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Legislative Representation, Bargaining Power, and the Distribution of Federal Funds: Evidence from the US Congress*

Abstract

This paper investigates the relationship between representation in legislatures and the geographic distribution of federal funds. In a legislative bargaining model, we demonstrate that funds are concentrated in high representation areas, and two channels underlie this result. The proposal power channel reflects the role of representation in committee assignments, and the vote cost channel reflects the role of representation in coalition formation. In our empirical analysis, we find that small states, relative to large states, receive more funding in the U.S. Senate, relative to the House. We also find empirical support for the two channels underlying this relationship.

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Throughout the history of federations and international organizations, a key constitutional design question involves how jurisdictions of different sizes are represented in legislative bodies and how their votes will ultimately be weighted. Large jurisdictions typically argue for delegation sizes or voting weights that are roughly proportional to population whereas small jurisdictions typically argue for an equal number of delegates or votes for each jurisdiction. This conflict over representation is presumably driven, at least in part, by a belief that increased representation strengthens bargaining power in the battle over the geographic distribution of funds authorized by these legislative bodies.

In this paper, we analyze the relationship between legislative representation, bargaining power, and the geographic distribution of federal funds from both a theoretical and empirical perspective. In addition to investigating the existence of a relationship between representation and federal funds, we also explore the underlying mechanisms. That is, we ask which political institutions, such as agenda control provided to committees and the formation of coalitions under majority rule, shape the bargaining power of jurisdictions in central legislatures and thus facilitate the relationship between representation and the distribution of federal spending.

To provide a framework for analyzing these issues, we begin by developing a simple theoretical model of a central legislature that determines the cross-jurisdiction distribution of local public goods, which are financed by a national tax base. Both delegation sizes and population are variable, allowing us to consider a variety of institutional arrangements for jurisdictional representation. Legislators represent local interests, and, given the common pool problem associated with concentrated benefits and dispersed tax costs, attempt to increase own-jurisdiction spending but to restrain spending elsewhere. The model follows a recent literature on legislative bargaining, in which a proposer must secure a majority of votes in order to pass legislation and, due to the common pool problem, has an incentive to form the cheapest possible coalition. Under reasonable conditions, we show that increases in representation lead to increases in jurisdiction spending. Moreover, this relationship is a result of two underlying channels. The proposal power channel reflects the fact that increased representation improves the likelihood of being represented as the proposer. To the extent that proposal power is valuable to legislators in securing disproportionate spending for their home jurisdictions, it is clear that jurisdictions will benefit from this increased control over the agenda. The second channel, the vote cost channel, reflects the fact that increases in representation make jurisdictions more attractive from the perspective of proposers attempting to form the cheapest possible coalition.

In addition to generating these testable predictions, the theoretical model provides insights regarding the identification of the effect of representation on the geographic distribution of public spending in empirical analyses. In particular, cross-jurisdiction methods, as typically employed in the existing literature, may not be able to identify the effect of representation separately from the effects of population and other state-level characteristics. To overcome this limitation associated with cross-jurisdiction analyses, we conduct a within-state, cross-chamber analysis using a new dataset that identifies projects as originating in the US House, where representation is roughly proportional to population, or in the US Senate, where all states have two delegates. Thus, we examine whether small states receive more funding in the Senate, relative to the House, and whether large states receive more funding in the House, relative to the Senate. We also empirically investigate the two theoretically-identified channels underlying the relationship between representation and federal spending.

1 Related Literature

Much of the related empirical work has focused on the effect of representation in the US Senate on the cross-state distribution of federal funds. Atlas et. al. (1995) report a statistically significant relationship between per-capita federal spending, as measured by G_s/N_s where G_s is federal spending located in state s and N_s is state population, and per-capita representation in the US Senate, as measured by $2/N_s$. This correlation is interpreted as evidence of a small state bias associated with Senate representation. In a related analysis, Lee (1998) finds evidence of a small state advantage using data from the US Domestic Assistance Programs Database, as compiled by Bickers and Stein (1991).[1] As noted above, these cross-jurisdiction analyses rely solely on variation in population across states and may not be able to identify the effects of representation separately from the independent effects of population. This idea will be developed more fully below in the context of the theoretical model.

Several papers have examined the effect of representation on the geographic distribution of public spending in other legislative settings. Rodden (2001) finds a connection between votes per-capita and net transfers per-capita in the European Union. Ansolabehere, Gerber, and Snyder (2002) find that *Baker v. Carr*, which required that state legislative districts be re-apportioned every ten years, significantly altered the flow of state transfers to county governments. The authors calculate that, as a result of this ruling, approximately $7 billion were diverted annually from formerly over-represented counties, which were primarily rural, to formerly under-represented counties, which were primarily urban.

More broadly, this paper is related to a growing empirical political economy literature on common pool problems in central legislatures. Del Rossi and Inman (1999) find that the size of federal water project requests fell significantly when cost sharing requirements for local governments increased. Knight (2004) finds that legislators are more likely to vote in favor of federal spending the higher the fraction of funds spent in their own district but the lower the tax liability associated with spending elsewhere. Baqir (2002) finds a

[1] These data contain federal spending by Congressional districts, although the author aggregates up to the state level in order to focus on differences in per-capita Senate representation.

positive relationship between the size of city councils and public spending, and Gilligan and Matsusaka (1995) and Bradbury and Crain (2001) find similar results for legislatures in US states. These empirical results relating to the size of the legislature are consistent with the theoretical model of Weingast, Shepsle, and Johnsen (1981), who argue that spending will increase in the number of legislative districts given that each legislator only internalizes tax costs for their own constituents. Several studies have also examined how the cross-state conflict associated with the common pool problem is ultimately resolved. Knight (2005) finds that committee members use their proposal power to secure disproportionate transportation projects for their home districts. Levitt and Snyder (1997) find that Congressional districts with a large fraction of Democratic voters received significantly more federal funds between 1984 and 1990, a period in which Democrats controlled the US House. Levitt and Poterba (1999) find that states with powerful representatives experience more rapid economic growth than do other states; this effect cannot be explained, however, via higher federal spending.

This paper also contributes to a growing literature, primarily theoretical, on legislative bargaining. Recent applications of this legislative bargaining model include comparative politics (Persson, Roland, and Tabellini, 2000), federalism (Besley and Coate, 2003 and Lockwood, 2002), intergovernmental transfers (Knight, 2002), legislative elections (Chari, Jones, and Marimon, 1997 and Coate, 1997), legislative seniority (McKelvey and Riezman, 1992), pork barrel inefficiencies (Baron, 1991), social choice (Banks and Duggan, 2000), special interest politics (Persson, 1998, Helpman and Persson, 2001 and Bennedsen and Feldman, 2001), tax expenditures (Dharmapala, 1999), and public investment goods (Leblanc, Snyder, and Tripathi, 2000).

2 Theoretical framework

Here we present the simple theoretical model underlying our empirical analysis. Given our empirical motivation, we keep things simple and use specific parametric forms and distribution functions where appropriate. The role of the assumptions will be examined at the end of this section.

2.1 *Economic environment*

Consider a collection of S states, or jurisdictions, indexed by s, with a total national population equal to N. In a given state s, each of N_s residents is assumed to have the following quasilinear preferences over consumption of a statewide public good (G_s) and consumption of a private good (z_s):

$$U(G_s, z_s) = h\left(G_s/N_s^{\gamma}\right) + z_s \tag{1}$$

where the h is a strictly increasing function and is normalized so that zero utility is received from zero spending [$h(0) = 0$]. The congestion parameter $\gamma \in [0, 1]$ captures the degree of rivalry in consumption; this specification nests the case of private goods ($\gamma = 1$) as well as the case of pure public goods ($\gamma = 0$). Finally, we assume that each resident in state s is endowed with m_s units of the private good, which can be converted into public goods at a dollar-for-dollar rate.

2.2 *Political environment*

Following a literature on legislative bargaining, we assume that a central legislature determines the cross-state distribution of local public goods from a fixed budget, which we normalize to one. Thus, federal spending (G_s) can be interpreted as the fraction of the federal budget located in state s. These public goods are financed from a national, or common pool, tax base, and each resident pays an equal fraction $1/N$. Finally, private consumption is determined residually and equals $z_s = m_s - 1/N$ in the event that federal spending is approved in the legislature.

The legislature is composed of delegates who represent the interests of individual states, and we normalize the total number of delegates to one. Thus, the delegation size of state s, given by V_s, can be interpreted as a fraction of the legislature affiliated with delegation s. We allow for delegation sizes to be variable, and the model thus nests representation in the US Senate, in which each state has the same number of delegates ($V_s = 1/S$), as well as representation in the US House, in which representation is proportional to population ($V_s = N_s/N$).

The political process is modeled as a one-shot version of the legislative bargaining model due to Baron and Ferejohn (1987 and 1989) and Persson and Tabellini (2002). In the first stage, a single delegate is chosen to be the agenda-setter, which we alternatively refer to as the proposer. Let $A_s \in \{0, 1\}$ indicate whether state s is represented by the agenda-setter and let $\Pr(A_s = 1)$ denote this probability. While we allow this probability to be general for now, note that it is equal to the fraction of the legislature represented by state s if each delegate is selected with equal probability [i.e. $\Pr(A_s = 1) = V_s$].

In the first stage of the game, the agenda-setter proposes a geographic distribution of the federal budget, subject to a balanced budget condition ($\sum_s G_s \leq 1$). In the second stage, each delegate votes over whether to accept or reject the proposed budget. If the proposal receives a majority of votes from delegates in support, it is implemented and taxes are levied; otherwise, a zero reversion budget is implemented. Projects are funded via a national tax base and each citizen is assumed to pays taxes equal to $1/N$. Thus, while project benefits are concentrated within states, costs are dispersed; this common pool problem will be a key component of the model.

2.3 *Subgame Perfect Equilibrium*

Working backwards, each delegate will support proposals for which the total benefits accruing to a representative constituent exceed the tax costs associated with aggregate provision:

$$h\left(G_s/N_s^{\gamma}\right) \geq 1/N \tag{2}$$

Given that, within a state, delegates use equivalent voting rules, the cost (C_s) to the proposer of securing votes from all of the delegates of state s, the spending level G_s that sets equation (2) to binding, can be expressed as follows:

$$C_s = \theta N_s^{\gamma} \tag{3}$$

where θ is a constant that depends upon the function h as well as national population (N). Thus, the cost of securing the votes of delegation s is increasing in state population so long as some congestion is present ($\gamma > 0$). In the special case of pure public goods ($\gamma = 0$), this cost is independent of population. Regardless of the degree of congestion, however, the cost of securing the votes from a given delegation is independent of its size V_s.

In order to maximize the level of the public good provided to his home state, the agenda-setter has an incentive to form the cheapest possible coalition (M). Let $M_s \in \{0, 1\}$ indicate inclusion in the coalition. In the context of this model, the agenda-setter, taking voting rules as given, selects delegates from those states with the highest vote yields, defined as the ratio of delegation sizes to the total cost of securing the votes from a given delegation:

$$\frac{V_s}{C_s} = \frac{V_s}{\theta N_s^{\gamma}} \tag{4}$$

As shown, holding population constant, vote yields are proportional to delegation sizes. In order to smooth the probability of inclusion in the coalition, we assume that, in addition to selecting states with vote yields above some cutoff η, the agenda-setter experiences a mean-zero cost equal to ξ_s, which has a distribution function F, from including state s in the coalition. This cost could represent, for example, a distaste for including members of the opposition party, an issue that we will examine empirically below. Including this additional cost, the payoff to the proposer from including state s equals $V_s/C_s - \eta - \xi_s$, and the probability of inclusion in the coalition is thus given by:

$$\Pr(M_s = 1) = F(V_s/C_s - \eta) \quad (5)$$

To summarize, the agenda-setter forms a minimum-sized coalition of states, who tend to have high vote yields and who receive a payment equal to their cost (C_s), which is independent of the delegation size. States excluded from the coalition receive no spending. Finally, the agenda-setter receives a residual equal to δ, which is independent of both state population and delegation size.

At the agenda-setter's optimal proposal, expected spending (G_s), unconditional on the identity of the agenda-setter, can be expressed as follows:

$$E(G_s) = \Pr(A_s = 1)\delta + [1 - \Pr(A_s = 1)]\Pr(M_s = 1)C_s \quad (6)$$

Taking the derivative of equation (6) with respect to representation, *holding state population constant*, we have that:

$$\frac{\partial E(G_s)}{\partial V_s} = \underbrace{\frac{\partial \Pr(A_s = 1)}{\partial V_s}[\delta - \Pr(M_s = 1)C_s]}_{\text{Proposal-power channel}} + \underbrace{\frac{\partial F(V_s/C_s - \eta)}{\partial V_s}[1 - \Pr(A_s = 1)]C_s}_{\text{Vote-cost channel}} \quad (7)$$

Thus, so long as proposal power is valuable ($\delta > \Pr(M_s = 1)C_s$), there is a positive relationship between representation and expected federal spending. Moreover, this relationship can be decomposed into two underlying channels. The proposal power channel reflects the fact that increases in representation may lead to increased representation as the agenda-setter. Indeed, this partial derivative equals one if each delegate is selected with equal probability (i.e. $\Pr(A_s = 1) = V_s$). To the extent that proposal power is valuable, $[\delta > \Pr(M_s = 1)C_s]$, it follows that federal spending is increasing in representation due to this proposal power channel.[2] The vote-cost channel reflects the fact that, holding constant population, increases in representation improve the attractiveness as a potential coalition member from the perspective of the agenda-setter attempting to form an optimal coalition.[3] This channel is increasing in the probability that the state is not represented as the agenda-setter $[1 - \Pr(A_s = 1)]$ and in the ultimate payment for the state conditional on inclusion in the coalition (C_s).

2.4 *Role of the Assumptions*

This section discusses the role of key assumptions and the robustness of our results to alternative assumptions. The first of these assumptions, statewide public goods, is made for tractability. In particular, this assumption guarantees that delegations vote cohesively and thus the agenda-setter receives the votes of all delegates so long as spending is at least as high as the state-specific cost ($G_s \geq C_S$). An alternative model would allow for states to be sub-divided into legislative districts and for proposers to be able to channel funds to specific districts within a state. It is clear that the proposal power channel will continue to operate if $\Pr(A_s = 1)$ is increasing in V_s. We conjecture that the cost-channel will also continue to operate so long as some congestion is present. To see this, note that the cost of securing the vote of a single delegate from a state divided into D equally-sized legislative districts equals $\theta(N_s/D)^\gamma$ and the cost of securing a single vote is thus decreasing in the number of

[2] Knight (2005) finds that Congressional districts represented on the transportation authorization committee received significantly more federal funds in earmarked transportation projects than did districts not represented on the committee.

[3] Note that the vote-cost channel operates regardless of the degree of congestion. Under the special case of pure public goods ($\gamma = 0$), vote yields are proportional to delegation sizes ($V_s/C_s = V_s/\theta$) and are independent of population under Senate-type representation but are higher for large states under House-type representation. Thus, increases in representation lead to an increased probability of inclusion in the coalition. Under the special case of pure private goods ($\gamma = 1$), by contrast, vote yields are proportional to delegates-per capita ($v_s = V_s/N_s$) and are thus independent of population under House-type representation but are higher for small states under under Senate-type representation. Again, increases in representation make jurisdictions more attractive from the perspective of the agenda-setter.

districts D if $\gamma > 0$. While it seems that our model is robust to local public goods, we choose to retain our assumption of statewide public goods for two reasons. First, our data has no geographic information below the level of the US state. Second, our analysis is motivated by the battle over representation and funds across, rather than within, states.

The second issue involves the result that the cutoff for inclusion in the coalition is independent of the identify of the agenda-setter; this result in turn guarantees that the agenda-setter's share δ is homogenous across states. This constant cutoff may be violated by integer problems in our model, and we have abstracted from this issue above.[4] This problem of a non-constant cutoff for inclusion in the coalition is related to the problem of non-homogeneity described by Snyder, Ting, and Ansolabehere (2005). Coalitions are said to be homogenous if all minimum winning coalitions have the same number of votes. They address this problem of non-homogeneity by multiplying the number of players of each type, or state in our case, by some positive integer r, which they refer to as the number of replications; our baseline model above has $r = 1$. They then show that the problem of non-homogeneity grows small as r increases.

The third issue involves the assumption of a default of zero public spending in the event that a federal budget is not passed. There are two ways to relax this assumption. The first would allow for continued bargaining in the event of a failed vote. Snyder, Ting, and Ansolabehere (2005) examine a model with multiple rounds of bargaining, variable voting weights, and recognition probabilities that are proportional to voting weights. Although their model includes neither variation in population nor a congestion parameter, it predicts that expected payoffs are proportional to voting weights. The intuition is that votes are perfect substitutes and thus a player with k votes should command a price for those votes equal to

[4] For example, suppose that an agenda setter in the U.S. Senate needs to secure the votes of 24 other states and finds it optimal to choose the smallest states. Then, an agenda setter from a small state will include the 25th smallest state, whereas an agenda setter from a large state will exclude this 25th smallest state.

the total price of k players with one vote each. The second way to relax the assumption of a zero default involves introducing an exogenous and state-specific reversion equal to R_s and assuming that citizens pay taxes equal to $1/N$ regardless of the voting outcome. In this case, the cost of securing the votes of the delegation from state s is equal to this reversion level, and vote yields are thus equal to V_s/R_s. Regarding our two underlying channels, it is clear that the proposal power channel will continue to operate under this alternative model, and the vote-cost channel should as well so long as reversion levels are independent of the number of delegates. While it seems that our model is robust to alternative assumptions regarding reversion levels, we choose to retain our assumption of a reversion of zero spending for two reasons. First, our data contains no information on reversion levels. Second, this assumption seems natural given our empirical analysis of spending on new projects, as opposed to incremental spending on existing programs.

Finally, we assume that tax prices are equal to $1/N$ and are thus both independent of project spending and homogenous across states. Regarding the first issue, it is straightforward to introduce cost-sharing by the state such that the federal government pays a fraction f of project costs with the state paying a fraction $1 - f$. In this case, delegates support legislation if $h(G_s/N_s^\gamma) \geq 1/N + (1-f)G_s/N_s$. Again, the proposal power channel continues to operate, and we conjecture that the vote cost channel will continue to operate as well. Although one cannot solve explicitly for costs (C_s) with $f > 0$, it is clear that this cost continues to be independent of delegation sizes. Regarding the second issue, the homogeneity assumption, it is straightforward to introduce a state-specific per-capita tax price p_s, which are assumed to sum to one nationally, and delegates now support the proposal if $h(G_s/N_s^\gamma) > p_s$. Thus, the costs of securing the votes from a given delegation are increasing in p_s as high-tax states must be compensated accordingly.

2.5 *Implications for Empirical Analysis*

In addition to formalizing the theoretical relationship between representation and public spending, the baseline model also provides insights for existing cross-state analyses focusing on the US Senate, which attributes to Senate representation the finding that small states receive more funding on a per-capita basis. In particular, the model demonstrates that such a cross-state strategy is hampered generally by the role of state-level characteristics and specifically by the role of state population. To see this, consider a special case of the above model in which the probability of selection as agenda-setter is equal to delegation sizes ($\Pr(A_s = 1) = V_s$) and in which ξ_s is uniformly distributed, in which case the probability of inclusion in the coalition is linear $[F(V_s/C_s - \eta) = \beta + \tau V_s/C_s]$. In this special case, expected per-capita federal spending can then be written as follows:

$$E(g_s) = v_s\delta + [1 - V_s][\beta c_s + \tau v_s] \tag{8}$$

where $c_s = \theta N_s^{\gamma-1}$ represents the per-capita cost of securing the votes from the delegation representing state s. As can be seen, state population exerts an independent effect upon per-capita federal spending through c_s so long as congestion is incomplete ($\gamma < 1$). Thus, it is difficult to disentangle the effects of Senate representation from the effects of population using only cross-state variation. More generally, cross-state analyses are limited by the role of unobserved state-level factors. For example, a finding that small states receive more federal spending on a per-capita basis could be due to any state-level factor that is correlated with population.

To overcome these limitations associated with existing studies, we focus on cross-chamber variation. That is, we exploit the bicameral feature of the US Congress and compare federal spending originating in the US Senate, relative to federal spending originating in the US House. This allows us to difference out all state-level characteristics, including population, that do not vary at the state level between the House and Senate chambers. To the extent that representation matters, we then expect small states to receive relatively more Senate funds and for large states to receive relatively more House funds.

3 Empirical Analysis

In this section, we provide an empirical analysis of the relationship between representation and the geographic distribution of federal spending. This analysis focuses on a cross-chamber analysis of House-sponsored projects, under which large states are predicted to receive relatively more spending, versus Senate-sponsored projects, under which small states are predicted to receive relatively more spending. We also investigate the two theoretically-identified channels underlying the relationship between representation and federal spending.

3.1 *Data*

The main source of data on federal spending is provided by the Citizens Against Government Waste (CAGW), a private, non-partisan, non-profit organization that has catalogued funds for projects that were earmarked in annual appropriations bills. As shown in Table 1, Congressional earmarks are an important component of federal spending; the 9,362 projects listed in the fiscal year 2003 appropriations bills totaled $23 billion. Moreover, as shown, these appropriations earmarks have increased over time, rising from about $13 billion in fiscal year 1995.

For each of the 37,336 projects catalogued between 1995 and 2003, data include 1) the state in which the project is to be located, 2) the dollar amount appropriated, 3) relevant appropriations bill (Congress appropriates funds through 13 separate bills each fiscal year), and 4) the sponsoring chamber (i.e. the chamber, House or Senate, responsible for the appropriation). For the purposes of the econometric analysis, I focus on the subset of projects for which the relevant state is listed, and the remaining analysis thus ignores those projects that were not targeted to a specific state.[5] To provide a sense of the types of projects funded, Table 2 lists the largest projects, those with appropriations in excess of $60 million in 2003 dollars. As shown, the three largest projects were all included in the Defense appropriations bill, were sponsored by the Senate, and were located in Mississippi, a relatively small state and also the home state of Sen. Trent Lott, who served as Senate Majority Leader during the period in which the projects were funded. The remaining projects listed span a wide variety of states, appropriations bills, and sponsoring chambers. To provide a broader sense of spending categories, Table 3 details the number of projects and total funding by appropriations bill over this time period. As shown, military construction and transportation appropriations bills provided the most funding, followed by VA/HUD, defense, and energy.[6] Table 4 provides a breakdown of project spending by sponsoring chamber, one of the key variables in the econometric analysis as it allows us to identify the effects of representation separately from the effects of population. As shown, Senate projects provided the most funding, at $20 billion, followed by House projects, which funded just over $13 billion. Conference committees added a smaller amount, and the CAGW did not classify an additional $9 billion in project spending (presumably due to missing or ambiguous data).

A skeptical reader might be justifiably concerned over possible biases in the database. While CAGW is non-partisan, they do appear to have a political agenda of reducing earmarks, and this agenda could arguably lead to biases in the database. While a complete audit of the CAGW database is beyond the scope of this analysis, we did conduct a case study of projects included in the 2003 Military Construction Appropriations Bill. Encouragingly, we

[5] Many projects in the database fit into this category. For example, the fiscal year 2003 Senate Defense Appropriations bill earmarked $500,000 for M48 masks (Procurement - Defense Wide), and this project was thus not targeted to a specific state. While this earmarked project may clearly benefit some states more than others, it is not clear how the analyst would measure these cross-state differences for each project and we thus ignore these projects without a targeted state in the empirical analysis.

[6] The District of Columbia, foreign operations, legislative, and Treasury provided, perhaps not surprisingly, the least project funding given the difficulty of locating projects in a specific state in these cases.

found that all 191 projects listed in the database were also detailed in the legislation. Regarding the converse, while almost all projects in the legislation were included in the database, we did find a couple of exceptions (i.e. projects listed in the legislation that were not included in the database). We suspect that these exceptions were due to differences in interpretation rather than a systematic bias in the construction of the database. Although limited to a single appropriations bill, this analysis is encouraging and increases our confidence in the quality of the database.

For the purposes of the econometric analysis, the federal spending measures are scaled in two ways. First, for comparability across chambers and years and for consistency with the theoretical model, which interpreted federal spending as the fraction of the budget located in each state, I scale the spending measure by total cross-state spending in each chamber and year. Second, some specifications use per-capita measures, and data on population by year from the Census Bureau are thus incorporated into the analysis. Although the Census is only conducted every 10 years, the Census Bureau provides annual estimates of population as of July 1.

Finally, in order to gauge the importance of underlying channels, we also incorporate data on assignments to House and Senate appropriations subcommittees, each of which has agenda control over a single appropriations bill. Thus, while the theoretical model envisions a single proposer, agenda-setting powers in Congress are conferred upon sets of legislators, or committees. To make the committee measure consistent with the agenda-setter variable in the theoretical model, we compute the fraction of the committee represented by state s. That is, let A denote an agenda-setting committee with N_A members. Then, the fraction of the committee represented by state s is given by $A_s = 1(s \in A)/N_A$, where $1(s \in A)$ indicates state representation on the committee. Intuitively, the power conferred upon each committee member is decreasing in the overall size of the committee.

3.2 *Basic Results*

Table 5 provides results of tests for the presence of relationship between representation and the geographic distribution of federal spending. In particular, we estimate the following simple linear difference equation relating federal spending to representation:

$$\Delta G_{st} = \beta_0 + \beta_1 \Delta V_{st} + U_{st} \tag{9}$$

where s indexes states, t indexes time. The key dependent variable is the Senate-House difference in spending ($\Delta G_{st} = G_{st}^{SENATE} - G_{st}^{HOUSE}$), while the key independent variable is the Senate-House difference in representation ($\Delta V_{st} = V_{st}^{SENATE} - V_{st}^{HOUSE}$). Finally, U_{st} represents unobserved determinants of the geographic distribution of federal spending that differ within a state-year between the Senate and House.

Figure 1, which plots the Senate-House difference in spending by state (averaged over time) against the Senate-House difference in representation by state (averaged over time), provides a graphical sense of the identification strategy. As shown, California, the largest state, has roughly 12% of delegates in the House but only 2% in the Senate, and the Senate-House difference in representation is thus roughly -10 percentage points. At the same time, California receives roughly 10 percentage points less of the fraction of the federal budget in the Senate, relative to the House. Small states, by contrast, have more representation in the Senate and, as shown, also tend to receive more project spending in Senate bills than in House bills.

This relationship is also reflected in column 1 of Table 5. As shown, a one percentage point increase in representation, which could be achieved, for example, by giving a single state an additional Senator, is associated with an increase in the fraction of federal funds located in that state of roughly one percentage point. This effect is statistically significant and the 95% confidence interval is tight at $[0.91, 1.21]$. For comparability with the existing empirical literature, which has examined the relationship between per-capita federal spending and per-capita Senate representation, Column 2 of Table 5 provides the results from a specification in per-capita terms:

$$\Delta g_{st} = \beta_0 + \beta_1 \Delta v_{st} + u_{st} \tag{10}$$

As shown, the results in column 2 are quite similar to those in column 1, and the baseline results are thus robust to scaling our key measures by state population.

Given that our underlying channels analysis to follow is at the level of the appropriations bill and appropriations subcommittee, we next conduct an analysis at that level of aggregation. In particular, we estimate the following equation:

$$\Delta G_{sta} = \beta_0 + \beta_1 \Delta V_{st} + U_{sta} \tag{11}$$

where a indexes appropriations bills. As shown, our results are even stronger at this disaggregated level, and the point estimates suggest that a one percentage point increase in representation is associated with an increase in the fraction of federal funds located in that state of 1.28 percentage points.[7] As shown in column 4, the results from a corresponding per-capita analysis are similar in magnitude to those in column 3.

It is important to note that these results in Table 5 rest upon an implicit assumption of strategic independence across legislative chambers. Under this strategic independence assumption, the House and the Senate independently develop an allocation of projects, and these projects are then simply merged during the conference committee, which reconcile the House and Senate appropriations bills. Unfortunately, I cannot directly test this implicit assumption as projects that were removed during the conference committee are excluded

[7] Given that there are 13 appropriations bills, this should yield a total sample size of 5,850. Many bills, such as the appropriations bill for the District of Columbia and Foreign Operations, however, have zero or negligible spending. After eliminating these bills, we are left with a matched sample of 3,350.

from the CAGW data. As an alternative to this direct test, I conducted a case study of the fiscal year 2003 Military Construction appropriations bill. Based upon an analysis of projects included in the initial House bill, the initial Senate bill, and the final conference bill, over 80% of projects included in the House and Senate bills were also included in the conference version. The large proportion of projects funded is consistent with this implicit assumption of strategic independence across chambers.[8]

3.3 *Underlying Channels*

In order to provide further interpretation of these results, we next investigate the two underlying channels identified by the theoretical model. As shown in equation (7), the size of the proposal-power channel depends upon the relationship between the representation and selection as the agenda-setter ($\partial \Pr(A_s = 1)/\partial V_s$) along with the premium associated with membership on the committee $[\delta - \Pr(M_s = 1)C_s]$. We investigate each of these two components of the proposal power channel in turn. To measure the effect of representation on committee assignments, we regress of the Senate-House difference in representation on the Senate-House difference in committee assignments:

$$\Delta A_{sta} = \beta_0 + \beta_1 \Delta V_{st} + U_{sta} \tag{12}$$

Figure 2 provides a plot of this relationship, where the horizontal axis is identical to that in Figure 1 and the vertical axis reflects the difference in the fraction of appropriations bills under which state delegations were assigned to the appropriations committee (averaged over time and appropriations bills). As shown, the relationship is strongly positive as large states

[8] An alternative approach to addressing this issue would involve explicitly modeling the bicameral negotiations between the House and Senate. Snyder, Ansolabehere, and Ting (2003) develop such a model and find that a small state bias emerges if the Senate has proposal power or if federal dollars fund statewide public goods. While their model is more involved than the model in this paper and would thus be more difficult to analyze empirically, it is encouraging to note that a small state bias emerges in their model under the framework of this paper, which assumes statewide public goods and focuses on the role of proposal power in the U.S. Senate.

are represented far more often on House committees and small states tend to be represented more often on Senate committees.

As shown in column 1 of Table 6, the coefficients from the corresponding regression demonstrate that the relationship is positive and statistically significant. Although the coefficient is statistically different from one and we can thus reject proportional assignments ($\Pr(A_s = 1) = V_s$), it is large at 0.8 and clearly different from zero. Of course, increased likelihood of assignment to the committee will translate into higher federal spending only if committee members tend to receive more funds than do other states. To investigate this issue, we next regress the Senate-House difference in spending on the Senate-House difference in committee representation:

$$\Delta G_{sta} = \beta_0 + \beta_1 \Delta A_{sta} + U_{sta} \tag{13}$$

As shown in column 2, a delegation assigned to a committee of size one would receive roughly 43 percentage points more of the budget than do other states, and this effect is statistically significant. Taken together, results from the first two columns of Table 6 provide significant evidence in favor of the proposal power channel.

We next investigate the vote yield channel, which relates the size of the delegation to the probability of inclusion in the coalition ($\partial \Pr(M_s = 1)/\partial V_s$). To measure this relationship, we estimate the following specification relating inclusion in the coalition to delegation sizes.

$$\Delta M_{sta} = \beta_0 + \beta_1 \Delta V_{st} + U_{sta} \tag{14}$$

where $\Delta M_{sta} = \Delta M_{sta}^{SENATE} - \Delta M_{sta}^{HOUSE}$ represents the Senate-House difference in the indicator for coalition membership, which we measure by the presence of positive project spending.[9] This regression is run over the sample of appropriations bills for which the state

[9] An alternative approach to measuring inclusion in the coalition would involve roll-call voting records.

is represented on neither the House nor the Senate appropriations subcommittee. As shown in column 3, there is a positive and statistically significant relationship, providing evidence in favor of this vote-cost channel.

3.4 *Parties and Coalition Sizes*

This section investigates two additional issues raised by our theoretical model: the role of parties and the size of coalitions. Regarding the first issue, recall that our model includes a cost to the agenda-setter from including members in the coalition (ξ_s). The most obvious interpretation of this cost is a distaste for including members of the opposition party in the coalition. Given that committee chairs, who have significant power within the committee, are members of the majority party, we hypothesize that committees may thus reflect the interests of the majority party. In this case, one would expect members of the minority party to have higher cost terms and thus have a lower probability of inclusion in the coalition with opposite effects for members of the majority party. To investigate this issue empirically, we develop measure of the Senate-House difference in the fraction of the delegation associated with the majority party. Consistent with the above hypothesis and as shown in column 4 of Table 6, there is a positive and statistically significant relationship as delegations with a higher fraction associated with the majority party are more likely to be included in the coalition. Importantly, however, after controlling for the partisan composition of delegations, the coefficient on the size of delegations is similar to that in column 3, suggesting that our evidence in favor of the vote cost channel is not driven by underlying partisan composition

This would allow us to investigate the prediction that delegations behave cohesively in this model and thus all vote yes or all vote no. The problem with constructing such a voting measure is three-fold. First, some appropriations bills are passed via a voice vote and individual legislator votes are thus not recorded. Second, appropriations bills are, in some cases, passed in an omnibus bill, in which all thirteen appropriations bills are combined into a single bill. Third, appropriations bills contain other provisions in addition to projects earmarked for specific states. Evidence from Knight (2004), which demonstrates a positive correlation between transportation project spending in Congressional districts and support by representatives, as expressed in roll-call votes over an amendment to strip projects in all districts from a larger bill, suggests that project spending-based measures and roll call voting-based measures of inclusion in the coalition may yield similar results.

variables.

Another prediction of our model involves the size of coalitions. In particular, given the incentive of the agenda-setter to form minimum-sized coalitions, the empirical prediction is that just over 50% of delegate-weighted states should receive positive spending. As a test of this hypothesis, Figure 3 provides the empirical distribution of delegate-weighted states receiving positive spending across appropriations bills, fiscal years, and chambers. As shown, there are roughly twice as many appropriations bills with positive spending for 50 to 60% of delegate-weighted states compared to appropriations bills with positive spending for 40 to 50% of delegate-weighted states, suggesting an important discontinuity at 50 percent. On the other hand, many appropriations bills provide positive spending for over 60% of delegate-weighted states, suggesting inefficiently-sized coalitions. There are at least two explanations for the presence of over-sized coalitions. First, Congressional legislation is subject to Presidential veto, and bills with a large number of earmarks are a common target for veto threats. Thus, in order to guarantee the two-thirds vote required to over-ride any vetoes, proposers may optimally choose to expand coalition sizes beyond 50 percent. Second, there could be logrolling across appropriations bills. For example, committees with jurisdiction over water projects may fund projects in states represented by committee members with jurisdiction over transportation projects in exchange for transportation projects.

4 Conclusion

This paper provides a theoretical and empirical investigation of the relationship between representation in legislatures in the geographic distribution of federal funds. We begin by developing a simple legislative bargaining model in which both delegation sizes and state population are variable. In this model, increases in representation lead to increases in federal spending, and this relationship is the result of two underlying channels. First, increased representation leads to an increased likelihood of being represented by the agenda-setter.

Second, increased representation increases the attractiveness of the district from the perspective of agenda setters attempting to form optimal coalitions.

While the existing empirical literature has focused on cross-state analyses, we show that such analyses may be hindered by the presence of unobserved state-level variables, and we instead focus on a within-state analysis. In particular, we show that small population states, which are over-represented in the Senate but not the House, receive significantly more funding in Senate bills than in House bills, and the reverse is true for large population states. As evidence regarding the underlying channels, we find that these small states are also significantly more likely to be assigned to key Senate Appropriations committees than to corresponding House committees, and the reverse is true for large states. Committee members also receive significantly more funding than do non-committee members, and we thus find evidence in favor of the proposal power channel. We also find that small states are significantly more likely to be included in coalitions in Senate bills than in House bills. Again, the reverse is true for large states. This finding in support of the vote-cost channel is robust to the inclusion of measures of the affiliation of the delegation with the majority party. Taken together, the empirical analysis provides strong support for the hypothesized relationship between representation and federal spending along with the underlying channels identified in the theoretical model.

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Table 1: Total Project Appropriations by Fiscal Year

Fiscal year	Number of projects	Appropriations (billions of $2003)
1995	1439	$12.8
1996	958	$10.1
1997	1596	$16.3
1998	2143	$14.6
1999	2838	$13.1
2000	4326	$18.6
2001	6333	$19.0
2002	8341	$20.0
2003	9362	$22.5

Table 2: Largest Projects in CAGW data

(among those projects with state listed in project description)

State	Cost	Approp.	FY	Chamber	Description (abbreviated)
MS	$807,579,462	DEF	1998	S	DDG-51 (Ship Building and Conversion - Navy)
MS	$473,415,592	DEF	2001	S	LHD-8 [LHD-1 Amphibious Assault Ship [MYP]
MS	$396,157,168	DEF	2000	S	LHD-1 Amphibious assault ship [MYP]
MO	$290,515,256	DEF	2000		F-15 [+5] (Aircraft Procurement - Air Force)
SC	$176,000,000	ENERGY	2003	S	Cleanup for the Savannah River Site
NY	$166,806,855	TREAS	1999		Brooklyn U.S. Courthouse (General Services Administration)
WA	$141,000,000	ENERGY	2003	S	Cleanup for the Hanford site Richland
GA	$122,843,359	DEF	1999	H	KC-130J (Aircraft Procurement - Navy)
MO	$120,000,000	DEF	2003	S	Purchase 2 additional aircraft [F/A-18E/F Hornet]
LA	$116,872,000	COM	2003	S	FCI Pollock (Buildings and Facilities - Federal Prison System)
NM	$113,000,000	ENERGY	2003	S	Microsystems and engineering science applications [MESA]
LA	$112,163,814	DEF	1998	H	LPD-17 [AP-CY] (Ship Building and Conversion - Navy)
ID	$105,000,000	ENERGY	2003	C	Idaho site (Environmental and Other Defense Related Activities)
AZ	$97,868,264	TREAS	1995		U.S. courthouse- Tucson ($69 million ABR)
FL	$94,001,400	TREAS	1999		Jacksonville U.S. Courthouse (General Services Administration)
CO	$91,759,836	TREAS	1999		Denver U.S. Courthouse (General Services Administration)
WV	$89,833,551	ENERGY	1995		Corridor H (Appalachian Regional Commission)
TX	$81,504,963	MILCON	1997		Family Housing Construction Improvements (Army)
AL	$80,875,521	DEF	1999	S	Space based laser demonstrator
AL	$79,245,653	DEF	2001	S	Procure HAB [Heavy Assault Bridge {HAB} SYS {MOD}]
FL	$74,028,117	INT	1998	S	Everglades National Park
OR	$70,000,000	TRANS	2003	H	Portland Interstate MAX Light Rail Extension
CO	$70,000,000	TRANS	2003	H	Denver Southeast Center LRT [T-REX]
WV	$66,600,000	COM	2003	S	Hazelton (Buildings and Facilities - Federal Prison System)
FL	$65,574,747	INT	1999		Grant to the state of Florida (National Park Service)
TN	$65,000,000	ENERGY	2003	S	East Tennessee Technology Park [ETTP]
WA	$63,000,000	ENERGY	2003	S	To accelerate cleanup of the River Corridor
UT	$61,749,860	TRANS	2001	H	Olympic Transit Program, Salt Lake City
IN	$61,494,000	MILCON	2003		Ammunition Demilitarization Facility (Phase V)

Table 3: Project Appropriations by Appropriations Bill
(among those projects with state listed in project description)

Appropriations bill	Number of projects	Appropriations (billions of $2003)
Agriculture	2076	$1.3
Commerce	2131	$2.8
District of Columbia	1	$0.0
Defense	576	$5.3
Energy	2965	$5.6
Foreign Operations	12	$0.0
Interior	1896	$2.3
Labor, HHS	4297	$2.6
Legislative	4	$0.0
Military Construction	1692	$10.7
Transportation	5149	$11.8
Treasury	153	$1.2
VA/HUD	5994	$5.3

Table 4: Project Appropriations by Sponsoring Chamber
(among those projects with state listed in project description)

Sponsoring chamber	Number of projects	Appropriations (billions of $2003)
Senate	8820	$19.6
House	6600	$12.7
Conference committee	8646	$7.5
Not listed	2883	$9.2

Table 5: Representation and Federal Spending

	(1)	(2)	(3)	(4)
Dependent variable	Senate-House spending difference	Senate-House per-capita spending difference	Senate-House spending difference	Senate-House per-capita spending difference
unit of observation	state-year	state-year	state-year-appropriations bill	state-year-appropriations bill
Senate-House representation difference	1.0619**		1.2834**	
	(0.0758)		(0.0604)	
Senate-House per-capita representation difference		1.0440**		1.2704**
		(0.0960)		(0.0687)
Observations	450	450	3350	3350
R-squared	0.3044	0.2088	0.1189	0.0927

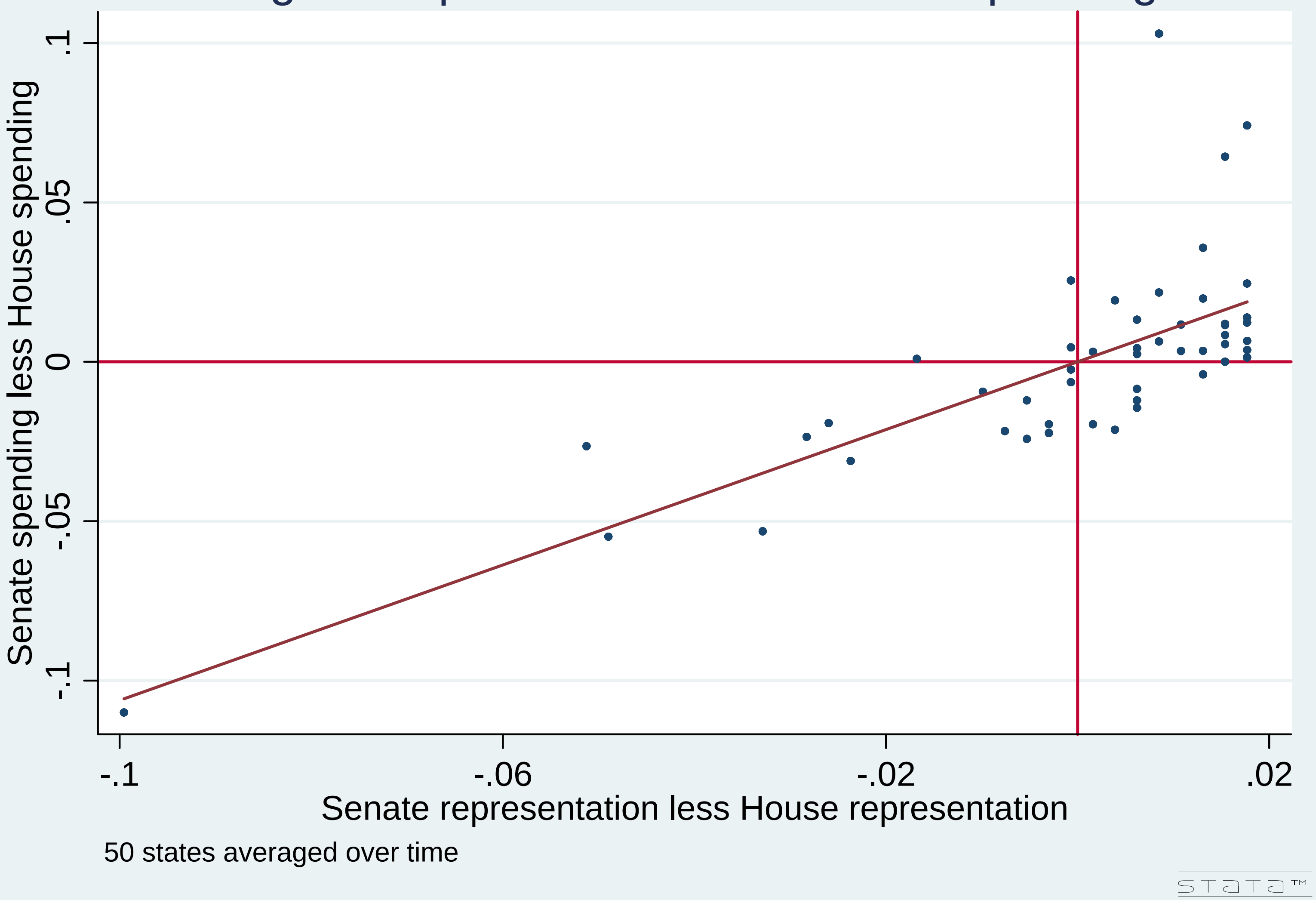
Notes: dependent variable is budget shares, std errors in parentheses, ** denotes 95% significance, * denotes 90%, constant not reported

Table 6: Underlying Channels Analysis

	(1)	(2)	(3)	(4)
Dependent variable	Senate-House committee representation difference	Senate-House spending difference	Senate-House coalition indicator difference	Senate-House coalition indicator difference
unit of observation	state-year-appropriations bill	state-year-appropriations bill	state-year-appropriations bill	state-year-appropriations bill
Senate-House representation difference	0.7967**		9.3179**	9.5891**
	(0.0397)		(0.8596)	(0.8627)
Senate-House committee representation difference		0.4385**		
		(0.0253)		
Senate-House fraction majority party difference				0.0873**
				(0.0293)
Observations	3350	3350	1997	1997
R-squared	0.1072	0.0822	0.0556	0.0598

Notes: dependent variable is budget shares, std errors in parentheses, ** denotes 95% significance, * denotes 90%, constant not reported

Fig. 1: Representation and Public Spending



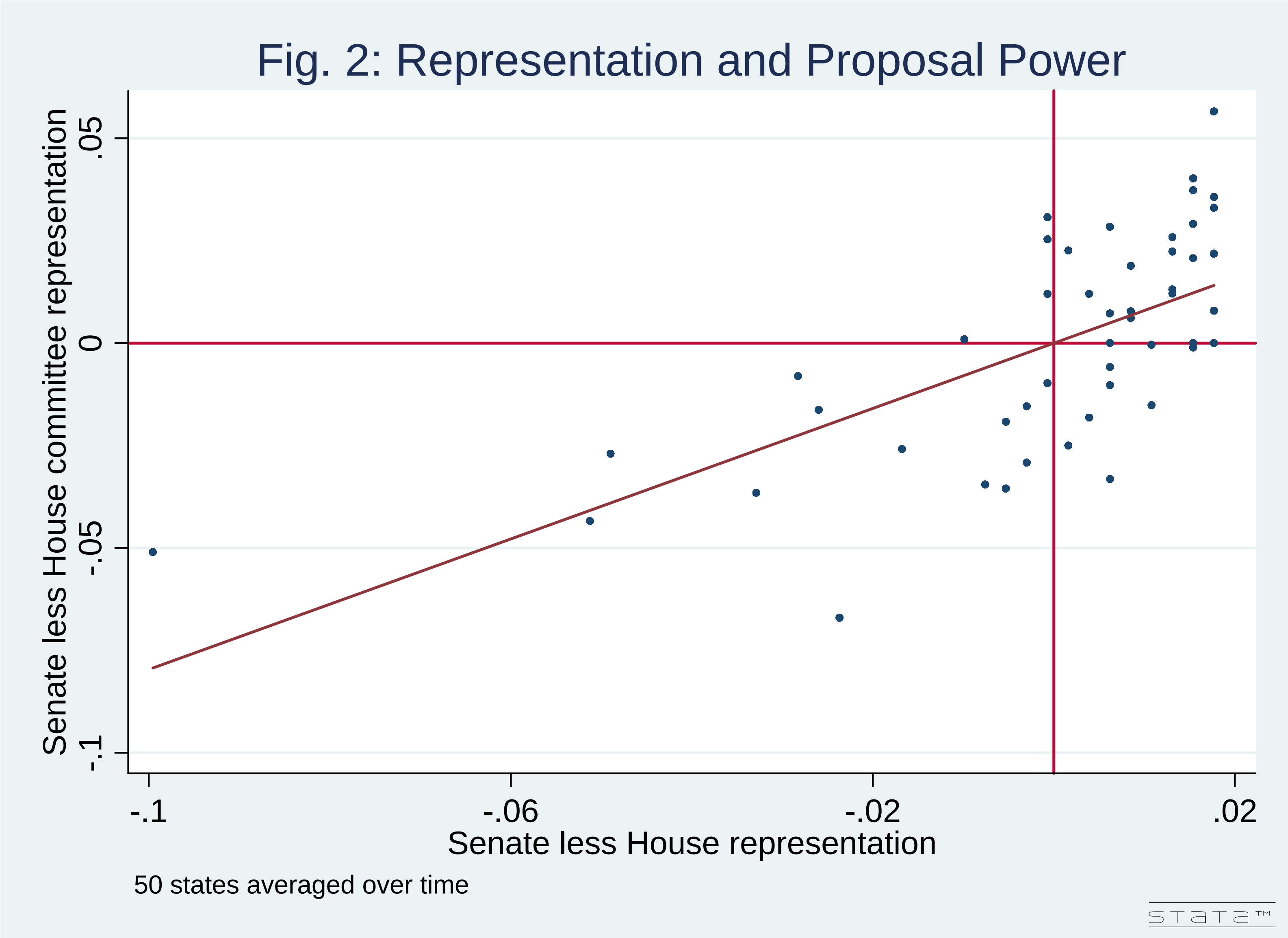


Fig. 2: Representation and Proposal Power
Senate less House committee representation
.05
0
-.05
-.1
-.1
-.06
-.02
.02
Senate less House representation
50 states averaged over time
stata™

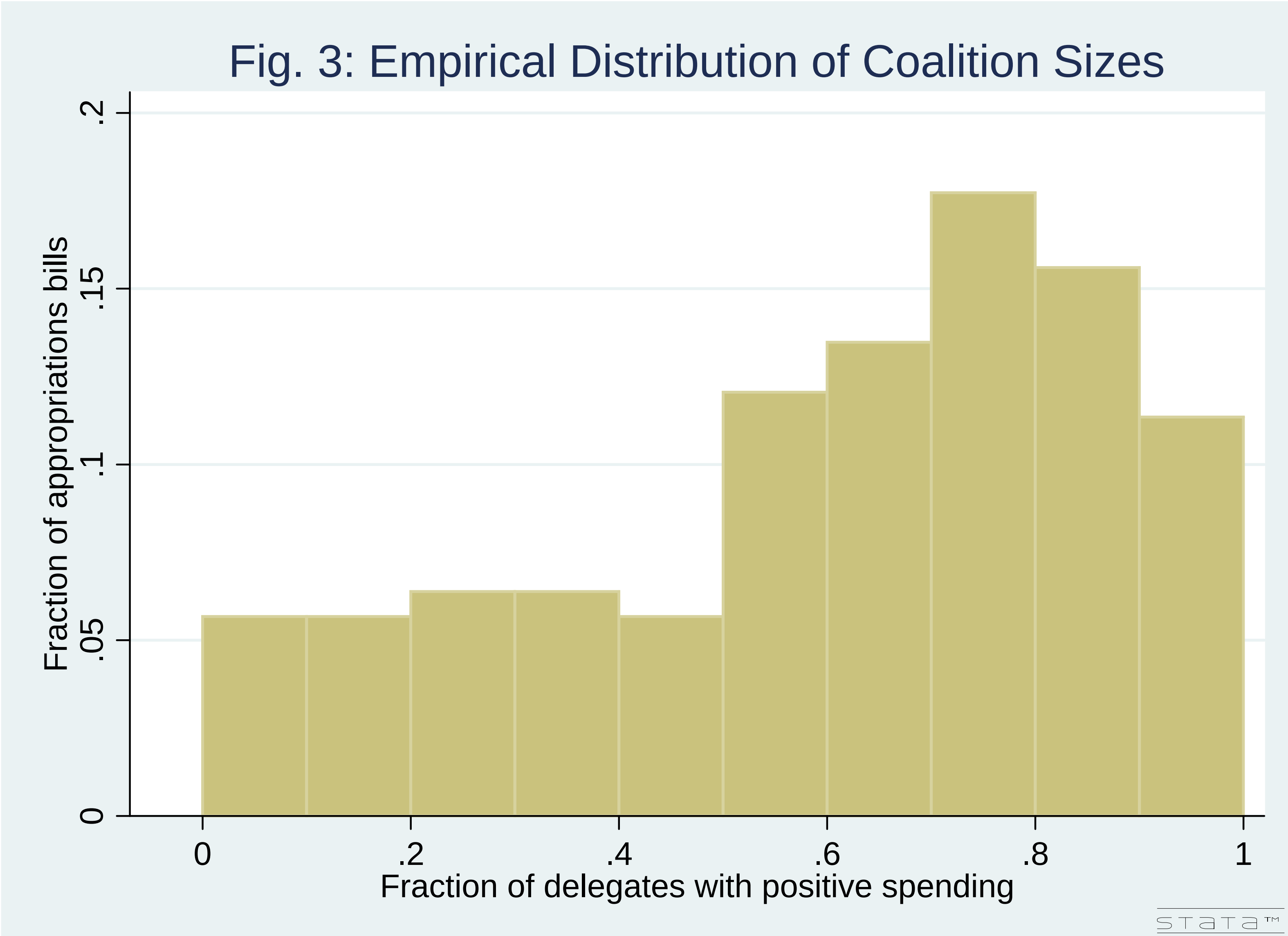


Fig. 3: Empirical Distribution of Coalition Sizes
Fraction of appropriations bills
0
.05
.1
.15
.2
0
.2
.4
.6
.8
1
Fraction of delegates with positive spending
stata™