annual lobbying expenditures | 315.8 | 981.4 | 10 | 30796.6 | Lobbying Database, Center for Responsive Politics (CRP) |
| Number of actively lobbying interest groups within industry | 77.38 | 101.4 | 4 | 767 | Lobbying Database (CRP) |
| Number of firms within industry † | 76953 | 184919 | 52 | 1114637 | US <i>Census of Manufacturers</i> |
| Number of industries | 76 | | | | |
| Number of sectors | 12 | | | | |

All monetary variables are in thousands of 2006 dollars.

† This variable is defined for only 40 industries by the Census Bureau.

The benefit of the latter approach is that it allows for simple multivariate analysis. More specifically, statistical estimates of common power law exponents can easily be obtained even if the intercepts of the tails of the distributions are different. If a common power law exponent is suspected for the lobbying expenditures of two different industries, then we can simply test the significance of the slope coefficient in a log-log OLS regression of the corrected rank on expenditure shares if we include industry specific fixed effects. In addition, when dealing with panel data, it is possible to account for temporal effects as well.

Tests of power law behavior are provided in table 13. This is a common exponent for all groups. The coefficient on log expenditures is estimated very precisely in all four specifications and does not statistically differ between columns (1) and (2) and between columns (3) and (4). Furthermore, the coefficient on $(\log \text{ expenditures})^2$ is small and insignificantly different from zero, and the R^2 does not materially differ when the quadratic term is added. This indicates that the regression line fits no better as a quadratic curve than as a straight line. At the very least, the distribution of lobbying expenditures very closely resembles a power law.

I also employ a second approach to test whether the lobbying data are generated by a power law process. First, I compute initial maximum likelihood estimates of the tail exponents of the distribution in each industry in each year. If the parametric assumption that the data are distributed according to a power law is true, then these will be the most efficient estimates of power law exponents. Next, I compare the standard empirical cumulative density functions of expenditures in each industry in each year with a theoretical cumulative density function from a power law random variable with exponent equal to the maximum likelihood estimate. This comparison is performed with the non-parametric Kolmogorov-Smirnov test. I reject the hypothesis that these distributions are equal for only 19% of the industry-years at the 10% level. Furthermore, I cannot reject this hypothesis in at least one year for 70 of the 76 industries at the 10% level. This is very strong evidence that the lobbying expenditure data are generated by a power law process.

Of course, the distribution of lobbying expenditures within industries is also of interest. Due to the large number (76) of distinct industries in the sample I do not provide exponent estimates for each industry. However, all of these estimates are highly statistically significant with even the most

Table 13: Common OLS Power Law Exponent Estimates

| Variable | (1) | (2) | (3) | (4) |
|---|-----------------|-----------------|-----------------|-----------------|
| Industry share of expenditures † | -1.07 (0.02) | -1.04 (0.12) | -1.27 (0.04) | -1.13 (0.11) |
| Industry share of expenditures ² † | | | | 0.02 (0.02) |
| Year and Industry Fixed Effects | No | No | Yes | Yes |
| R^2 | 0.88 | 0.88 | 0.92 | 0.92 |
| 10409 observations | | | | |

Dependent variable is $\ln(\text{industry rank}-0.5)$. Only the largest 75% of observations by industry are used in these regressions.

† Indicates variable has been transformed by natural logarithm.

Standard errors clustered by industry are in parentheses below coefficient estimates.

generous standard errors only on the order of 4% of the estimates. With such precisely estimated exponents, I can test whether the distribution of lobbying expenditures is well predicted by sector and industry specific fundamentals.

In table 14, I present alternative specifications of power law exponent regressions. The idea behind these tests is to see whether sector and industry level lobbying information can shed any light on the power law distribution of lobbying expenditures. The regressions are consistent and indicative of the fact that there is little predictive power in basic industry and sector level lobbying fundamentals. The right hand side variables are transformed by natural logarithms to provide for the best fit possible. Still, all coefficients are statistically insignificant. While this is an admittedly rudimentary test – it is loosely proving a negative – it is surely indicative of the fact that the distribution of lobbying expenditures within industries is not governed by industry lobbying structure. I also perform nonparametric tests of the similarity of the empirical distribution of lobbying expenditures in different industries in different years. By performing Kolmogorov-Smirnov tests of the equivalence of the distribution of lobbying expenditures for all pairs of industry-years in the sample, I am unable to reject the hypothesis that these distributions are the same for over 60% of the combinations at the 10% level.

Broadly speaking, these results are well supported by the anecdotal evidence presented in table 15. Here, I provide three examples of groups of industries with highly similar power law exponents. In each group, there are a number of disparate industries from a wide variety of sectors, each of which assumes the same power law distribution. As an example, it is highly unlikely that sugar producers, defense electronics manufacturers, and industrial unions all have similar political access and costs and benefits of lobbying, yet their lobbying expenditures are distributed nearly identically. This is suggestive that the aggregate lobbying behavior is governed by other forces common to all industries.

Table 14: Industry Level Power Law Exponents and Industry Structure

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|--|----------------|------------------|-----------------------------------|----------------------------------|-------------------|-------------------|
| Number of active interest groups within industry | 0.01 (0.08) | | | | 0.07 (0.10) | |
| Total industry expenditures on lobbying | | 0.002 (0.073) | | | | 0.08 (0.07) |
| Number of active interest groups within sector (thousands) | | | $-7*10^{-13}$ ($4*10^{-13}$) | | -0.17 (0.25) | |
| Total sector expenditures of lobbying (millions) | | | | $-6*10^{-14}$ ($5*10^{-7}$) | | -0.04 (0.03) |
| Year and Industry Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 684 | 684 | 108 | 108 | 684 | 684 |

Dependent variable is $\hat{\gamma}$ as computed following the method of Gabaix and Ibragimov (2007) for each industry. All estimates of $\hat{\gamma}$ are highly with over 99% confidence.

All independent variable have been transformed by natural logarithm. Standard errors are clustered by industry in columns (3) and (4) and by sector in all other columns.

Table 15: Selected Industries Grouped by Industry Level Rank-Size Slope

| $-\hat{\gamma}$ | Industries |
|-----------------|---|
| 1.07-1.12 | Sugar, Mining, Industrial Unions, Health Professionals, Defense Electronics, Forestry and Forest Products, Telecom Services and Equipment, Oil and Gas, Livestock, Fruits and Vegetables |
| 1.16-1.23 | Credit Unions, Automotive, Computers Internet, Electronics Manufacturing and Services, Lawyers and Law Firms, Securities and Investment, Recreation Live Entertainment, General Contractors, TV/Movies/Music, Business Services |
| 1.40-1.46 | Insurance, Food and Beverage, Textiles, Special Trade Contractors, Electric Utilities, Railroads, Retail Sales, Construction Services, Printing and Publishing, Meat Processing Products |

Dependent variable is $\hat{\gamma}$ as computed following the method of Gabaix and Ibragimov (2007) for each industry. All estimates of $\hat{\gamma}$ are highly with over 99% confidence. This is not an exhaustive list of industries in the sample.

3.4. An Alternative Model of Decision Making

In order to understand how this power law in lobbying could arise, it is useful to identify what could not generate it. Given this strong empirical regularity, I begin by eliminating a class of decision making processes that has become the standard tool for analyzing special interest politics. In particular, it is extremely unlikely that that a power law distribution in lobbying expenditures arises from the standard common agency bargaining game popularized by Grossman and Helpman (1996).

Costs and benefits (and hence payoff functions) to lobbying in different industries are likely to be vastly different, whereas the distributions of expenditures were shown to be quite similar, casting doubt on the ability of common-agency models to accurately capture aggregate features of the lobbying process. For this reason, I move away the competitive models of lobbying and provide a more mechanical modeling alternative. Instead of a game theoretic approach to strategic decision making, I consider a conception of lobbying as a stochastic process whose structure is based upon sensible behavioral assumptions. This is not to say that models based on bargaining do not have a role in understanding special interest behavior; simply put, aggregate spending behavior is probably best understood through a different lens.

The preceding empirical analysis provides a good starting point for developing this alternative model. The most commonly discussed processes which give rise to power law behavior are accumulative. However, they turn out to be poor candidates in this case for a variety of reasons. Accumulative processes are those in which the growth rates of various quantities (in this case, level are proportional to initial levels. As time elapses, the distribution of these quantities then assumes a power law over some relevant domain, usually the rightmost tail of the distribution. One characteristic of accumulative processes that we would expect to observe is that the rank ordering of the largest variables tends to remain fairly stable over time. In particular, those special interests who lobbied the most in a particular year would be almost certainly expected to be the ones who lobby the most in subsequent years.

A brief examination of the US data, however, soundly refutes this prediction. The most active special interest group within an industry in a particular year is also the most active special interest group in the following year only 60% of the time. If an interest group is one of the five most active groups within an industry, they are in the top five in the following year only 65% of the time. If we expand the subsample, the probability that a top ten most active special interest group maintains their top ten ranking in consecutive years rises only to 67%. This casts serious doubt on an accumulative process driving lobbying behavior.

This also provides evidence against the most disarmingly simple explanation of the observation of power law behavior in lobbying expenditures. In a tradition dating back to the 1950s, Axtell (2001) among others notes that firms' sizes within US industries follow power laws. One might think that if firms spend an amount on lobbying directly proportional to their size, then the power law observed in this paper would be a simple artifact of market structure. This is easily refuted by the fact that the rankings of large firms tend to remain quite stable from year to year, whereas the rankings of active special interest groups vary considerably, as explained above.⁴⁷

There are alternatives to accumulative processes that also can give rise to power law behavior. Mathematically, they assume a number of forms, and there is no transparently common mechanism that these processes share. Many are spatial in the sense that they related to the geometry of the

⁴⁷Recently, Rossi-Hansberg and Wright (2007) have argued that the distribution of establishment (firm) sizes in the American economy does not – and should not be expected to – follow a power law.

variables endogenous to the process. The previously discussed models of percolation and forest fires fit into this category. Other processes are related to physical stresses and can be used to model avalanche behavior.⁴⁸ In this vein, I propose a very general type of non accumulative processes based upon simple behavioral assumptions of internal and external group activity. Underlying this explanation is the idea that interest groups are beholden to their constituents who may differ the intensity of their support for the common cause. Making a simple reduced form assumption on constituent and interest group preferences, I derive a clear “rule of thumb”: the amount spent by a group in response to an external stimulus is proportional to the share of its constituency that is receptive to the stimulus.⁴⁹

There is abundant anecdotal evidence for this result in the organizational structure of most special interest groups. Nearly all groups periodically elect leaders and executives, and a number of groups (e.g., the National Rifle Association) explicitly hold floor votes at annual meetings to decide on policy direction and spending. Furthermore, many special interest groups, especially unions, report additional voluntary individual expenditures under the umbrella of group expenditures. These totals would obviously be proportional to the share of the constituency that is active and responsive. Although campaign contributions are formally and legally (thought perhaps not functionally) separate from lobbying expenditures, it is also worth mentioning that members of political action committee’s (PAC’s) also file individual expenditures with the Federal Election Commission (FEC) under the umbrella of the PAC.⁵⁰

I must stress that I merely offer a potential explanation of the decision making process, and I make no claims as to its uniqueness. Having said that, I believe it is a good candidate because it is robust to many specifications of interest group composition, motives and actions. Furthermore, it emphasizes the role of the internal organization of special interest groups which has largely been ignored in the political economy literature. This model is admittedly ill equipped to describe specific strategic actions that a group may take; however, it explains the aggregate features of the lobbying environment far better than strategic models which fail on this point. This makes it a more appropriate tool for policymakers that wish to enact broader lobbying reforms. I first give a descriptive overview of the process, after which I introduce the details of the modeling environment and then show that such a process does in fact generate lobbying expenditures consistent with the evidence presented.

Briefly, the decision-making process of a single special interest group is as follows: groups are composed of constituents with similar policy goals, but heterogeneous intensity of preferences. This constituency periodically receives common stochastic signals relevant to its interests. These signals could potentially come from politicians, news media, or even the interest group itself. Every constituent’s utility is a function of individual specific responsiveness to signals. If a signal is large enough to elicit a response from a particular constituent, he conveys this to the group. An interest group makes expenditures at a level which maximizes the aggregate utility of its constituency.

I prove that for certain signal distributions, there exists a particular distribution of constituent responsiveness which implies a power law in interest group expenditures. If constituent responsiveness is endogenously determined by a reasonable adjustment process, then this particular distribution

⁴⁸See, for example Sneppen and Newman’s (1997) model of coherent noise.

⁴⁹The use of heuristics as a legitimate alternative to strictly rational games is not new in the field of political economy. Bendor, et. al. (2003) use a well defined adaptive behavioral model to help explain the “paradox of voting,” which rational, strategic models fail to explain in a fully satisfactory way.

⁵⁰Incidentally, PAC contributions by industry for all two year federal election cycles from 1989-2006 also appear to be generated by power law processes.

of responsiveness will in fact be observed in the constituency. This implies that a single interest group's lobbying expenditures will be distributed according to a power law. If several interest groups' expenditures are distributed as a power law, then the distribution of all expenditures will also approximately be distributed as a power law.

More formally, assume special interest group i is composed of a continuum of constituents. Periodically, the constituents of the special interest group receive a common signal θ^i which is drawn from some distribution p_θ^i . Constituent z has a threshold level λ_z^i drawn from distribution p_λ^i which captures how responsive he is to these signals. Low levels of λ_z^i correspond to highly responsive constituents and vice versa. In particular, constituent z 's benefits from expenditures of D^i , in response to a signal can be represented by

$$u_z^i(D, \theta) = \begin{cases} \omega(D) & \lambda_z^i < \theta \\ k \lambda_z^i & \lambda_z^i \geq \theta \end{cases} \quad (35)$$

for some constant k and increasing function ω . That is to say, constituent z obtains constant (e.g., zero) benefits from small signals, and at some level of signal strength, constituent z 's benefits increase with greater expenditures.

Definition 3.1. Let $x \propto y$ indicate that x is proportional to y . i.e. $x = Cy$ for some C .

Proposition 3.2. If constituent benefits are of the form in (35) with $\omega(D) \propto \ln D$, then the level of expenditures which maximizes the sum of constituent utilities is proportional to the share of the constituency with $\lambda_z^i < \theta^i$.

Proof. See appendix B.

Hence, if we assume a logarithmic specification of benefits, we can abstract from constituent utilities and interest group optimization and simply note that if the signal received ever exceeds the threshold ($\theta^i > \lambda_z^i$) then constituent z indicates his desire for the interest group to respond financially and the expenditure, D^i , that an interest group makes in response to a signal is assumed to be proportional to the responsive share of its constituency. As D^i is a function of a random variable, I denote as the density of these expenditures p_D^i .

Consider the subset of constituents who respond to a signal (that is, those constituents whose $\lambda_z^i < \theta^i$). I assume that after responding, a fraction of these constituents change their thresholds by obtaining new ones from the distribution p_λ^{iNew} . This adjustment can be interpreted as the constituent learning something about his preferences based on taking action as an example of cognitive dissonance.⁵¹ Thus, the signals may shape the preferences of constituents.

Of course, it is the joint distribution of the expenditures of many interest groups which is observed in the lobbying data where N special interest groups independently make their spending decisions as detailed above. Denote the probability that group i 's lobbying expenditure is of size D as π_D^i , and the probability that any particular group makes an expenditure of size D as $\pi(D)$ (that is, the joint distribution of the π_D^i .)

This process is defined by three sets of distributions: p_λ^i , p_θ^i and p_λ^{iNew} . Without loss of generality, I assume new thresholds are distributed uniformly on the unit interval and renormalize the random

⁵¹Bowles (1998) gives a general overview of how institutions such as markets or voting structures may lead to the evolution of preferences. John (1989) examines the volatility of the intensity of voters' preferences for candidates in primaries before and after votes are cast, which is consistent as ex post rationalization.

variables of the other two distributions as

$$\lambda^i \rightarrow \int_{-\infty}^{\lambda^i} p_{\lambda}^{iNew}(x) dx \quad (36)$$

$$\theta^i \rightarrow \int_{-\infty}^{\theta^i} p_{\lambda}^{iNew}(x) dx \quad (37)$$

This is merely a standard change of variable and does not qualitatively affect the results of the model. All of the forthcoming analysis is performed after renormalization; hence any assumptions on signal and threshold distributions are really assumptions on their transformed counterparts. Again, I stress that this does not qualitatively affect the assumptions upon which the model is built but simply provides clarity and tractability.

Definition 3.2. A probability density is thick tailed if its right tail is at least as thick as that of some exponential distribution. That is, there exist constants k_0 , α and C such that

$$\int_k^{\infty} p(x) dx \geq Cp(k)^{\alpha} \quad (38)$$

for all $k > k_0$. The exponential distribution obviously satisfies (38) with $\alpha = 1$, and power law distributions also satisfy (38) with $\alpha = 1 - \gamma^{-1}$ where γ is the power law exponent.⁵²

Definition 3.3. Let X_1, X_2, \dots be a sequence of random variables with distributions p_{X_1}, p_{X_2}, \dots defined on a common support. Then p_X is a steady state distribution of X if the X_i converge in probability to X . That is, the p_{X_i} converge to p_X at every point in the support of X .

Theorem 3.1. Assuming the signal distributions p_{θ}^i are thick tailed, the steady state distribution of individual interest groups' expenditures is approximately a power law. Provided that the exponents of these individual power laws are distributed on a finite domain or continuously within a closed interval, then the function π_D as described in the model above approximately obeys a power law in the right tail. That is, there exists a γ such that $\pi_D(D) \propto D^{-\gamma} + O(D^{-(\gamma+1)})$.

The proof of theorem 3.1 follows below. I first prove two intermediate propositions. As the analysis in these propositions only applies to a single interest group, I omit the i superscripts.

Proposition 3.2. If the distribution of signals, p_{θ} , is thick tailed and the density of constituent thresholds $p_{\lambda}(\lambda) \propto (\int_{\lambda}^{\infty} p_{\theta}(x) dx)^{-1}$, then the density of expenditures made for large D .

⁵²Other familiar distributions with thinner tails than the exponential distribution may also generate approximate power law behavior in the process described below (e.g., normal, log normal and Poisson distributions). Empirically, it is difficult to identify exact power laws but rather just approximate power law behavior. In the simulations provided, I show that signal densities with slightly less than thick tails do generate approximate power laws in lobbying behavior which is qualitatively consistent with evidence. That said, the analytical results described below require the density of signals to have thick tails.

Proof. The size of the expenditure made by the group is proportional to the share of constituents that wish to lobby in response to a signal θ , or

$$D(\theta) \propto \int_{-\infty}^{\theta} p_{\lambda}(x) dx \quad (39)$$

Let $\theta(D)$ be the signal required to induce a lobbying effort of size D . Then

$$p_D(D) = p_{\theta}(\theta) \frac{d\theta}{dD} \propto \frac{p_{\theta}(\theta(D))}{p_{\lambda}(\theta(D))} \quad (40)$$

where $\frac{d\theta}{dD}$ is obtained from (39).⁵³

By assumption,

$$p_{\lambda}(\lambda) \propto \left(\int_{\lambda}^{\infty} p_{\theta}(x) dx \right)^{-1} \quad (41)$$

The term within the parentheses is interpreted as the probability that a constituent with threshold λ responds to a signal. Equation (41) can be substituted into equations (39) and (40) yielding

$$D(\theta) \propto \int_{-\infty}^{\theta} \left(\left(\int_x^{\infty} p_{\theta}(y) dy \right)^{-1} \right) dx \quad (42)$$

$$p_D(D) \propto p_{\theta}(\theta(D)) \int_{\theta(D)}^{\infty} p_{\theta}(x) dx \quad (43)$$

respectively. Together, equations (42) and (43) define the distribution of lobbying expenditures p_D . What is left is to combine them in order to obtain p_D solely as a function of expenditure size.

Provided that p_{θ} has thick tails, we can rewrite (42) and (43) as

$$D(\theta) \leq C_1 \int_{-\infty}^{\theta} p_{\theta}(x)^{-\alpha} dx \quad (44)$$

$$p_D(D) \geq C_2 p_{\theta}^{\alpha+1} \quad (45)$$

respectively by invoking definition 2. The C 's are constants, and these equations hold

⁵³The first equation in (40) is just a change of variables.

for $\theta > \theta_0$. By a change of variable, the integral in (44) becomes⁵⁴

$$D(\theta) \leq C_1 \int_0^{p_\theta(\theta)} p_\theta(x)^{-\alpha} \left(\frac{dp_\theta}{dx} \right)^{-1} dp_\theta \propto \frac{1}{p_\theta(\theta)} \quad (46)$$

Equations (45) and (46) imply that

$$p_D(D) \geq CD^{-\gamma} \quad (47)$$

where $\gamma = \alpha + 1$ and the constant $C = C_1 C_2$. Since the area under the tail of p_D must be finite, the distribution of expenditures can be expressed as some polynomial in D with negative exponents. Large values of θ (where the signal distribution is thick tailed) correspond to large values of D , so this implies approximate power law behavior in the tail of the distribution of expenditures.

Remark. In a given length of time (say a year), an interest group may respond to many signals and make several expenditures. These will each be distributed as $p_D(D) \propto D^{-\gamma}$. Provided they are independent, the total expenditure is then simply the sum of these random variables which is distributed as a power law with identical exponent in the tail.⁵⁵ Hence, irrespective of the temporal unit of observation, power law behavior should still be observed.

Despite the thin tails of the normal and log normal distributions, simulations using signals from these distributions generate expenditure distributions that resemble power laws reasonably closely. θ can then approximately be thought of as an additive or multiplicative aggregation of smaller independent and identically distributed signals with finite second moments using a central limit theorem. To the empiricist, this greatly widens the applicability of the model.

Of course, proposition 3.2 relies heavily upon the assumption in (41). I argue that this is the natural result of a simple assumption on constituents' behavior. After responding some fraction of these constituents changes their thresholds. (As discussed earlier, the distribution from which their new thresholds are drawn is renormalized to the uniform on the unit interval.) This threshold adjustment directly implies that the steady state distribution of thresholds must be p_λ as given in (41).

Proposition 3.3. Suppose that a fraction $0 < \eta \leq 1$ of responsive constituents obtain new thresholds drawn from a uniform density defined on the unit interval. Then there exists a steady state distribution of thresholds p_λ with the property $p_\lambda(\lambda) \propto \left(\int_\lambda^\infty p_\theta(x) dx \right)^{-1}$.

Proof. There are two countervailing forces which determine the steady state distribution of constituent thresholds. Periodic signals disproportionately target responsive constituents (with low thresholds) to change their thresholds possibly. That is, if a signal targets a constituent with a particular threshold, by definition it also targets all other constituents with lower thresholds. The lower a constituent's threshold, the

⁵⁴From equation (38), $\frac{dp_\theta}{dx} \propto p_\theta(x)^{2-\alpha}$.

⁵⁵For an exact derivation of the sum of i.i.d. power law random variables, see Ramsay (2006). If the random variables are no longer identically distributed, the sum is still asymptotically distributed as a power law with the smallest exponent of its components (see Roehner and Winiwarter 1985). Simulation evidence suggests that this approximation worsens as the exponents are more and more dispersed.

easier it is that they are targeted by a signal. Over time, threshold adjustment due to signal response should increase the average thresholds of constituents in the group. However, this does not increase without bound, because as thresholds continue to rise, then constituents who change their thresholds are more likely to select lower ones from the uniform density.

The expected number of constituents whose thresholds no longer fall in the interval $d\lambda$ is given by $d\lambda\eta p_\lambda(\lambda) \int_\lambda^\infty p_\theta(x) dx$. Since the new thresholds are uniformly distributed, $Cd\lambda$ represents the expected number of constituents whose newly changed thresholds fall in that interval where C is a constant. Let p_{λ_k} represent the distribution of thresholds after k successive signals. I can recursively define this distribution in any interval as

$$p_{\lambda_{k+1}} d\lambda = Cd\lambda + d\lambda p_{\lambda_k} \left(1 - \eta \int_\lambda^\infty p_\theta(x) dx \right) \quad (48)$$

Given that η and $\int_\lambda^\infty p_\theta(x) dx$ both take on values in the unit interval, the term in parenthesis is also less than 1. In other words, (48) defines a first order difference equation with a dynamic multiplier less than or equal to 1. This clearly converges to a steady state.

In this steady state, $p_{\lambda_k} \approx p_{\lambda_{k+1}}$. This fact, combined with equation (46) yields

$$d\lambda\eta p_{\lambda_k} \left(1 - \eta \int_\lambda^\infty p_\theta(x) dx \right) = Cd\lambda \quad (49)$$

and with a simple rearrangement, equation (49) becomes

$$p_\lambda(\lambda) \propto \left(\int_\lambda^\infty p_\theta(x) dx \right)^{-1} \quad (50)$$

Following the analysis above for group i , $p_D^i(D) = C_i D^{-\gamma_i}$ for some C_i and γ_i . As they are determined by the group specific signal and threshold densities, the coefficients and exponents for the individual groups can be thought of as random variables. Thus, the coefficients C_i are distributed according to some density f (with cumulative density F) and the exponents γ_i are distributed according to some density h . Recall that h is assumed to be either a continuous function or defined on a finite domain, and the exponents fall only in the interval $0 \leq \gamma_i \leq \bar{\gamma}$.⁵⁶ Let $\pi_D(D)$ be the probability that any particular group makes an expenditure of size D .

Proof of Theorem 3.1. By the Stone-Weierstrass theorem, the density of exponents, h can be arbitrarily well approximated by a polynomial in any closed interval of the real line. Hence,

$$h(\gamma) = \begin{cases} P(\gamma) & 0 \leq \gamma \leq \bar{\gamma} \\ 0 & \text{otherwise} \end{cases} \quad (51)$$

⁵⁶As long as the domain of possible potential expenditures includes some values greater than C_i^{-1} , it must be the case that $\gamma_i \geq 0$. The upper bound for γ_i is empirically sensible because power law densities are rarely observed in nature to have exponents larger than 4.

where P is a polynomial approximation in the specified interval. If h is defined only on a finite domain, then we can always find a polynomial P by which we can approximate it. The aggregate density of expenditures is then given by

$$\pi_D(D) = \int_0^\infty \int_0^{\bar{\gamma}} CD^{-\gamma} P(\gamma) d\gamma dF(C) \quad (52)$$

To simplify this, first note that for large x ,

$$\int P(\gamma) x^{-\gamma} d\gamma \approx \frac{Cx^{-\gamma}}{\ln x} \quad (53)$$

(See lemma 3.2.) Similarly, for large x and $b \leq 1$,

$$\frac{(bx)^{-\gamma}}{\ln bx} \approx b^{-\gamma} \frac{x^{-\gamma}}{\ln x} \quad (54)$$

(i.e., the expression on the left has the power law property.) Since $\pi_D(bD) \approx g(b) \pi_D(D)$ for $b \leq 1$, then according to lemma 3.1, equation (52) approximately simplifies to $\pi_D(D) \propto D^{-\gamma}$.

Theorem 3.1 is simply a statement of the fact that the aggregate density of large clusters approximately follows a power law. The general argument is that when joining power law distributions, the one with the smallest exponent dominates all of the others in the right tail.⁵⁷ Thus, the quality of the approximation is related to the variance of the distribution of exponents h . If the exponents of individual groups' expenditures tend to be quite similar to each other (i.e., h is the density of a random variable with low variance) then the approximation will be very nearly exact. Since groups within an industry are probably receiving many common signals (from the media, industry reports and polls for example) and probably have similar distributions of thresholds in their constituencies (e.g., dairy farmers in California are relatively similar to their counterparts in Wisconsin) then their signal distributions will probably also be quite similar. Hence, it is reasonable to believe that individual interest groups' expenditure distribution exponents will be quite similar making their joint, industry level expenditure distribution very nearly an exact power law.

One appeal of this formulation is that it is robust to many features of the lobbying environment. For example, it is agnostic regarding the motives of special interests. Expenditures for signaling credibility, obtaining access, and directly influencing policy are all consistent with the modeled interest group behavior. This reduces reliance on several models (with potentially contradictory predictions) of lobbying to study a single source of data.

Existing models of interest groups treat their constituencies as monolithic; in many instances, special interest groups are defined as groups of individuals with identical policy preferences. While it is true that the individuals take collective action around common preferences, it is heroic to assume that the intensity of these preferences is also identical. In a stark departure from the literature on special interest groups, this model allows for constituent heterogeneity. As the old saw goes, "Politics makes strange bedfellows."

⁵⁷This is loosely analogous to sums of power laws as well, where it can be shown that the term with the lowest exponent dominates all of the others. For a more detailed treatment, see Roehner and Winiwarter (1985).

Furthermore, the model makes no restrictions on the targets of lobbying. Much previous work has made strong predictions that groups will target only particular politicians – be they marginal legislators (Snyder 1991) or like minded legislators (Bennedson 1998) for instance. Other equally strong assumptions are that groups lobby for very well narrowly defined policy alternatives. However, most major groups lobby members of both major parties. Using the designations in the sample, contributions in all twelve sectors are no more unbalanced than 60-40% between Democrats and Republicans.⁵⁸ Dealing specifically with lobbying in two empirical case studies, Wright (1990) finds that when access is less of motive, legislative committee members “consider the preferences of groups on all sides of an issue.” In fact, Wright suggests that groups who lobby a variety of politicians (contrary to standard theory) for particular policies are hardly exceptional, and furthermore, they seem to be much more effective. Thus it is crucial for any model of lobbying to account for the reality that contributions might span politicians and policy preferences in very general ways.

Perhaps the most appealing characteristic of this model of lobbying is the clear ergodicity of the process. That is, the limiting distribution of lobbying expenditures is qualitatively independent of the initial conditions on signal and threshold distributions. This is intuitive since the result is intended to be viewed in a steady state which is accessible (in the sense of a Markov process) from any other state of constituent preferences. This stands in stark contrast to many game theoretic results. It is commonly and rightfully acknowledged that a multitude of equilibria of dynamic games are made possible through careful manipulation of the structure of the game. Hence, as Bendor et al. (2002) show, it is impossible to empirically test the predictions of these models independent of structural assumptions. By definition, steady state results of ergodic processes do not run into this obstacle. Instead, there is a clear and testable empirical prediction – the steady state distribution of lobbying expenditures within an industry approximately follows a power law – which is in fact shown to hold in the data.

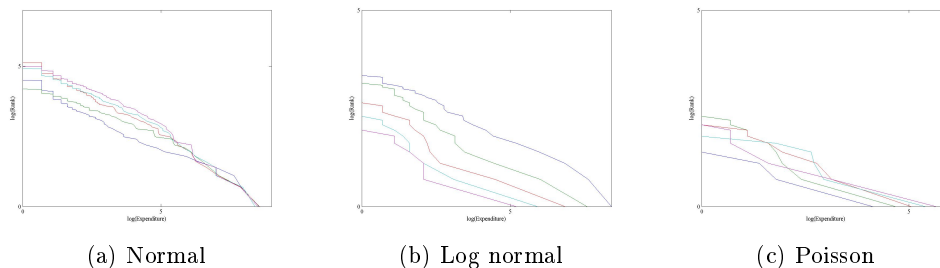
3.5. Discussion

There are three key approximations underlying this analysis. First, the actual lobbying data can only be shown to be consistent with a power law distribution. It is fundamentally impossible to prove that the data don’t come from a process whose distribution possesses another function form. Second, the distribution of signals is required to fall off sufficiently fast. While this definition only holds for thicker tailed distributions, I argue that the model’s result holds to a reasonable approximation for other familiar distributions (notably the normal and log normal distributions), which, as remarked, vastly extends the appeal of the result. Third, I show that total industry lobbying expenditures approximately follows a power law, with the quality of this approximation based upon the heterogeneity of interest group preferences and signals within the industry. The first approximation is a reasonable one given the empirical tests provided in section 3.3. At the very least, they are highly suggestive of power law behavior. In defense of the second and third approximations, I offer the following simulations.

Figure 4 show log rank-size plots of single group expenditures when signals are drawn from normal,

⁵⁸The partisan breakdown corresponds only to campaign contributions which are not included in the sample. Disclosure of the targets of lobbying expenditures is not required by law. Nevertheless, the statistic is suggestive of partisan balance in contributions. This is supported by theory even in common agency models (Grossman and Helpman 2002) and other empirical work (Chamon and Kaplan 2007). In fact, Chamon and Kaplan find “it is very common for [political action committees] to contribute to both Democrat and Republican House candidates.”

Figure 4: Simulated Expenditures



log-normal and Poisson distributions respectively with varying parameters.⁵⁹ Each plot is developed from 1000 simulated signal responses for a group of 1000 constituents. In each graph, there is a large region of expenditure sizes in which all plots are parallel. This indicates that the exponents of the power laws are roughly invariant to the parameters of the signal distribution over much of the support.

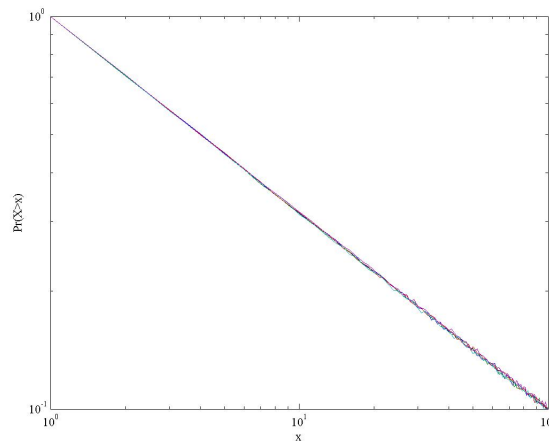
They certainly confirm the visual cue that the plots are roughly parallel within each graph. Reducing the constituency size or number of signals does not qualitatively affect the results or quantitatively affect the exponent estimates. However, with less data, the plots are far more discretized and the precision of the estimates understandably is reduced (thought not to a very large extent). For illustrative purposes only, I keep these parameters relatively large.

Figure 5 contains the empirical cumulative densities of five aggregate power law plots. Each log-log plot of $1 - \text{cdf}$ corresponds to a joint distribution of 10 power laws with normally distributed exponents. The mean of each exponent distribution is 0.5, while the standard deviation varies from 0.01 to 0.1 across plots. Analytically, the approximation is worst for low values of x . However, the simulated distribution is actually of high quality for these low values. Numerically, the simulation slightly breaks down slightly for high values of x , since they represent very low probability events. This numerical breakdown is somewhat mitigated by the fact that draws are taken in 1% logarithmically scaled increments for purposes of simulation. Still, it is quite clear from these plots that the joint distribution follows a power law to a very good approximation.

This signal-response model of lobbying behavior has significant and unique implications, both for academics and policy makers. For the former group, this modeling technique is a significant departure from the standard game theoretic approach to modeling lobbying and other complex decision making. For the latter group, this model implies that standard political reforms which target lobbying expenditures are not likely to have any effect on the distribution of lobbying within and across industries. In some sense, they are doomed to fail since they do not address the appropriate determinants of lobbying decisions.

⁵⁹In plot (a), transformed signals are normally distributed with mean ranging from 0.45 to 0.55 and standard deviation ranging from 0.01 to 0.05. All implied maximum likelihood estimates of the power law exponent are between 1.65 and 1.75 throughout the distribution. In plot (b), transformed signals are log normally distributed with mean ranging from 0.2 to 0.45 and standard deviation ranging from 0.05 to 0.15. All implied maximum likelihood estimates of the power law exponent are between 1.5 and 1.55 in the 50% right tail of the distribution. In plot (c), transformed signals are Poisson distributed, scaled in increments of 10^{-4} with mean ranging from 0.05 to 0.25. All implied maximum likelihood estimates of the power law exponent are between 1.6 and 1.7 in the 50% right tail of the distribution. All signal distributions are truncated so that only signal values between 0 and 1 are considered.

Figure 5: Joint Power Law Simulation



Although difficult to distinguish, there are five plots, each representing the joint distribution of 10 individual power laws with normally distributed exponents. For all plots, the mean of the exponent distribution is 1.5 and the variance ranges from 0.1 to 0.5. Each plot of 1-cdf is simulated using 10,000 draws in logarithmic increments of 1% of the width of the x-axis.

I repeatedly stress that this approach is empirically driven. It is only in response to the inability of existing models of special interest groups to describe aggregate lobbying trends that I posit this alternative approach. The evidence on aggregate expenditures is inconsistent with any reasonably simple Nash equilibrium in lobbying decisions. As such, I depart from that solution concept and instead provide an alternative mechanism for lobbying expenditures with an intuitive steady state result. This leads to a prediction that is borne out of the actual data. In contrast, existing common agency based models tend to either predict atomistic distributions of lobbying expenditures where one dominant group spends all of the money in an industry, or all groups spend equally. Neither of these two equilibria is well supported by the data.

The existence of this observed power law should be of great interest to policy makers. Recall from tables 3 and 4 that the power law exponent in each industry does not seem to be correlated with industry fundamentals. Furthermore, nonparametric tests indicate the distribution of lobbying expenditures in different industries in different years is statistically indistinguishable. This suggests that the relative distribution of lobbying expenditures is not a function of the costs and benefits of lobbying for groups in a particular industry. (As stated before, it would be a stretch at best to claim that the costs and benefits of lobbying for the defense electronics manufacturers are in the same proportion as they are for livestock farmers and industrial unions.) That is not to say that the costs and benefits of lobbying do not affect decisions by special interest groups; on the contrary, lower costs and higher benefits are likely to be associated with greater lobbying activity by special interest groups. And individual strategic decisions at the group level may be guided by these costs and benefits. However, the relative distribution of expenditures is likely to remain unchanged. As this is a matter of first order importance to policy makers, the implication is clear: policies which seek to affect the shape of the distribution of lobbying expenditures by altering the costs and benefits of lobbying are likely to fail.

A natural question is then, “What sorts of policies could have an impact on the shape of the dis-

tribution of lobbying expenditures?" First of all, remember that the approximations detailed above hold best in the right tail of the expenditure distribution. Hence, if the costs of lobbying became so onerous relative to the benefits that special interest groups dramatically reduced their activity, then the statistical approximations in the model would grow tenuous. So very extreme policies aimed at curbing influence could in fact have the effect of reshaping the distribution of lobbying expenditures. Secondly, making constituents less responsive to common signals could lead to a breakdown in the power law distribution. While this is speculative at best, it is consistent with the idea that political transparency could lead to less market concentration and more industrial liberalization (Razin and Sadka 2004). If constituents constantly receive small signals from government and the press, then it is unlikely that enough will respond to any one signal, resulting in a relatively static distribution of responsiveness. In other words, it may not be reasonable to analyze the model at a steady state. Alternatively, bundling policymaking may also cause a breakdown in the power law distribution. For instance, constituents of an interest group may have extreme preferences over a narrowly tailored appropriations bill, but more diluted preferences over broadly defined appropriations.

3.6. Concluding Remarks

In recent years, research in political economy has become almost singularly focused on strategic models of behavior which generate well defined Nash equilibria. While this is certainly of value in providing a systematic approach to understanding interactions between political actors, it often fails to describe adequately aggregate behavior in a manner consistent with empirical observations. While I say very little about how individual interest groups will act, I do make predictions of aggregate behavior which are very well supported by actual lobbying data. In addition, I emphasize the importance of explicitly modeling constituencies apart from the groups themselves. This identifies an oft overlooked source of heterogeneity in the standard monolithic view of special interests.

My empirical contributions are clear: I identify a power law in lobbying expenditures, and I provide evidence suggesting that the shape of the distribution of these expenditures is uncorrelated with industry fundamentals and industry specific costs and benefits of lobbying. The policy implications of these facts are that most modest lobbying reforms will have little effect on the relative amounts spent by interest groups on lobbying; hence, they will fail at one of their primary objectives. Furthermore, I show that the distribution of expenditures can provide empirical insights into other applications in political theory. Extensions to this research are twofold. First, I believe that this work underscores the importance of basing theoretical models in the social sciences on actual empirical observations. If predictive power is a standard by which economic models are to be judged, then this is imperative. Second, while strategic equilibrium concepts often perform admirably to describe many economic phenomena, they do not have a monopoly on explanatory ability. Echoing Timothy Besley, they are just one of many tools which we can use to understand the world.

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A. Mathematical Appendix

Lemma 1.1. In any SPNE in pure strategies, at most one group will make payments to legislators in the second stage.

Proof. Because the two groups have opposing views, as defined above, one will be in favor of the status quo policy and one will be in favor of the bill. By assumption, the group in favor of the alternative can make payments first, and then the group in favor of the status quo can opt to make payments second. Say both make payments. If the bill ultimately passes, then the group in favor of the status quo would have been better off avoiding payments, as they have no effect on policy. If the bill ultimately fails, then the group in favor of the bill would have been better off avoiding payments, as they have no effect on policy. Hence, only one group will make payments in equilibrium.

Proposition 1.1. There exists a SPNE in pure strategies in the game described in the text.

Proof. In the second stage, there is a pure strategy Nash equilibrium where at most one group makes the minimal payment required to either push the bill through or block it depending on their preference. The minimal payment is well defined by the opposing group's willingness to pay to for the bill or the status quo, depending on their preference.

The paying group in stage two can either spend to promote the policy (buy "yea" votes) or to suppress the policy (buy "nay" votes). Hence for any policy y , I can define functions and that are the respective costs to group i of passing or blocking policy y .

In the first stage, both groups submit bids consisting of payments and policies. Since the proceedings of stage 2 are completely captured in the functions $P_i(y)$ and $B_i(y)$, I can define the private value to each group i of a policy y as

$$Value_i(y) = \max \{V_i(y) - P_i(y), V_i(s) - B_i(y)\}. \quad (55)$$

Since it is known whether a given policy will ultimately pass or fail in stage 2, the legislative sponsor also has a well defined valuation for each policy given by his utility over the policy in the event of a pass or his utility over the status quo in the event of a block, plus the payment X he accepts in this stage.

I define the "winning" group as that group which makes payments in the second stage, and the "losing" group as that group which does not make payments in the second stage. If neither group makes payments, the "winning" group is the one who prefers the outcome of the vote. Denote these groups by W and L respectively.

For every potential policy y , is well defined for W as the lowest amount they would need to pay the sponsor for policy y such that the sponsor's valuation exceeds their valuation of all offers that L might make.

This reduces the first stage to a first price auction with public valuations. The item to be auctioned is the right to control the legislative sponsor, who plays the role of the auctioneer. Since I assume that the bidder with higher valuation of sponsor control wins the auction when the sponsor derives

equal utility from both bids, this auction possesses a Nash equilibria in pure strategies. Hence, we can induce a Nash equilibrium in pure strategies in each subgame, which proves the claim.

Proposition 1.2. In any subgame perfect Nash equilibrium (SPNE) in pure strategies,

$$V_W(y_W) - V_W(y_L) - P(y_W) + V_L(y_W) + P_L(y_L) - V_L(y_L) + U(y_W) - U(y_L) \geq 0. \quad (56)$$

Proof. I proceed by backwards induction. The second stage of the game has already been described. At most one group makes payments, and for any policy y , and that are the respective costs to group i of passing or blocking policy y .

Claim 1. If the winner makes a bid in stage 1 that will lead to him blocking the policy in stage 2, $B_W(y_W) = 0$.

Proof. First assume a policy exists such that $B_W(y_W) = 0$. Then selecting a policy that is costly to block will result in the same outcome at greater cost. So W could always deviate to y .

Any policy that is farther from the median voter than the status quo in the direction of W 's blisspoint will neither pass on its own nor be fought for by the opposing lobby. Hence for those policies, $B_W(y_W) = 0$.

There are two individual rationality (IR) constraints that must hold for the winning group and the sponsor respectively. For the winning group W , the costs of pursuing policy y_W must be exceeded by the surplus benefit to W from implementing policy y_W over y_L , or

$$X_W(y_W) + P_W(y_W) \leq V_W(y_W) - V_W(y_L). \quad (57)$$

The legislative sponsor must be better off accepting W 's bid for policy y_W than they would be if they went for the policy y_L , or

$$X_W(y_W) + U(y_W) \geq X_L(y_L) + U(y_L). \quad (58)$$

Claim 2. In any subgame perfect Nash equilibrium, W 's bid must make the sponsor IR constraint bind.

Proof. Suppose not. Then W could lower their bid by some positive amount and still satisfy the sponsor IR constraint. But this is a utility increasing deviation for the winning group, so it does not constitute a SPNE.

Claim 2 simply implies that W spends just barely enough to win. For L , there does not exist an IR constraint, strictly speaking. However, their bid must satisfy an equilibrium condition.

Claim 3. In any SPNE, L 's bid must satisfy

$$X_L(y_L) + P_L(y_L) \geq V_L(y_L) - V_L(y_W). \quad (59)$$

Proof. Suppose not. Then the costs to L of pursuing policy y_L , as given on the left hand side of (59), are smaller than the benefits to L of pursuing y_L . By claim 2, W 's bid forces the sponsor's IR constraint to bind. That is, W bids the minimum amount necessary to make the sponsor better off with their bid over L 's bid. As such, any increase in $X_L(y_L)$ switches the winning policy to y_L . But since $X_L(y_L) + P_L(y_L) < V_L(y_L) - V_L(y_W)$ by

assumption, L could increase $X_L(y_L)$ by some nonzero amount and be better off with policy y_L over y_W . This represents a profitable deviation for L , so it does not constitute a SPNE.

Define \bar{X} to be the bribe any group must offer the sponsor to propose a bill which will be ultimately blocked. There are three potential cases to consider, all of which can be neatly represented by inequalities (57)-(59).

Case 1: W induces the sponsor to write their bill over the alternative of L 's bill. In this case, (57)-(59) remain as is.

Case 2: W induces the sponsor to write the bill over the alternative of the status quo. In this case, $y_L = s$, $X_L(y_L) = \bar{X}$, and $P_L(y_L) = 0$. That is to say, L 's proposed policy is functionally equivalent to the status quo, their payment to the sponsor in favor this policy is equal to that of any bill which would be ultimately blocked, and the cost to get a status quo bill passed in the second stage is obviously zero.

Case 3: W induces the sponsor to write an intentionally failing bill in defense of the status quo. In this case, $y_W = s$, $X_W(y_W) = \bar{X}$, and $P_W(y_W) = 0$. That is to say, W 's policy alternative is functionally equivalent to the status quo, their payment to the sponsor in favor this policy is equal to that of any bill which would be ultimately blocked, and the cost to get a status quo bill passed in the second stage is zero.

Hence all possible cases are embedded within (57)-(59). Since the three IR constraints all hold, I can simplify the set of inequalities which define a SPNE by summing them as follows:

$$\underbrace{V_W(y_W) - V_W}_{W's \text{ surplus} \geq 0} + \underbrace{V_L(y_W) - V_L(y_L)}_{L's \text{ surplus} < 0} + \underbrace{U(y_W) - U(y_L)}_{\text{sponsor's surplus}} \geq \underbrace{P_W(y_W) - P_L(y_L)}_{\text{surplus cost of implementing } y_W} \quad (60)$$

For further intuition, suppose inequality (60) did not hold. Then rearranging,

$$V_W(y_L) - V_W(y_W) - P_W(y_W) - X_W(y_W) + V_L(y_L) - V_L(y_W) + P_L(y_L) + U(y_L) - U(y_W) + X_W(y_W) > 0 \quad (61)$$

Inequality (61) simply states that the sum of utilities from enacting y_L exceeds the sum of utilities from enacting y_W . Since $V_W(y_L) - V_W(y_W) - P_W(y_W) - X_W(y_W) < 0$, either $V_L(y_L) - V_L(y_W) + P_L(y_L) > 0$, or $U(y_L) - U(y_W) + X_W(y_W)$ or both. If the former is true, L could increase to enact their policy, and if the latter is true, then the sponsor is not being compensated enough by W to enact their policy. Both are incompatible with a SPNE, hence inequality (60) must hold.

Proposition 1.3. Legislation will be promoted if and only if the total surplus that W , L and the legislative sponsor derive from versus the status quo policy is positive. That is, legislation will be promoted if and only if

$$V_W(y_W) - V_W(s) - P_W(y_W) + V_L(y_W) - V_L(s) + U(y_W) - U(s) > 0 \quad (62)$$

holds. Otherwise W will play a blocking strategy intentionally introducing legislation to fail.

Proof. For legislation to be promoted, the winning group must be better off than they would be with the status quo policy remaining. Formally, this is the same as

$$V_W(y_W) - X_W(y_W) - P_W(y_W) > V_W(s) - X_W(s) \quad (63)$$

holding. In order to win, W must ensure the sponsor's IR constraint holds for all choices of y_L . Invoking the fact that the sponsor's IR constraint must bind,

$$X_W(y) = \max_{y_L} \{X_L(y_L) + U(y_L) - U(y)\} \quad (64)$$

$$\text{s.t. } X_L(y_L) + P_L(y_L) = V_L(y_L) - V_L(y_W) \quad (65)$$

for all policies y . Note that $P_L(s) = 0$. Substituting (64) into (63) and simplifying yields

$$V_W(y_W) - V_W(s) - P_W(y_W) + V_L(y_W) - V_L(s) + U(y_W) - U(s) > 0 \quad (66)$$

as the condition under which W will pass policy. If this does not hold, then W blocks and the associated net utility change on the left hand side is equal to 0. This represents a simple transfer of $X_W(s)$ from W to the legislative sponsor.

Lemma 3.1. For any differentiable function $f(x)$, $f(x) = Cx^{-\gamma}$ if and only if $f(bx) = g(b)f(x)$ for all $b < 1$ and functions g .

Proof. The “only if” proposition is trivially true with $g(b) = b^{-\gamma}$. I now prove the reverse direction, first allowing b to be any number (possibly greater than or equal to 1) and then showing that it is sufficient for the proposition to hold only when $b < 1$.

Set $x = 1$. Then $g(b) = \frac{f(x)}{f(1)}$, so $g(bx) = \frac{f(b)f(x)}{f(1)}$. As this holds for all values of b , we can differentiate both sides with respect to b to get

$$xf'(bx) = \frac{f'(b)f(x)}{f(1)} \quad (67)$$

Setting $b = 1$, we (67) simplifies to

$$f'(x) = \frac{f'(1)f(x)}{f(1)x} \quad (68)$$

(68) is a simple, separable first order differential equation with solution

$$\ln f(x) = \frac{f'(1)}{f'(1)} \ln x + \ln C \quad (69)$$

Exponentiating both sides, we get $f(x) = Cx^{-\gamma}$, where $\gamma = \frac{f'(1)}{f'(1)}$.

It is actually sufficient for the “if” proposition to hold only for $b < 1$. Suppose $f(bx) = g(b)f(x)$ for $b < 1$. Define $c = b^{-1} > 1$. Then the following is true:

$$g(b)f(x) = f(bx) = f\left(b^2 \frac{x}{b}\right) = g(b^2)f\left(\frac{x}{b}\right) = g(b^2)f(cx) \quad (70)$$

This implies that $f(cx) = h(c)f(x)$ where $h(c) = \frac{g(c^{-1})}{g(c^{-2})}$. As a postscript, we can solve for the coefficient C by setting $x = 1$, finding $C = f(1)$.

Lemma 3.2. If x is large, $\int P(\gamma)x^{-\gamma}d\gamma$ is approximately proportional to $\frac{x^{-\gamma}}{\ln x}$ for any polynomial function P .

Proof. I prove the lemma heuristically. First, note that

$$\int x^{-\gamma}d\gamma = -\frac{x^{-\gamma}}{\ln x} \quad (71)$$

Say n , the order of the polynomial P , is equal to 1. Then $\int \gamma x^{-\gamma}d\gamma$ can be evaluated using integration by parts.

Let $u = \gamma$ and $dv = x^{-\gamma}d\gamma$. Then

$$\int \gamma x^{-\gamma}d\gamma = uv - \int vdu = -\frac{\gamma x^{-\gamma}}{\ln x} - \frac{x^{-\gamma}}{(\ln x)^2} \quad (72)$$

For large x , the second term in (72) is dominated by the first, and the integral is indeed roughly proportional to $\frac{x^{-\gamma}}{\ln x}$.

In the general case of $n > 1$, the leading term $\int \gamma^n x^{-\gamma}d\gamma$ is evaluated using n successive integrations by parts. After j iterations, this intergral produces a leading term of $\frac{\gamma^j x^{-\gamma}}{\ln x}$ followed by $j - 1$ terms proportional to increasing powers of $\frac{\gamma}{\ln x}$ (starting with $(\frac{\gamma}{\ln x})^2$) followed by an integral with a leading coefficient of $(\ln x)^{-j}$. Hence, for large x , the first term dominates all of the following terms.

The important thing to note is that for large x , this integral is approximately proportional to an expression that is not a function of n . That means that these integrals terms can be neatly collected for different powers of γ . That is, $\int P(\gamma)x^{-\gamma}d\gamma$ is approximately proportional to $\frac{x^{-\gamma}}{\ln x}$ for any polynomial function P .

B. Measures of Textual Complexity

Below are standard measures of textual complexity. For a given body of text, the following objects can be enumerated:

wc = word count

sc = syllable count

lc = letter (and number) count

cc = complex word (three or more syllables) count

SC = sentence count

From these I can define the following metrics:

Flesch reading ease score (FRE) = $206.8 - 1.015 \frac{wc}{SC} - 84.6 \frac{sc}{wc}$

Automated readability index (ARI) = $4.71 \frac{lc}{wc} + 0.5 \frac{wc}{SC} - 21.43$

Gunning-FOG index (FOG) = $0.4 \left(\frac{wc}{SC} + 100 \frac{cc}{wc} \right)$

SMOG index (SMG) = $3.1291 + 1.043 \sqrt{30 \frac{cc}{SC}}$

(Flesch (1948), Kinkaid, et. al. (1975), Gunning (1952), and McLaughlin (1969) respectively.) The general idea behind these variables is that the complexity of a corpus is increasing in the number of words per sentence and the number of syllables per word. Accordingly, textual complexity is decreasing in the Flesch reading ease score and decreasing in the remaining four indices.

C. Estimator of a Power Law Exponent

This derivation of the maximum likelihood estimate of the power law exponent follows Newman (2006).

Consider the arbitrary power law density $\pi(x) = Cx^{-\gamma}$. In order to estimate the power law exponent, we need to identify the minimum scale at which the power law arises. Often times, this is simply the smallest observation in the sample, denoted x_{min} . Because any probability density must integrate to 1, $1 = \int_{x_{min}}^{\infty} Cx^{-\gamma} dx = \frac{C}{1-\gamma} (x^{1-\gamma})$. This implies $C = (\gamma - 1) x_{min}^{\gamma-1}$, so

$$\pi(x) = \frac{\gamma - 1}{x_{min}} \left(\frac{x}{x_{min}} \right)^{-\gamma} \quad (73)$$

We are trying to compute a maximum likelihood estimate of the parameter γ , or

$$\hat{\gamma}_{ML} = \arg \min_{\gamma} \prod_{i=1}^N \pi(x_i; \gamma) \quad (74)$$

As is often the case, it is easier to take logarithms and minimize the log-likelihood function. Plugging

in equation (73) and taking logarithms, we get

$$\hat{\gamma}_{ML} = \arg \min_{\gamma} \left[N \ln(\gamma - 1) - N \ln x_{min} - \gamma \sum_{i=1}^N \ln \left(\frac{x_i}{x_{min}} \right) \right] \quad (75)$$

Setting the derivative of the argument with respect to equal to zero and solving for $\hat{\gamma}_{ML}$ yields

$$\hat{\gamma}_{ML} = 1 + N \left(\sum_{i=1}^N \ln \left(\frac{x_i}{x_{min}} \right) \right)^{-1} \quad (76)$$

Estimating the standard error on $\hat{\gamma}_{ML}$ is done by computing the width of the likelihood function as a function of the parameter γ . For clarity, let $a = x_{min}^N$, and let $b = \sum_{i=1}^N \ln \left(\frac{x_i}{x_{min}} \right)$, neither of which are functions of the parameter γ . Then we can rewrite the likelihood function from (74) as $\ell = ae^{-b\gamma}(\gamma - 1)^N$. To obtain the variance of $\hat{\gamma}_{ML}$, denoted as σ_{ML}^2 , we first need to compute the mean and the mean square of $\hat{\gamma}_{ML}$, which are respectively given by

$$\frac{\int_1^{\infty} e^{-b\gamma} (\gamma - 1)^N \gamma d\gamma}{\int_1^{\infty} e^{-b\gamma} (\gamma - 1)^N d\gamma} = \frac{N + 1 + b}{b} \quad (77)$$

$$\frac{\int_1^{\infty} e^{-b\gamma} (\gamma - 1)^N \gamma^2 d\gamma}{\int_1^{\infty} e^{-b\gamma} (\gamma - 1)^N d\gamma} = \frac{N^2 + 3N + b^2 + 2b + 2Nb + 2}{b} \quad (78)$$

σ_{ML}^2 is then simply equal to the difference of (77) and (78), or $\frac{N+1}{b^2}$. Substituting back for b , this gives us

$$\sigma_{ML}^2 = (N + 1) \left(\sum_{i=1}^N \ln \left(\frac{x_i}{x_{min}} \right) \right)^{-2} \quad (79)$$

For large values of N , $N + 1 \approx N$, so we can rewrite equation (79) neatly in terms of the parameter estimate given in (76) as

$$\sigma_{ML}^2 = \frac{(\hat{\gamma}_{ML} - 1)^2}{N} \quad (80)$$