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Supermajority rule and the law of 1/*n*

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Abstract This paper investigates the impact of a supermajority rule on the law of 1/*n*, which posits that a larger number of districts increases the size of government. Our analysis suggests that supermajority rule, despite the claim that it restrains excessive spending, increases the 1/*n* effect, because qualified majorities require logrolling to attract additional members. Using data from US states from 1970 to 2007, we find that the adoption of a supermajority rule has a robust, worsening effect on the fiscal commons problem identified by the law of 1/*n*.

Keywords Law of 1/*n* · Supermajority rule · Budget institutions · Public expenditures

JEL Classification D72 · H72

1 Introduction

According to the oral tradition, the law of 1/*n* comes from the notion of a large group going to dinner where the bill will be split equally. Each diner then orders more expensive food from the menu for him or herself than would be the case otherwise. Similarly, the law of 1/*n* states that public spending increases with the number of legislative districts (Weingast et al. 1981). This theory is based on the original intuition of Buchanan and Tullock (1962), who suggested that elected representatives logroll to bring pork barrel projects to their districts because the costs are distributed evenly across all districts.

Although the law of 1/*n* is generally accepted as a stylized fact, empirical evidence is mixed. Despite a number of studies in support of the 1/*n* effect (Gilligan and Matsusaka 2001; Bradbury and Crain 2001; Baqir 2002; Bradbury and Stephenson 2003; Schaltegger and Feld 2009; Egger and Koethenbuerger 2010), recent studies have found either

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insignificant or even negative effects of the number of legislators on the size of government (Primo 2006; Chen and Malhotra 2007; MacDonald 2008; Jordahl and Liang 2010; Petterson-Lidbom 2012).[1]

This paper builds on the fiscal commons literature by bringing the role of voting rules into the analysis of the law of $1/n$. A necessary condition for the $1/n$ effect is that legislators follow a norm of universalism, in which all projects are passed—a point largely neglected in the empirical research (Jordahl and Liang 2010; Raudla 2010). If majority votes must be obtained to pass legislation, however, logrolling will play a large role in determining the $1/n$ effect (MacDonald 2008).[2] For instance, in a study of the 26 Swiss cantons, Schaltegger and Feld (2009) found that fiscal referendums that require majority votes reduce the $1/n$ problem (by limiting logrolling activities).[3]

More inclusive voting rules for budget decisions have been proposed to reduce the fiscal commons problem by making the formation of a winning coalition more difficult (Buchanan and Tullock 1962; Crain and Miller 1990; Knight 2000; Bradbury and Johnson 2006). Supermajority rules, however, can perversely increase legislative bargaining, including side payments and package deals, if the dominant coalition must attract additional members to form a supermajority—new marginal members demand subsidies as a condition to join the coalition (Shaviro 1997; Gabel and Hager 2000; Lee et al. 2014). Thus, larger legislatures with a supermajority requirement may suffer more severely from fiscal common problems.

The central finding of this paper is that a supermajority rule in a legislature increases, not dampens, the $1/n$ effect, because qualified majorities require logrolling to attract additional members to the coalition. In the context of existing studies, the current paper relates two conceptually different ideas of fragmentation of fiscal policy, defined as "the degree to which individual fiscal policy-makers internalize the cost of one dollar of aggregate expenditure" (Perotti and Kontopoulos 2002), namely, size fragmentation (i.e., number of legislators) and procedural fragmentation (i.e., coalition success rules). More fragmented budgetary rules likely magnify the fiscal commons problem associated with size fragmentation (Raudla 2010). Thus, it is not the size of the legislature per se, but the size of a logrolling coalition that determines the growth of government (Inman and Fitts 1990).

Using a panel of US states over 38 years, we test the hypothesis suggested by the model of the law of $1/n$ under different coalition success rules. US state legislatures provide an ideal laboratory for testing the effects of budget institutions (that differ across polities and time periods) owing to homogenous populations, governments, economic development, as well as stable political institutions (Bradbury and Johnson 2006; Persson and Tabellini 2003). The empirical methodology used in this paper inspects the causal effect of legislative seats on the size of government under different coalition success rules. This means adding to the standard government size regressions interactions between legislature size and a dummy variable indicating the presence of a supermajority rule. To identify exogenous sources of variation in the interaction term, the supermajority rule dummy was instrumented by neighborhood effects and constitutional variables that cause states to

[1] For example, Primo (2006) and Chen and Malhotra (2007) found that upper chamber size has a positive impact on government size, while the effect of lower chamber size is either insignificant or negative.

[2] As legislature size increases, vote trading becomes more important to pass a spending project, leading to the approval of more projects.

[3] The proposal for a spending project exceeding the threshold must be approved by majority of voters in a referendum.

adopt some variant of a supermajority rule. In effect, this methodology allows for identification of exogenous variations in the size of logrolling coalitions, since the changes in legislature sizes in the US states typically are determined by the original state constitutions or other exogenous factors. The empirical results of this paper suggest that the adoption of a supermajority rule increases the tendency of legislature sizes to increase public spending.

This paper is organized as follows. Section 2 presents a model of the law of 1/*n* extended to incorporate different coalition success rules. Section 3 reports empirical evidence for the hypothesis suggested by the model. Section 4 concludes the paper and discusses its policy implications.

2 Law of 1/*n* and supermajority rule

The intuition behind the model in this section is simple: If supermajority rules increase the size of the coalition needed to approve narrowly focused expenditures, the number of district projects will have to increase in order to secure passage of the budget. Supermajority rules interact with the 1/*n* effect because increasing the size of the legislature *n* increases the number of legislators in the minimum winning coalition (see Riker 1962).

2.1 Basic model

Consider a publicly provided good z, which is provided at constant marginal cost, p. There are n districts each with a single legislator.[4] With an equal distribution of the tax burden across districts, each district pays 1/*n*th of the cost of providing z, or $p\ /\ n$. We assume that all district legislators have the same preferences for z:

$$z = z(p/n), \quad z' < 0. \tag{1}$$

Since z can be either private or public in nature (across districts), the total quantity of public goods, Z, can be written as

$$Z = n^{\gamma} \cdot z \quad (0 \leq \gamma \leq 1), \tag{2}$$

where γ parameterizes the congestion effects. Setting $\gamma = 0$ represents the case of pure public goods, and setting $\gamma = 1$ represents the case of private goods.

Using (1) and (2), the total expenditures, E, can be written as:

$$E = p \cdot n^{\gamma} \cdot z(p/n). \tag{3}$$

Differentiating (3) with respect to n,

$$\partial E/\partial n = \gamma \cdot p \cdot n^{\gamma-1} \cdot z(\cdot) - p^2 \cdot n^{\gamma-2} \cdot z'(\cdot) \quad (> 0). \tag{4}$$

Equation (4) formulates the 1/*n* effect—a large legislature n increases total government spending. In the first term on the right-hand side of (4), n affects E directly because a larger number of legislators acquire z. In the second term, a higher n increases the size of individual projects, $z(\cdot)$, by reducing the cost borne by individual legislators, p/n. This

[4] This paper does not address the aggregation of demand within a district because supermajority rules are associated with formulation of the coalition across districts.

standard formulation of the $1/n$ effect, however, relies on a failure of the Coase (1960) theorem whereby the legislators do not vote in their joint interest and the bill passes owing to universalism.

2.2 Role of supermajority

The above generalization of the law of $1/n$ can be modified to take into account the role of coalition success rules. In particular, this paper employs the simple fiscal commons model, in which a supermajority rule influences budget outcomes (Lee et al. 2014). Chen and Malhotra (2007) previously examined a variant of the $1/n$ effect in a bargaining game, in which bills must pass by a simple majority. Primo (2006) used a bargaining model to examine the effect of supermajority coalitions (induced by executive veto authority). Similarly, we incorporate a simple bargaining framework based on previous studies (Baron and Ferejohn 1989; Harrington 1990; Ansolabehere et al. 2003; Primo 2006). The general finding of these studies is that an agenda setter can exploit other coalition members by strategically manipulating the agenda formation process. For ease of interpretation, we focus on the case of private goods (i.e., $\gamma = 1$), and allow side payments among coalition members.[5]

Consider a voting rule, V, that requires m of n district legislators to agree. The value of V ($\equiv m/n$) is assumed to fall between 1/2 (simple majority rule) and 1 (unanimity). The legislature selects a set of district-specific projects $(z_1, z_2, \ldots, z_n)$ using the following procedure: (1) one member is selected at random to propose a project for each of n districts, (2) if m or more members vote for the proposal, then the proposal is implemented, and (3) if the proposal does not pass, another proposer is chosen at random to make a new proposal. The process continues until a proposal secures the minimum vote requirement.[6] For simplicity, we assume that legislators are risk neutral, the discount factor is 1, and the legislature operates under a closed rule.[7] We also exclude weakly dominated strategies, in which legislators vote against their true preferences.

The stationary subgame perfect equilibrium is as follows: The agenda setter proposes to distribute the continuation value for $m-1$ coalition members and to keep the rest of the budget for her district.[8] This proposal is accepted in the first period.

Since m legislators acquire projects, and all n legislators share the costs, total government expenditure E is given by:

$$E = p \cdot m \cdot z(pV). \tag{5}$$

Derivation See Appendix

Intuitively, the agenda setter determines E that is consistent with maximizing the sum of the utilities of m coalition members—because such expenditure maximizes the agenda

[5] More general cases ($0 < \gamma < 1$) give qualitatively similar results.

[6] This voting procedure is essentially a non-cooperative game which consists of infinite periods and two stages in each period. That is, an agenda setter makes a proposal in stage 1, and n legislators vote on the proposal in stage 2 (Harrington 1990; Baron and Ferejohn 1989).

[7] The closed rule prevents amendments once a proposal has been made.

[8] Stationarity means that each legislator takes the same action in structurally identical subgames (Baron and Ferejohn 1989; Primo 2006). A member's continuation value equals his expected payoff in any round. Note that a more inclusive voting rule (i.e., an increase in m) reduces the size of agenda setter's projects, thus limiting the tendency for the agenda setter to exploit other coalition members.

setter's utility.[9] In Eq. (5), $pV(\equiv p \cdot (m/n))$ reflects the effective price of z to the winning coalition. Districts in the winning coalition pay anywhere from one-half of the marginal cost to the full cost, depending on the voting rule.

Given the constant coalition success rule, V, differentiating Eq. (5) with respect to n yields:

$$E_n = p \cdot V \cdot z(pV), \tag{6}$$

where the subscript n denotes a derivative. Equation (6) states that, holding V constant, increasing the size of the legislature n increases the number of m coalition members that logroll z to their districts (since $V = m/n$). Thus, more districts lead to greater total expenditures.

Note that in the coalition model, the number of districts does not affect the district-level demands, z (pV) (since V is held constant). In the coalition environment, the law of $1/n$ holds because the number of projects is increasing in n, not because project sizes are increasing in n (because of a lowered price). As Primo and Snyder (2008) pointed out, this interpretation of the law of $1/n$ is not a mere technicality, because increasing legislature size leads to an increase in the number of rent-seeking legislators—even if the population represented by the coalition is unchanged.

Equation (6) shows that the size of the $1/n$ effect depends on the choice of voting rules. To determine the impact of a more inclusive voting rule, Eq. (6) can be differentiated with respect to V to obtain:

$$\partial E_n/\partial V = p \cdot z(pV) \cdot (1 + \epsilon), \tag{7}$$

where ϵ is the elasticity of demand for z with respect to the effective price to legislators, p V. Equation (7) states that more inclusive voting rules increase the $1/n$ effect if legislators' demand for z is price-inelastic $(-1 < \epsilon \leq 0)$. This result is similar to the fiscal outcome under a supermajority rule (Lee et al. 2014). Adopting a supermajority rule has two offsetting impacts on the law of $1/n$: a positive effect, because qualified majorities require logrolling to attract additional members, and a negative effect, because more inclusive rules raise effective prices for the existing coalitions. The first effect dominates the second if legislators have price-inelastic demands for government services, which is well established in the public finance literature (Reiter and Weichenrieder 1997; Borcherding 1985; Holsey and Borcherding 1997; Brasington 2002; Oates 1996, 2006). Previous studies have estimated that the price elasticity of demand for public services ranges between −0.3 and −0.5. Thus, when more districts are added, more projects are passed under a supermajority rule than under a simple majority rule.

Our results can be extended to more general cases of public goods $(\gamma < 1)$ as long as the goods are not purely public.[10] If the good is purely public across districts (i.e., $\gamma = 0$), there is no law of $1/n$, and thus the supermajority rule does not interact with that law.[11] For instance, suppose there is a 3/5 requirement to pass a bill for 100 districts. The coalition of sixty districts, representing 60 % of the population, pays 60 % of the price (cost) of the public good. Now with 1000 districts with the same underlying population, the coalition of 600 districts—representing 60 % of the population—pays 60 % of the good's price. The

[9] Note that $z(pV) = \underset{z}{\operatorname{argmax}}[u(z) - m \cdot (p/n) \cdot z]$, where $u(\cdot)$ is the value of z to coalition members. In the standard formulation of the law of $1/n$, $z(p/n) = \underset{z}{\operatorname{argmax}}[u(z) - (p/n) \cdot z]$.

[10] More generally, E can be written as $p \cdot m^{\gamma} \cdot z(pV)$, which implies that $E_n = \gamma \cdot p \cdot n^{\gamma - 1} \cdot V^{\gamma} \cdot z(pV)$.

[11] If $\gamma = 0$, E can be written as $p \cdot z(pV)$, from which $E_n = 0$ given V.

aggregate demand for the (non-divisible) public good from these districts is unchanged. However, typical state-funded projects, such as grants and subsidies, are private in nature (i.e., $\gamma \neq 0$), as they are provided either on a competitive basis or to benefit a narrow set of constituents (Chen and Malhotra 2007).

In addition, adding other institutional rules could potentially alter our main results. For instance, Primo (2006) found that supermajority rules (which are required for overriding an executive veto) can either increase or decrease government spending, depending on the presence of a spending limit.[12] Our focus is, however, on the interaction between the supermajority rule and the law of $1/n$—in which the size of legislature n varies rather than being constant.

3 Empirical model and results

To test the effects of the supermajority rule on the law of $1/n$, we estimate a multiplicative interaction model with a dummy endogenous variable:

$$T_{it} \text{ or } G_{it} = \beta_1 N_{it} + \beta_2 S_{it} + \beta_3 N_{it} S_{it} + \Phi X_{it} + \omega_i + \mu_t + u_{it} \tag{8}$$

$$S_{it}^* = \gamma_0 + \gamma_1 D_{it} + \gamma_2 N_{it} + \gamma_3 X_{it} + \theta_i + \pi_t + \zeta_{it} \tag{9}$$

$$S_{it} = \begin{cases} 1 & \text{if } S_{it}^* > 0 \\ 0 & \text{if } S_{it}^* \leq 0 \end{cases}$$

where T_{it} is total tax revenue in state i at time t, and G_{it} is government expenditures; N_{it} is the size of a state's legislature (N_L for the lower chamber and N_U for the upper chamber); S_{it} is a dummy variable for the supermajority rule; X is a vector of control variables; ω_i and θ_i are the set of state-specific effects; μ_t and π_t are the time effects; and u_{it} and ζ_{it} are the error terms.

In Eq. (8), $\beta_1 + \beta_3 S_{it}$ captures the marginal effect of the supermajority rule on the $1/n$ effect. If a supermajority rule is present, $\beta_1 + \beta_3$ constitutes the law of $1/n$. The theoretical model implies that $\beta_1 + \beta_3 > \beta_1$, from which $\beta_3 > 0$.[13]

Equation (9) indicates a latent index formulation, implying that the adoption of the supermajority rule is a political decision that reflects voters' demands. In general, S_{it} is potentially correlated with u_{it} because the choice of budgetary institution is often endogenous to political factors (de Figueiredo 2003). For instance, if a pro-spending state with a larger public budget is less likely to adopt a supermajority rule, the result is a downward bias in the estimate of β_3 (Knight 2000). To solve this problem of endogeneity, Eqs. (8, 9) require a structural assumption that D_{it}, an instrumental variable, is independent of the error terms u_{it} and ζ_{it}. This setup allows us to address both adoption of a supermajority rule and its causal effects on fiscal commons problems. Note that Eq. (8) contains two potentially endogenous variables: supermajority rule S_{it} and interaction terms $N_{it}S_{it}$. This requires instrumenting for the two variables by D_{it} and $N_{it}D_{it}$, respectively (Balli and Sørensen 2013).

To test the empirical model, we use data from US states for the 1970–2007 period. Among the 49 states with bicameral legislatures, the average legislature size in 2007 was

12 Primo (2006) finding is partially driven by the assumption that costs of projects are convex.

13 The issue of multicollinearity involving S_{it} and N_{it} is ignored because the correlations between the two variables are low (-0.08 for lower chambers and -0.18 for upper chambers).

39 seats for the upper chamber and 110 seats for the lower chamber.[14] Between 1970 and 2007, 21 states changed the size of the legislature in one of the chambers at least once.

The size of a state legislature is considered exogenous, since the number of seats is typically determined as part of a state's original constitution. Some cross-country studies (e.g., Petterson-Lidbom 2012) have raised the possibility of the endogeneity of legislature size. For example, a larger government may require a large number of legislators to deal with the greater complexity of budget matters. However, Baqir (2002) noted that greater government spending is more likely to require more government employees rather than larger legislatures, because government programs typically correspond to the executive function of a government. Regardless, endogeneity is less problematic in the current context because reasons for changes in legislature sizes include constitutional links between seats and counties, as well as seats and population (Gilligan and Matsusaka 1995). Some states have amended their constitutions to alter their legislatures' size, but those changes were often the result of exogenous events, including banking crises (Rhode Island 2002), political scandals involving pay raises (Illinois 1982), court decisions regarding equal population reapportionment (Connecticut 1972), and statewide legislative reforms (Massachusetts 1974). In general, the reasons for changing the size of a legislature apply to all legislative matters, including efficiency in representation, not limited to budget allocation. Table 1 presents the mean number of seats for each state and the supermajority requirements in various states.

Seventeen states have adopted various sorts of a supermajority rule to limit government expenditures and taxation. These states require a supermajority vote to pass the budget, to allow increases in tax and revenue projects, or to allow government expenditure growth to exceed income or inflation growth (Bradbury and Johnson 2006). These rules were adopted with sufficient time variance, but the requirements differ relatively little across states: nine states have a two-thirds rule, five states have a three-fifths rule, and three states have a three-fourths rule.

The index function (9) employs two instrumental variables: adoption of supermajority rules in neighboring states and the legislative vote required to initiate a constitutional amendment.[15] States with a neighboring supermajority state are more likely to adopt a supermajority rule (Lee et al. 2014). We use a neighborhood adoption dummy that is one if neighboring states have recently—that is, within 10 years—adopted a supermajority rule.[16] Figure 1 shows the years of adoption of supermajority rule in various states in which the arrows denote neighborhood effects. The figure indicates that states with a supermajority rule are more likely than the others to have neighboring states that recently adopted the rule. Some states require supermajority votes to initiate a constitutional amendment—including the adoption of a supermajority rule. This requirement potentially makes the adoption of a supermajority rule more difficult (Knight 2000). Another possibility is that states with supermajority requirements for constitutional amendment are more likely to adopt a supermajority rule, if the requirements reflect the voters' preference for a supermajority rule in general. For instance, out of 17 states with a supermajority rule, nine states require supermajority votes to initiate a constitutional amendment.

[14] Only Nebraska has a unicameral structure.

[15] Our choice of instrumental variables is drawn from Knight (2000) and Lee et al. (2014).

[16] Supermajority states typically adopted the rules in 10-year waves.

Table 1 Mean legislature size, 1970–2007

State	Mean legislature size, 1970–2007			Supermajority required
	Upper	Lower	Combined	
Alabama	35	105	140	–
Alaska	20	40	60	–
Arizona	30	60	90	2/3
Arkansas	35	100	135	3/4
California	40	80	120	2/3
Colorado	35	65	100	2/3
Connecticut	36	152	188	–
Delaware	21	41	62	3/5
Florida	40	120	160	3/5
Georgia	56	181	237	–
Hawaii	25	51	76	–
Idaho	36	73	109	–
Illinois	59	137	196	–
Indiana	50	100	150	–
Iowa	50	100	150	–
Kansas	40	125	165	–
Kentucky	38	100	138	3/5
Louisiana	39	105	144	2/3
Maine	34	151	185	–
Maryland	47	141	188	–
Massachusetts	40	177	217	–
Michigan	38	110	148	3/4
Minnesota	67	134	201	–
Mississippi	52	122	174	3/5
Missouri	34	163	197	2/3
Montana	50	100	150	–
Nebraska	49		49	–
Nevada	21	41	62	2/3
New Hampshire	24	400	424	–
New Jersey	40	80	120	–
New Mexico	42	70	112	–
New York	61	150	211	–
North Carolina	50	120	170	–
North Dakota	50	100	150	–
Ohio	33	99	132	-
Oklahoma	48	101	149	3/4
Oregon	30	60	90	3/5
Pennsylvania	50	203	253	–
Rhode Island	48	96	144	2/3
South Carolina	46	124	170	–
South Dakota	35	70	105	2/3
Tennessee	33	99	132	–

Table 1 continued

State	Mean legislature size, 1970–2007			Supermajority required
	Upper	Lower	Combined	
Texas	31	150	181	–
Utah	29	77	106	–
Vermont	30	150	180	–
Virginia	40	100	140	–
Washington	49	98	147	2/3
West Virginia	34	100	134	–
Wisconsin	33	99	132	–
Wyoming	30	62	92	–

Source National Conference of State Legislatures

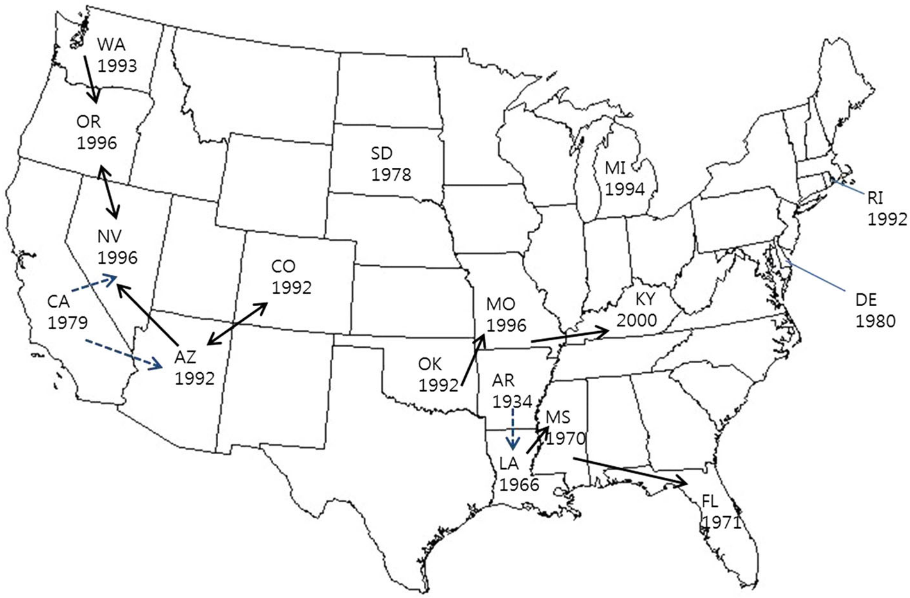

Fig. 1 States with supermajority rules and neighborhood effects Notes. *Solid arrows* represent direct neighborhood effects within 10 years (except MS-FL that are not directly neighboring states). *Dashed arrows* indicate that the effect is more than ten years old (CA-NV, CA-AZ, AR-LA). AK and HI are not shown in the map

These instrumental variables are expected to influence the budget only through the adoption of a supermajority rule. Neighboring states' characteristics have no direct relationship with government size. Constitutional amendment rules typically are adopted as part of states' original constitutions and apply to all amendments, not just the adoption of supermajority rules (Knight 2000).

Dependent variables include total tax revenue and general state expenditure. We also examine nine subcategories of spending, including education, highways, public welfare, public safety, health, natural resources, police, sanitation, and utilities.

Control variables reflect previous research on government growth. The standard variables include income per capita (*YPC*), population (*POP*), percentage of the population over age 65 (*ELDERLY*), percentage of the population under age 18 (*YOUTH*), and a dummy variable indicating whether the Republicans control a chamber (*REP*). These variables reflect activities on the demand side of government spending.[17] Data sources include the US Census Bureau State Government Finances (total revenue and government expenditures), US Bureau of Economic Analysis (income per capita), US Census Bureau (population, percentage of elderly and youth, and Republican control), and the *Book of the States* (Council of State Governments 1970–2008) (voter initiatives for constitutional amendment). Appendix Table 7 shows summary statistics for all the variables used in this study.

Table 2 shows the results of estimating state tax revenue, in which the dependent variables are per capita total tax revenue.[18] As a simple benchmark, column (1) takes a basic equation that includes legislature sizes and control variables. Columns (2) through (4) show the results of simply adding the supermajority rule dummy. The three columns include the number of seats in the lower house, the upper house, and both houses, respectively. Separating the lower and the upper houses in columns (2) and (3) was motivated by the fact that geographic overlap between lower house and upper house districts may dilute the relationship between legislative size and government size (Chen and Malhotra 2007). Columns (5) through (7) add interaction terms that allow the impact of legislature size to vary across states according to whether a supermajority rule is in place. The two-stage least squares (2SLS) models in (2) through (7) instrument the supermajority rule dummy using neighborhood effects and legislative votes required to initiate a constitutional amendment.

Columns (1) through (4) indicate that legislature size in the upper house, N_U, has a positive impact on total revenue, although the effect is not large. For instance, in columns (3) and (4), a one-seat increase in N_U increases tax revenue by \$40 (about 2 % of the average per capita revenue). The coefficients on N_L are statistically insignificant. Similarly, Gilligan and Matsusaka (1995, 2001) and Chen and Malhotra (2007) examined US states and found that the $1/n$ effect was positive and significant in the upper house, but not in the lower house. Chen and Malhotra attribute the finding to the geographic embedding of House districts within Senate districts, which potentially mitigates the $1/n$ effect in the lower house.

When the interaction terms in S, $N \times S$, are added in columns (5) through (7), legislature sizes have a robust, sizable impact on total revenue. One broad effect of introducing the interaction terms is that the coefficients on the simple legislature sizes become either negative or insignificant. On the other hand, the interaction effects are positive and mostly significant. Consistent with theoretical implications, the coefficients on the interaction terms are somewhat larger than those on simple legislature size (in columns (1) through (4)). This result confirms the hypothesis that a supermajority rule reinforces the $1/n$ effect, the magnitude of which is discussed below.

[17] Control variables are similar to those used by Bradbury and Johnson (2006) and Lee et al. (2014).

[18] Total revenue is treated the same as expenditure because most American states have balanced budget requirements and cannot expect a bailout from the federal government (McKinnon and Nechyba 1997). Note that many state governments finance capital spending (e.g., schools and highways) by issuing bonds, and that only the interest payments on those bonds appear in the public budget.

Table 2 Effects of supermajority rule on the law of 1/*n*: Revenue

Dependent variable: per capita total tax revenue							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
N_L	1.197	−0.258		−1.376	−2.727**		−2.773**
	(1.489)	(1.090)		(1.213)	(1.312)		(1.148)
N_U	−2.634		38.57**	39.68**		7.491	11.81
	(3.981)		(17.72)	(18.20)		(10.07)	(17.05)
S		1646***	1584***	1545***	−2269*	−1827	−1632
		(594.4)	(567.9)	(542.9)	(1360)	(1140)	(1201)
$N_L \times S$					38.00**		34.85***
					(15.32)		(11.84)
$N_U \times S$						66.60**	−7.501
						(31.38)	(33.66)
ln (YPC)	3244**	3855***	3843***	3818***	3999***	3533***	3995***
	(1379)	(701.7)	(694.0)	(694.7)	(719.6)	(691.6)	(735.5)
ln (Pop)	−162.0	−716.2***	−708.4***	−681.1***	583.2	102.6	409.4
	(198.4)	(251.1)	(245.9)	(233.6)	(444.2)	(228.0)	(310.2)
Elderly	1259	3880	3351	3350	14,005***	6740**	12,595***
	(6727)	(2766)	(2669)	(2643)	(4479)	(3040)	(4134)
Youth	1,607	−3670	−3815	−3731	161.6	−886.3	−337.2
	(2560)	(2428)	(2448)	(2389)	(2026)	(1751)	(1819)
Rep (lower)	−24.16	−17.95	−18.40	−15.91	−57.87	−29.11	−53.01
	(27.69)	(50.03)	(49.19)	(49.20)	(51.64)	(44.25)	(50.49)
Rep (upper)	−36.55	−44.90	−35.33	−36.52	−170.1***	−34.89	−157.8***
	(34.38)	(47.99)	(47.17)	(46.70)	(64.85)	(38.27)	(57.91)
No. obs.	1862	1862	1862	1862	1862	1862	1862
No. id	49	49	49	49	49	49	49
Pseudo R^2	0.459	0.071	0.106	0.124	0.080	0.344	0.106
1st stage F statistics		9.62	9.95	9.75	9.37	11.33	10.83
Sargan test, $p <$		0.625	0.810	0.821	0.641	0.529	0.767

S is a dummy variable that is 1 if a supermajority rule is present and 0 otherwise

All columns include fixed effects and time dummies

All dollar figures are in constant 2005 US dollars

Estimation methods: Fixed effects for (1) and fixed effects 2SLS for (2) through (7)

Cluster-robust standard errors are reported in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Instrumental variables are valid as they sufficiently explain the adoption of supermajority rule without overidentifying the effect. The first-stage F-statistics generally rule out the underidentification of the model, while the Sargan statistics indicate that the instruments are exogenous. The first-stage regressions reported in Appendix Table 8 show that the coefficients on neighboring effects and legislative votes required for constitutional amendments are statistically significant.

Table 3 Marginal effects of legislature size

Specifications from Tables 2 and 4	(5) Lower house	(6) Upper house	(7) Lower house	(7) Upper house
Panel A: dependent variable is per capita total tax revenue				
Supermajority absent	−2.727**	7.491	−2.773**	11.81
	(1.312)	(10.07)	(1.148)	(17.05)
Supermajority present	35.271**	74.09**	32.077***	4.312
	(14.411)	(31.226)	(11.316)	(33.246)
Panel B: dependent variable is per capita general expenditure				
Supermajority absent	−1.362	9.450	−2.013	20.39
	(1.442)	(8.692)	(1.306)	(15.64)
Supermajority present	20.856	65.067**	29.638***	−1.265
	(13.707)	(27.380)	(11.432)	(31.674)

Marginal effects for Panel *A* (Panel *B*) are based on estimates in columns (5) through (7) in Table 2 (Table 4)
** $p < 0.05$, *** $p < 0.01$

Throughout the columns, income per capita has a robust, positive impact on total revenue, consistent with common expectations. In line with Borcherding (1985), the effect of population is sensitive to specification and does not exhibit a consistent relationship with government size.[19] Percentage of elderly has a positive and significant relationship with revenue in columns (5), (6), and (7). In general, percentage of youth has insignificant association with revenue size. Republican control in the legislature has a negative association with government revenue, but this result is statistically insignificant in most cases.

When interaction terms are included in a regression, the marginal effects often become the most meaningful results. Panel *A* of Table 3 presents the marginal effect of legislature size on total revenue, conditional on the presence of a supermajority rule (i.e., $\beta_1 + \beta_3 S$ in Eq. (8)). Note that all of the marginal effects are positive and larger in magnitude when a supermajority rule is present. For instance, in the presence of a supermajority rule, expanding the legislature's size by one seat inflates per capita tax revenue by about \$35 in the lower chamber and \$74 in the upper chamber.[20] Thus, for an average state of five million people, the addition of one district would be associated with an increase of \$175 million and \$370 million in state revenue, which is substantial given a median state revenue of \$2.9 billion.[21] These results indicate that supermajority rules exacerbate the 1/*n* effect, possibly because additional votes are required for the formation of a winning coalition.

In addition, in columns (5) through (7) of Table 2, the point estimates on S and $N \times S$ can reveal the impact of adopting a supermajority rule. If N_L and N_U are centered around the mean (i.e., 112 and 40, respectively), the marginal effects of S on total revenue are about \$1971, which is above the mean total revenue.[22]

[19] Dropping the population variable did not affect the results.

[20] The marginal effects are based on the estimation results in (5) and (6).

[21] Data refer to the average values for the 1970–2007 period.

[22] Calculation is based on the results in column (7).

Table 4 Effects of supermajority rule on the law of 1/*n*: Expenditure

Dependent variable: Per capita general expenditure							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
N_L	1.475	0.643		−0.268	−1.362		−2.013
	(3.251)	(1.183)		(1.347)	(1.442)		(1.306)
N_U	4.094		32.99**	32.77**		9.450	20.39
	(13.21)		(15.92)	(16.66)		(8.692)	(15.64)
S		1145*	1072*	1047*	−472.4	−1679	−866.1
		(584.6)	(558.1)	(536.5)	(1,341)	(1,042)	(1100)
$N_L \times S$					22.22		31.65***
					(14.55)		(11.98
$N_U \times S$						55.62**	−21.65
						(27.79)	(32.59)
ln(YPC)	1364***	1789***	1765***	1753***	2123***	1543***	2,061***
	(422.2)	(631.2)	(624.3)	(621.0)	(619.5)	(560.8)	(618.5)
ln (Pop)	−491.2	−876.7***	−854.4***	−842.9***	−343.1	−211.4	−103.4
	(327.1)	(257.3)	(254.6)	(242.5)	(467.6)	(224.2)	(300.5)
Elderly	−121.7	1756	1318	1295	8757**	4274	9228**
	(7814)	(2805)	(2681)	(2678)	(4430)	(3060)	(4065)
Youth	−2084	−5696**	−5777**	−5702**	−5599**	−3662**	−4010**
	(3498)	(2286)	(2302)	(2253)	(2262)	(1769)	(1893)
Rep (lower)	14.87	18.83	20.01	20.46	−2.045	11.28	-9.481
	(33.47)	(44.18)	(43.02)	(43.48)	(52.30)	(40.67)	(48.58)
Rep (upper)	5.531	−1.443	5.808	5.551	−78.28	6.306	−104.8*
	(65.77)	(45.66)	(44.01)	(44.02)	(61.28)	(39.06)	(55.60)
No. obs.	1862	1862	1862	1862	1862	1862	1862
No. id	49	49	49	49	49	49	49
Pseudo R^2	0.814	0.733	0.744	0.747	0.663	0.790	0.697
1st stage F statistics		9.62	9.95	9.75	9.37	11.33	10.83
Sargan test, $p <$		0.825	0.536	0.484	0.490	0.706	0.096

S is a dummy variable that is 1 if a supermajority rule is present and 0 otherwise

All columns include fixed effects and time dummies

All dollar figures are in constant 2005 US dollars

Estimation methods: Fixed effects for (1) and fixed effects 2SLS for (2) through (7)

Cluster-robust standard errors are reported in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4 presents the regression estimates for general government expenditure measured in per capita terms. The results are qualitatively similar to the results for total revenue shown in Table 2. In columns (1) through (4), the models without interaction effects indicate that the coefficients on legislature size in the upper house are positive and statistically significant in columns (3) and (4). The effect is not large, however, in that the impact of adding one upper-house seat on general expenditure is less than \$33. The coefficients on legislature size in the lower house are statistically insignificant. On the other hand, the models including interaction effects in columns (5) through (7) indicate that the interaction terms have robust, sizable impacts on government expenditure. The marginal effects of legislature size on expenditure are more pronounced in the presence of a supermajority rule. This is confirmed by the estimates in Panel *B* of Table 3. Note that when a state is not bound by a supermajority rule, the marginal effects of legislature size are statistically insignificant. This indicates that the $1/n$ effect is conditional on whether a supermajority rule has been adopted. That is, the law of $1/n$ hypothesis is weakened by the fact that it can only be observed when there is a supermajority rule.

Table 5 shows the regression estimates for nine categories of state government expenditures. Most coefficients on the interaction term in the lower chamber, $N_L \times S$, are positive, and the relationship is statistically significant for six types of expenditure, including highway, public safety, health, natural resources, sanitation, and utilities. These goods have a notable degree of publicness, implying price-inelastic demands. In general, the presence of a supermajority rule indicates a positive marginal effect of legislature size on various types of expenditures. For the upper chamber, the estimates on interaction terms, $N_U \times S$, generally are insignificant, except for education, welfare, and sanitation.

Table 5 also reports the marginal effects of legislature size on nine categories of expenditures. In the presence of a supermajority rule, the marginal effects are positive and significant for education and health (both houses); public safety, natural resources, and utilities (lower house); and police (upper house). Note that we also observe negative marginal effects for welfare spending (both houses), as well as for natural resources and sanitation (upper house). The results with respect to welfare spending are consistent with Bradbury and Johnson (2006), who found that supermajority rules are associated with smaller public welfare transfers. The potential explanations for this finding include: (1) public welfare transfers are entitlement programs by nature, and thus exhibit lesser publicness, and (2) the data are limited, because welfare programs are subsidized heavily by federal grants—not determined at the state level (Lee et al. 2014). Section 3.1 provides a detailed discussion of the negative marginal effects in the upper house.

Table 6 shows the marginal effects of legislature size estimated from alternative specifications of the empirical model.[23] Panel *A* takes into account line-item veto powers by governors. Giving the chief executive veto power is an effective means of breaking the relationship between the number of players and government size. McCarty (2000) and Primo (2006) argued that executive veto power can affect the size and composition of winning coalitions by altering bargaining within a legislature and between legislators and chief executives. According to de Figueiredo (2003), the line-item veto is a type of insulation mechanism that conservative legislators with a tenuous hold on the legislature adopt in order to protect their future interests. This argument is valid if the item veto reduces total spending, but not if it affects only the mix of government expenditures. Since line-item veto variable is time-invariant, Panel *A* includes only the states that give line-item veto powers to governors.

For a similar reason, Panel *B* includes states that impose strict limits on budget deficits. A no-carryover rule, the strictest type of traditional tax and spending limit, prohibits a state from carrying over a budget deficit to the next fiscal year or next biennium. To satisfy the rule, the state must reduce spending, collect more revenue, or seek federal grants (Primo 2006). Similar to the executive veto, a no-carryover rule can diminish the impact of legislative size on government size, thus rendering the role of a supermajority rule ambiguous.

[23] Regression outputs used to calculate the marginal effects are available upon request to the author.

Table 5 Effects of supermajority rule on the law of $1/n$: Subcategories of expenditure

Dependent variable: Per capita expenditures

	(1) Education	(2) Highway	(3) Welfare	(4) Safety	(5) Health	(6) Natural res.	(7) Police	(8) Sanitation	(9) Utility
N_L	3.347***	−1.273***	2.103***	−0.289***	−1.009***	0.0413	−0.111***	−0.468***	0.191*
	(0.508)	(0.300)	(0.482)	(0.0740)	(0.141)	(0.0689)	(0.0305)	(0.0997)	(0.102)
N_U	−2.742	5.342**	3.532	−0.477	4.091*	−1.325	0.460**	1.587**	0.488
	(3.798)	(2.691)	(5.260)	(0.799)	(2.126)	(0.837)	(0.197)	(0.783)	(1.279)
S	−971.5**	−87.70	2085***	−92.29	−419.5***	−46.80	3.090	153.4***	−130.6
	(396.8)	(222.1)	(467.8)	(63.45)	(157.2)	(84.32)	(18.25)	(54.24)	(154.0)
$N_L \times S$	2.984	4.639**	−7.011**	1.367**	3.806***	1.400**	−0.0337	1.590**	2.446***
	(2.705)	(2.356)	(3.066)	(0.610)	(1.199)	(0.637)	(0.198)	(0.737)	(0.944)
$N_U \times S$	17.47**	−0.126	−36.79***	−0.110	4.329	−1.601	0.372	−5.551***	−2.493
	(8.377)	(6.681)	(9.343)	(1.585)	(3.473)	(1.686)	(0.461)	(1.807)	(2.692)
No. obs.	1862	1862	1862	1862	1862	1862	1862	1862	1862
No. id	49	49	49	49	49	49	49	49	49
Pseudo R^2	0.727		0.749	0.764	0.397		0.381		0.002
1st stage F statistics	10.83	10.83	10.83	10.83	10.83	10.83	10.83	10.83	10.83
Sargan test, $p <$	0.549	0.188	0.597	0.01	0.01	0.021	0.521	0.119	0.543
Marginal effects ($S = 1$)									
Lower house	6.331**	3.366	−4.909*	1.078*	2.798**	1.442**	−0.145	1.122	2.637***
	(2.536)	(2.226)	(2.879)	(0.578)	(1.145)	(0.591)	(0.185)	(0.689)	(0.906)

Table 5 continued

Dependent variable: Per capita expenditures

	(1) Education	(2) Highway	(3) Welfare	(4) Safety	(5) Health	(6) Natural res.	(7) Police	(8) Sanitation	(9) Utility
Upper house	14.727*	5.216	−33.254***	−0.587	8.421***	−2.926*	0.832*	−3.965**	−2.001
	(8.771)	(6.712)	(9.151)	(1.504)	(3.173)	(1.589)	(0.440)	(1.622)	(3.010)

Only the coefficients on the legislature size and the supermajority rule are reported from the full equation

S is a dummy variable that is 1 if a supermajority rule is present and 0 otherwise

All columns include fixed effects and time dummies

All dollar figures are in constant 2005 US dollars

Estimation methods: Fixed effects 2SLS

Cluster-robust standard errors are reported in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$,

Table 6 Marginal effects of legislature size from alternative specifications Dependent variable: Per capita total revenue for columns (1) and (2); Per capita general expenditure for columns (3) and (4)

	(1) Lower house	(2) Upper house	(3) Lower house	(4) Upper house
Panel A: states with line-item veto				
Supermajority absent	−1.466	11.162	−1.593	39.091*
	(1.152)	(24.422)	(1.333)	(21.522)
Supermajority present	38.062**	19.448	31.810**	2.983
	(15.854)	(76.364)	(15.670)	(69.083)
Panel B: states with no-carryover rule				
Supermajority absent	−1.009	2.244	5.247	4.618
	(17.389)	(48.475)	(17.795)	(49.674)
Supermajority present	16.123	229.37*	24.885	271.24**
	(32.321)	(122.140)	(33.135)	(126.73)
Panel C: pooled 2SLS				
Supermajority absent	−4.418***	−5.828	−5.789***	0.922
	(0.501)	(3.885)	(0.792)	(6.806)
Supermajority present	14.043***	9.628	28.344***	−73.838*
	(4.970)	(20.055)	(9.181)	(39.053)
Panel D: alaska excluded				
Supermajority absent	−1.640**	8.586	−1.295	19.265*
	(0.702)	(8.339)	(1.148)	(10.840)
Supermajority present	14.301**	−21.772	16.123**	18.106
	(5.776)	(15.631)	(7.286)	(22.513)
Panel E: supermajority rule thresholds				
Supermajority absent	−2.740***	10.380	−1.994	19.24
	(1.153)	(15.780)	(1.312)	(14.530)
Supermajority present	49.636***	−5.320	45.661***	−17.063
	(17.257)	(48.166)	(17.528)	(46.620)

Marginal effects are based on the full specification (7) in Tables 2 and 4

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel *C* estimates the model with pooled 2SLS, using variation in legislature sizes across states and years. Pooled 2SLS results may be overstated because they ignore the state fixed effects. However, fixed effects will not eliminate the endogeneity problem owing to within-state temporal changes in attitudes towards tax and expenditure (Knight 2000). Panel *D* excludes Alaska because the state's revenue per capita is considered an outlier. Finally, in Panel *E*, we let S take the values of the supermajority requirements rather than just 0 and 1.

Throughout the panels, the marginal effects of legislature size on government size are mostly positive and larger in the presence of a supermajority rule. Note in Panel *E* that the marginal effects of legislative size in the lower house ($50 and $46 when a supermajority rule is present) are larger in magnitude than the estimates based on a dummy variable S (i.e., $32 and $30 in Table 3). This implies that the $1/n$ effect is more pronounced in states with higher supermajority rule thresholds.

3.1 Discussion

A possible limitation to this study is that our empirical analysis focuses on bicameral state legislatures while the theoretical model is unicameral in nature. Supermajority rules potentially could have countervailing effects in the two chambers because of geographic linkages across the chambers. For instance, an upper-house legislator is more likely to support pork barrel projects if her lower-house colleagues (representing areas located within the upper-house legislator's district) are part of a coalition (Ansolabehere et al. 2003; Chen 2010).

Our empirical results suggest that bicameral interactions potentially offset the extension effect of supermajority rules—that require logrolling across additional members—in the upper house. In Table 5, for instance, the marginal effects of legislature size (when $S = 1$) are negative or insignificant for several expenditure items in the upper house (e.g., natural resources and sanitation), while the marginal effects are generally positive in the lower house.

The intuitive explanation for these mixed results is as follows.[24] Under a α-majority rule ($\alpha \in [0.5, 1]$), it is possible to form a minimal winning coalition entirely within the lower house, without having to back projects to obtain votes in the upper house. This is because an upper-house legislator will support a bill if more than half of the lower-house districts located within her district support it.[25] For instance, with the unanimity rule, the winning coalition includes all lower-house districts, thereby guaranteeing a unanimous coalition in the upper house. Thus the effects of supermajority rules in the upper house are uncertain—possibly diluted by supermajority rules in the lower house.

On the other hand, the existence of minimal winning coalitions in the upper house does not guarantee a minimal winning coalition in the lower house. For instance, in the case of the unanimity rule, a coalition of all upper-house districts does not guarantee that all lower-house districts support the bill.

For illustration, suppose that a state is divided into N equally populated upper-house (Senate) districts, and that each upper-house district is divided into K equally populated lower-house (House) districts (where $N, K \geq 3$). Thus the legislature consists of N senators and $N \cdot K$ representatives. Under a two-thirds rule, it is possible to form a minimal winning coalition entirely within the House comprising $2/3 \cdot N \cdot K$ representatives. This guarantees a minimal winning coalition in the Senate because winning the Senate requires $1/3 \cdot N \cdot K$ representatives—that is, $2/3 \cdot N$ (Senate districts) times $1/2 \cdot K$ (representatives supporting the bill in each Senate district). However, it is not generally possible to form a minimal winning coalition entirely within the Senate. For instance, if a coalition has just enough representatives to win in the Senate (i.e., $1/3 \cdot N \cdot K$ representatives), then it is forced to buy $1/3 \cdot N \cdot K$ additional representatives to win in the House.

A fruitful direction for future research would be to model explicitly the impact of supermajority rules in bicameral legislatures. Note that the early literature on legislatures (e.g., McCormick and Tollison 1980) suggested that outcomes in bicameral legislatures depend on the ratio of seats in one chamber relative to seats in the other chamber—because

[24] This intuition is based on Ansolabehere et al. (2003).

[25] Legislators in the upper house are assumed to choose the outcome most preferred by the median voter of their constituency. We also assume that lower-house districts with equal population are completely nested within the upper-house districts. Note that in some states, boundaries of districts in the upper house and lower house cross each other.

unequal sizes of the two chambers increase the cost of obtaining required majorities in both chambers.[26]

4 Concluding remarks

The conclusion of this paper is in line with (Raudla 2010, p. 209), who argued that "Only *counting* the participants involved on the commons would usually be insufficient...one has to analyse how these rules are combined with other relevant institutional rules governing the action arena."

Empirical evidence indicates that coalition success rules critically influence the fiscal commons problem associated with the law of $1/n$. While legislature size tends to positively influence the size of government, the effect is not unconditional. Indeed, the $1/n$ effect is significantly strengthened when the coalition success rule becomes more inclusive. These results violate existing beliefs by indicating that more inclusive voting rules may worsen the fiscal commons problem.

The finding of this study has a crucial policy implication. Supermajority rules have generally been viewed as limiting government expenditures by constraining majority tyranny. Accordingly, recent state budget crises have prompted some states to propose budgetary reforms, including the adoption of a supermajority rule. However, supermajority rules can expand the budget by causing larger logrolling coalitions that dominate the potential benefits of protecting against tyranny of the majority. This budget-expansion effect likely will prevail if legislative politics is dominated by rent-seeking coalitions. Given that locally oriented representatives focus on pork barrel spending for the benefit of narrow interests, adoption of a supermajority rule tends towards a larger government.

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Appendix

In equilibrium, the agenda setter offers $m-1$ coalition members their continuation values—i.e., E/n per member—and keeps the remaining value for herself—i.e., $E \cdot (n-m+1)/n$.[27] In every period, the $m-1$ members who receive an offer of E/n vote for the proposal, and all other members vote against it. The agenda setter votes for the proposal because $E \cdot (n-m+1)/n \geq E/n$.

The bargaining outcome indicates that the agenda setter selects m district projects of total value E that will maximize her payoff. Note that the agenda setter keeps the bargaining surplus through side payments, effectively sharing in the projects of other coalition

[26] Unequal chamber sizes in the presence of supermajority rules would add to the interest group's problem of allocating campaign contributions and lobbying effort across the two chambers optimally.

[27] A member's continuation value C equals his expected payoff in any round: $(m-1)/n \times C + 1/n \times (E-(m-1)C) + (n-m)/n \times 0$. Thus, $C = E/n$, and the agenda setter keeps $E-(m-1) \cdot E/n$.

Table 7 Summary statistics

	Mean	Standard deviation	Minimum	Maximum
Total revenue	1779	717	616	11907
General expenditure	3324	1489	1308	15712
Edcation	1205	432	366	3901
Highway	363	191	120	2086
Welfare	662	373	94	2300
Public safety	121	72	22	635
Health	110	74	9	650
Natural resource	82	79	13	924
Police	33	21	1	209
Sanitation	13	24	0	361
Utility	25	75	0	1018
Legislature size (upper)	40	11	19	67
Legislature size (lower)	112	56	39	400
Supermajority rule	0.197	0.398	0	1
Income per capita	27081	6080	13217	52,396
Population	4983,337	5423,852	302,583	3.62E+07
Percentage over 65	0.116	0.023	0.022	0.182
Percentage under 18	0.28	0.036	0.204	0.4
Republicans control (lower house)	0.342	0.474	0	1
Republicans control (upper house)	0.372	0.483	0	1
Neighboring effects	0.315	0.465	0	1
Legislative vote for constitutional amendment	0.61	0.092	0.5	0.8

members.[28] The agenda setter thus selects district projects as if to maximize the sum of the utilities of all coalition members. Intuitively, the agenda setter maximizes the size of the pie to be divided among the coalition members. This means selecting a set of projects $(z_1, z_2, \ldots, z_m)$ to maximize:

$$U = \sum_{i=1}^{m} \left[u(z_i) - z_i \cdot p \cdot (m/n) \right],$$

where $u(z_i)$ is the value of z_i to the ith coalition member.[29] The first-order conditions are $u'(z_i) = p \cdot (m/n), \forall i \in (1, \ldots, m)$. Noting that $p \cdot (m/n) \equiv pV$, the first-order conditions imply that $z_i^* = z(pV)$ for all i. Since each of m legislators gets $z(pV)$, the total government expenditures E can be written as $p \cdot m \cdot z(pV)$.[30]

[28] One way to think about this is that the agenda setter receives side payments from other coalition members—i.e., the difference between project values and continuation values.

[29] Note that the net benefits for a legislator in district i are $u(z_i) - (z_1 + z_2 + \ldots + z_m) \cdot p/n$. Summing this across all m coalition members gives U. By standard assumption, u is concave and increasing in z_i.

[30] Thus the agenda setter effectively allocates projects of size $pV \cdot z(pV)$ to exactly $m - 1$ other coalition members, and allocates a project of size $pV \cdot z(pV) \cdot (n - m + 1)$ to herself.

Table 8 2SLS 1st stage regressions

Dependent variable	(1) S	(2) S	(3) S	(4) S	(5) $N_L \times S$	(6) S	(7) $N_U \times S$	(8) S	(9) $N_L \times S$	(10) $N_U \times S$
Neighbor	0.038***	0.038***	0.041***	−0.027	−7.995**	−0.120***	−6.380***	−0.131***	−14.980***	−6.355***
	(0.011)	(0.011)	(0.011)	(0.036)	(3.337)	(0.042)	(1.549)	(0.044)	(3.307)	(1.527)
Amendment	1.061**	1.134**	0.461	−5.301***	−310.301***	−12.576***	−349.689***	−16.240***	−836.97***	−496.00***
	(0.454)	(0.445)	(0.421)	(1.397)	(91.647)	(2.514)	(104.021)	(2.592)	(228.271)	(103.023)
$N_L \times$ Neighbor				0.0006**	0.110***			0.0001	0.076*	-0.009
				(0.0003)	(0.031)			(0.000)	(0.045)	(0.013)
$N_L \times$ Amendment				0.033***	2.209***			0.024***	1.841***	0.876***
				(0.008)	(0.515)			(0.006)	(0.487)	(0.230)
$N_U \times$ Neighbor						0.004***	0.201***	0.004***	0.271**	0.229***
						(0.001)	(0.039)	(0.001)	(0.132)	(0.050)
$N_U \times$ Amendment						0.240***	7.176***	0.209***	9.764**	6.207***
						(0.043)	(1.757)	(0.045)	(4.139)	(1.829)
N_L	0.001*		0.002***	−0.017***	−1.047***			−0.011***	−0.771***	−0.391***
	(0.0005)		(0.000)	(0.004)	(0.293)			(0.003)	(0.259)	(0.121)
N_U		−0.025***	−0.028***			−0.162***	−4.915***	−0.147***	−7.588***	−4.503***
		(0.007)	(0.007)			(0.025)	(1.033)	(0.025)	(2.257)	(1.054)
YPC	−0.322***	−0.334***	−0.317***	−0.369***	−43.803***	−0.367***	−14.511***	−0.365***	−43.739***	−13.859***
	(0.108)	(0.109)	(0.108)	(0.112)	(9.732)	(0.109)	(3.966)	(0.111)	(9.681)	(4.028)
POP	0.324***	0.341***	0.323***	0.356***	4.250	0.396***	7.733***	0.382***	5.723	6.737***
	(0.060)	(0.059)	(0.060)	(0.061)	(5.072)	(0.060)	(2.066)	(0.061)	(5.030)	(2.089)
ELDERLY	−1.419	−1.092	−1.139	−1.682	−459.170***	−1.371	−121.137***	−1.468	−442.87***	−121.48***
	(1.039)	(1.044)	(1.043)	(1.067)	(98.929)	(1.053)	(37.962)	(1.074)	(100.149)	(38.550)

Table 8 continued

Dependent variable	(1) S	(2) S	(3) S	(4) S	(5) $N_L \times S$	(6) S	(7) $N_U \times S$	(8) S	(9) $N_L \times S$	(10) $N_U \times S$
YOUTH	3.217***	3.427***	3.489***	3.125***	212.105***	3.14***	119.081***	3.216***	221.23***	123.50***
	(0.643)	(0.657)	(0.657)	(0.650)	(56.551)	(0.665)	(26.532)	(0.664)	(57.983)	(26.429)
REP (lower)	−0.002	0.000	−0.003	−0.002	1.053	0.003	0.344	−0.0007	1.1429	0.153
	(0.018)	(0.018)	(0.018)	(0.019)	(1.721)	(0.019)	(0.681)	(0.019)	(1.722)	(0.682)
REP (upper)	0.002	−0.005	−0.004	0.003	3.452*	0.000	−0.125	0.0012	3.213*	−0.036
	(0.020)	(0.020)	(0.020)	(0.020)	(1.832)	(0.020)	(0.729)	(0.020)	(1.861)	(0.727)
No. obs.	1862	1862	1862	1862	1862	1862	1862	1862	1862	1862
R^2	0.260	0.269	0.270	0.265	0.230	0.278	0.254	0.283	0.239	0.26

Columns (1) through (3) refer to the 1st stage regressions in models (2) through (4) in Table 2, respectively

Columns (4) and (5) refer to model (5); columns (6) and (7) refer to model (6); and columns (8) through (10) refer to model (7) in Table 2

Cluster-robust standard errors are reported in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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