The Effect of Legislature Size on Public Spending

A Meta-Analysis*

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Abstract

In a seminal article, Weingast et al. (1981) argue that there is a positive relationship between legislature size and inefficiency in public expenditures. Their proposition is currently known as the "law of $1/n$" and has been widely debated in political science and public administration. However, recent studies have questioned the validity of the theory. In this letter, we estimate the first meta-analysis of the relationship between the number of legislators and public spending. Based on a sample of 29 articles, we find no robust evidence for the effect of legislature size on government budgets. Yet the aggregate results show significant heterogeneity. While earlier studies provide moderate support for the "law of $1/n$", papers using causal inference methods consistently find a negative relationship between seats and spending. The available evidence also indicates that proportional representation and mixed voting systems are no more likely to overspend than majoritarian ones.

Keywords: distributive politics; law of $1/n$; legislature size; meta-analysis; public spending

JEL Classification Codes: H21; H23; H50; H61

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1 Introduction

Agrupamentos possíveis (agrupar só os que batem no nosso resultado): - métodos (esse bate) - institutional design - electoral system

Introduction: 1 - como está originalmente. 2 - in this letter we run a meta analysis papapá, explicando o que fazemos no texto e o que encontramos. 3 - resultados são all over the place: e a literatura ja sabia que eram all over the place (vira revisãozinha de literatura). 4 - agora a gente diz o que nossos resultados representam pros estudos: no caso, podemos concluir que os autores x, y, z foram pela linha correta.

Results: Colocar resultados da meta-regressão completa na última tabela.

Discussion: 1 - ok 2 - ok, só corrigir 3 - como nossos resultados "resolvem" as questões da teoria a linha que avalia o desenho institucional está certa dessa forma. sobre a galera que escreve sobre as dinâmicas internas de competição e coalisão, nós podemos inferir que essas dinâmicas influenciam muito mais do que legislature size. Juntar a lit review com nosso ultimo paragrafo falando sobre as recomendações de para onde deve avançar a literatura. "Apesar de ela ser extensa, vemos que ainda poderiam ser explorados A B C". 4 - ultimo paragrafo vira o que é o terceiro. uma das sugestões é aumentar o numero de replicações, etc, de como a disciplina como um todo deve avançar, sobre como construimos conhecimento na disciplina.

Over the past decades, a large literature has examined the relationship between legislature size and public expenditure. Weingast et al. (1981) provided the general framework to analyse distributive politics. The authors argue that the larger the number of legislative districts (n), the smaller the share of tax burden each one will bear ($1/n$), thus legislators have an incentive to overspend in their districts and transfer the costs to the entire polity. Most early studies that empirically tested the "law of $1/n$", as the theory is currently known, indeed found a positive correlation between the number of legislature seats and different measures of government spending, although the effect was often limited to one house (e.g., Baqir 2002; Gilligan and Matsusaka 1995, 2001). More recently, the discussion of the "law of $1/n$" has surpassed its original formulation. Specifically, the theory meant to explain distributive behavior of US district legislators under majoritarian electoral rules. It has since then been applied to a number of contexts whose political features do not fit into what Weingast et al. (1981) had theorized.

Colocar aqui no final desse paragrafo "in this paper we…"

The mechanism behind $1/n$ is incumbents' choice of redistributive strategy to optimize chances of reelection. The *norm of universalism*, by which all legislators pass each other's bills, guarantees that all representatives are allotted an amount of resources to cater projects to their voters. Crowley (2019) contests this scenario where coordination costs are minimal, aiming at solving the discrepancies in previous works. The literature finds that a number of players and features can override the $1/n$ effect by posing checks to legislative activity and altering coordination costs. First, shifts in the level of intra or intergovernmental competition based on district homogeneity, supermajority rules, the size of coalitions, and even gerrymandering have been shown to interfere with the effect of chamber size on spending (???????). Second, we must take into account players who function as institutional checks, such as strong executives who take on legislative duties, other deliberative chambers, or spending limits, who also directly influence legislators' access to common pool funds (Bradbury and Crain 2001; ?; Primo 2006). Moreover, Primo and Snyder (2008) affirm that, due to spatial spillovers, a collection of small districts can supply public goods more efficiently than the central government. The authors conclude that a "reverse law of $1/n$" may hold, wherein a higher number of legislators in small constituencies decrease the overall public spending.

Our survey of the scholarship confirms this continuum of positive, insignificant, and negative results. Out of the 45 coefficients included in our article sample, 40% of them are positive and statistically significant, 22.2% are positive and statistically insignificant, 17.8% are negative and statistically insignificant, and 20% are negative and statistically significant. A comprehensive survey and systematic review of the existing evidence may help us reach a meaningful conclusion about the effect of legislature size on public spending.

Grudar aqui no final o início do pargrafo seguinte, retirando toda a descrição de ~como conduzimos a meta~, sem descrição das variaveis e modelos.

XXXXXX Meta-analysis is the most appropriate method for this task. Meta-analysis combines the outcomes of multiple studies into a single estimation and allows scholars to draw robust conclusions from the aggregated data (Cooper et al. 2019; Hedges and Olkin 1985). It can also identify potential sources of study heterogeneity, enabling researchers to assess threats to external validity and direct future efforts into more promising areas of academic inquiry (Doucouliagos and Ulubaşoğlu 2008). XXXXXXXX

In this letter, we conduct the first meta-analysis that tests the generality of the "law of $1/n$". We have selected 30 articles that use quantitative methods to assess the impact of legislature size over government spending across several dimensions. We run two sets of models: the first group uses only the main estimates of each selected paper (45), while the second set includes all coefficients reported in our sample (162).[1] Our independent variables consist of three measures, namely the size of the lower chamber, its natural logarithm, and the number of members in the upper chamber. We evaluate their effect upon public expenditure per capita, the natural logarithm of public expenditure per capita, and government expenditure as a percentage of GDP. We then estimate if the results vary according to four potential sources of effect heterogeneity.

Aggregate results show that legislative size has no significant impact on public spending. However, the meta-regressions suggest that our study sample has high levels of heterogeneity, and effects differ substantially according to study specifications. While papers that employ conventional linear regressions often find a

[1] Although there are 30 papers in our review, we include 45 coefficients in the restricted sample. This is because 13 articles report separate estimates for the impact of lower and upper house size on government expenditures. In the full model, we add every outcome reported in the papers, regardless of whether the coefficient comes from the main tables or from robustness checks. We discuss our sampling process in the Methods section and in the Supplementary Material.

positive relation between legislature size and government budgets, recent studies using modern methods of causal inference, specially those with regression discontinuity designs, provide consistent evidence for a negative relation. This goes in contrast with the original theory and supports the existence of a "reverse law of $1/n$". Additionally, we find that non-majoritarian voting systems decrease government spending as a percentage of GDP, which is also evidence against the theoretical expectations of the "law of $1/n$", and they do not have a relevant impact on the other measures of public expenditure. However, unicameralism strongly supports the positive effect predicted by the original theory. This result is contradictory to the rest of our findings, even if unicameral cases mostly reflect the very specific framework under which the theory developed (loosely checked local governments). In summary, our analysis does not provide robust support for the theory as originally conceived, and causal inference models suggest that larger legislatures are associated with lower public spending.

2 Methods

We compiled our final sample of papers from two large collections of records. In the first round of the search, we scraped three large academic databases (Scopus, Microsoft Academic, and Google Scholar) for studies that cited Weingast et al. (1981). We developed exclusion criteria to select only articles written in the English language that used quantitative methods to investigate the relationship between legislature size and public spending.[2] Upon restricting the sample, we identified which were the most commonly used measurements to operationalise these variables of interest, and adopted them as our key explanatory variables.[3] We found those to be public expenditure as a share of GDP, public expenditure per capita, and the natural logarithm of public expenditure per capita as dependent variables. As independent variables, most studies use lower chamber size, upper chamber size, and the natural logarithm of lower chamber size.[4] In the second round, we selected key terms to conduct a broader search of the literature on Google Scholar and applied the same eligibility criteria. Combined, the two searches produced a dataset of 30 studies as of the 10$^{\text{th}}$ of March, 2021. Table 1 contains the full list of articles from which we drew data.

[2]Please refer to section C in the Supplementary Material for a more detailed description of the selection procedure, including a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram Liberati et al. (2009) showing the number of resulting papers after each review step.

[3]As meta-analysis requires a single estimate per observation, we excluded articles that use interaction terms or quadratic specifications of our independent variables.

[4]There are a few important nuances to the coding of these variables. Unicameralism is captured by lower chamber size ($n = 7$) and by log lower chamber size ($n = 5$). Since much of the literature estimates how institutional designs affect this relationship, ours and many other articles use both lower and upper chamber sizes as key explanatory variables. We did not find any articles that used the natural logarithm of upper chamber size.

Table 1: Papers included in the meta-analysis, ordered by year of appearance

Author(s)	Journal	Country	Dependent Variable	Method	Institutional Design	Electoral System
Stein et al. (1998)	Unpub	Multiple (26)	PCTGDP	OLS	Mixed	NM
Baqir (1999)	Unpub	USA	logExpPC	OLS	Unicameral	M
Bradbury and Crain (2001)	JPubE	Multiple (37)	PCTGDP	PANEL	Mixed	NM
Bradbury and Crain (2001)	JPubE	Multiple (37)	ExpPC	PANEL	Mixed	NM
Gilligan and Matsusaka (2001)	NTJ	USA	ExpPC	PANEL	Bicameral	M
Baqir (2002)	PC	USA	logExpPC	OLS	Unicameral	M
Ricciuti (2003)	Unpub	Multiple (23)	ExpPC	PANEL	Mixed	NM
Mukherjee (2003)	CPS	Multiple (110)	PCTGDP	PANEL	Mixed	NM
Lledo (2003)	Unpub	BRA	PCTGDP	PANEL	Unicameral	NM
Ricciuti (2004)	RivPE	Multiple (75)	PCTGDP	OLS	Mixed	NM
Matsusaka (2005)	SPPQ	USA	ExpPC	IV	Bicameral	M
Primo (2006)	E&P	USA	ExpPC	PANEL	Bicameral	M
Erler (2007)	PC	USA	ExpPC	PANEL	Bicameral	M
Erler (2007)	PC	USA	PCTGDP	PANEL	Bicameral	M
Chen and Malhotra (2007)	APSR	USA	ExpPC	PANEL	Bicameral	M
Fiorino and Ricciuti (2007)	PC	ITA	ExpPC	IV	Unicameral	NM
MacDonald (2008)	PC	USA	logExpPC	OLS	Unicameral	M
Schaltegger and Feld (2009)	JPubE	CHE	ExpPC	PANEL	Unicameral	NM
Coate and Knight (2011)	AEJ	USA	logExpPC	OLS	Unicameral	M
Pettersson-Lidbom (2012)	JPubE	FIN & SWE	logExpPC	RDD	Unicameral	NM
Maldonado (2013)	SSQ	Multiple (92)	PCTGDP	OLS	Mixed	NM
Baskaran (2013)	EJPE	DEU	ExpPC	IV	Unicameral	NM
Kessler (2014)	JPE	USA	ExpPC	PANEL	Unicameral	M
Bjedov et al. (2014)	PC	CHE	ExpPC	PANEL	Unicameral	NM
Bjedov et al. (2014)	PC	CHE	PCTGDP	PANEL	Unicameral	NM
Lee (2015)	PC	USA	ExpPC	IV	Bicameral	M
Lee (2016)	PC	USA	ExpPC	IV	Bicameral	M
Drew and Dollery (2017)	UAR	AUS	logExpPC	PANEL	Unicameral	NM
Höhmann (2017)	PC	DEU	logExpPC	RDD	Unicameral	NM
Lee and Park (2018)	PC	USA	ExpPC	PANEL	Bicameral	M
De Benedetto (2018)	Unpub	ITA	logExpPC	RDD	Unicameral	NM
Crowley (2019)	SEJ	USA	ExpPC	PANEL	Bicameral	M
Lewis (2019)	SCID	IDN	logExpPC	RDD	Unicameral	NM

Table 1: Papers included in the meta-analysis, ordered by year of appearance

Author(s)	Journal	Country	Dependent Variable	Method	Institutional Design	Electoral System

Note: Unpub=Unpublished, JPE=Journal of Political Economy, EJPE=European Journal of Political Economy, PC=Public Choice, JPubE=Journal of Public Economics, JPriE=Journal of Private Enterprise, APSR=American Political Science Review, SEJ=Southern Economic Journal, UAR=Urban Affairs Review, SCID=Studies in Comparative International Development, SSQ=Social Science Quarterly, SPPQ=State Politics and Policy Quarterly, CPS=Comparative Political Studies, RivPE=Rivista di Politica Economica, E&P=Economics and Politics, NTJ=National Tax Journal.

Note: OLS=Ordinary least squares, IV=Instrumental variables, Panel=Panel data/fixed effects, RDD=Regression discontinuity design, M=Majoritarian, NM=Non-majoritarian (mixed or proportional representation).

Note: Country codes follow the ISO 3166-1 alpha-3 international standard.

Note: ExpPC=Per capita expenditure, logExpPC=Natural logarithm of per capita expenditure, PCTGDP=Expenditure as a percentage of GDP.

Our study sample reflects the development of the literature. Although the "law of $1/n$" was first formulated in 1981, the empirical assessment of the theory only started a few years later, as dates of publishing range from 1998 to 2019. Most studies focus on the United States (14), but our sample also contains papers on Australia (1), Brazil (1), Germany (2), Indonesia (1), Italy (2), and Switzerland (2). Eight articles use cross-national data and analyse from 2 to 110 countries. Early studies used OLS and panel data methods to estimate the results, whereas the use of regression discontinuity designs is a recent addition to the literature, as the first paper to apply it was published in 2012.

Regarding the dependent variables included in the sample, 16 studies employ public expenditure per capita, 9 papers use its natural logarithm, and 8 of them analyse the impact of legislature size on public expenditures as a percentage of GDP. This indicates that the area has refined the original formulation of $1/n$ suggested by Weingast et al. (1981) and tested the impact of larger legislatures on different measures of government spending. Our independent variables of interest are lower chamber size (26), the natural logarithm of lower chamber size (7), and upper chamber size (12).

We also coded five moderators that may help us understand the heterogeneity in the reported results. We included them in our meta-regressions alongside an indicator for the type of independent variable used in the original study. The additional moderators are: 1) publication year; 2) paper publication in an academic journal; 3) estimation method; 4) institutional design; 5) electoral system. Since the literature on the "law of $1/n$" is notably diverse, we included only moderators that either refer to important theoretical questions, such as the effect of the electoral system on public spending, or to essential characteristics of the publications themselves. Although more moderators exist in the literature (ie., data aggregation level), they do not appear as often as required for the meta-regressions. Table 2 shows the descriptive statistics of the moderator variables.

Table 2: Descriptive Statistics of Moderators

	[ALL] N=162	Other Coefficients N=117	Main Sample N=45
Independent Variables:			
K	47 (29.0%)	35 (29.9%)	12 (26.7%)
logN	33 (20.4%)	26 (22.2%)	7 (15.6%)
N	82 (50.6%)	56 (47.9%)	26 (57.8%)
Electoral system:			
Maj	73 (45.1%)	51 (43.6%)	22 (48.9%)
Non-Maj	89 (54.9%)	66 (56.4%)	23 (51.1%)
Estimation method:			
OLS	49 (30.2%)	40 (34.2%)	9 (20.0%)
PANEL	83 (51.2%)	58 (49.6%)	25 (55.6%)
IV	19 (11.7%)	12 (10.3%)	7 (15.6%)
RDD	11 (6.79%)	7 (5.98%)	4 (8.89%)
Year	2008 (6.15)	2007 (5.96)	2009 (6.54)
Published work:			
No	17 (10.5%)	11 (9.40%)	6 (13.3%)
Yes	145 (89.5%)	106 (90.6%)	39 (86.7%)
Institutional Design:			
Bicameral	49 (30.2%)	32 (27.4%)	17 (37.8%)
Mixed	50 (30.9%)	38 (32.5%)	12 (26.7%)
Unicameral	63 (38.9%)	47 (40.2%)	16 (35.6%)

One of the assumptions in meta-analyses is effect size independence. In our sample of coefficients, we have sources of independence within and between articles, and we solve them using two distinct procedures. Since authors often submit their data to different models, each paper reports several effect sizes using the same variables. To reduce the impact of multicollinearity, we produce and analyse two sets of study coefficients. The first group includes only the most rigorous model from each paper, that is, those estimated with the largest *n*, most control variables, and fixed effects if the authors added them. If the article employed a regression discontinuity design, we chose the coefficient from the optimal bandwidth or from the intermediate one. This sample encompasses 45 estimates, as 13 articles analysed two dependent or independent variables of interest [5]. Our second sample, in contrast, contains all the 162 effect sizes reported in the 30 papers. In both restricted and extended sets, a number of papers use overlapping data – from the same constituency, using the same variables, during the same time period.[6] We correct this source of bias by employing a multilevel random

[5]The papers that used more than one dependent or independent variable of interest were Baqir (1999); Bjedov et al. (2014); Bradbury and Crain (2001); Chen and Malhotra (2007); Crowley (2019); Erler (2007); Gilligan and Matsusaka (2001); Lee (2016); Lee and Park (2018); Maldonado (2013); Primo (2006); Ricciuti et al. (2003); Ricciuti (2004).

[6]For instance, 8 papers used U.S. State data from both the U.S. Census Bureau's "Annual Survey of State and Local Government

effects model (Cheung 2014), grouping redundant(?) studies. Here we focus on the results for our restricted sample as we consider them more robust, but the findings are very similar when we use the extended set. We discuss eventual differences in the next section.

3 Results

3.1 Binomial Z-Tests

The "law of $1/n$" states that more legislators increase government expenditure. Here we employ three methods to assess the empirical validity of that relationship. First, we run a binomial one-proportion z-test to determine whether the study coefficients have a positive or negative sign. Then, we fit 9 random-effect models using the `meta` (Balduzzi et al. 2019) and the `dmetar` (Harrer et al. 2019) packages for the `R` statistical language (R Core Team 2019). We estimate the true effect size variance (τ^2) with a Restricted Maximum Likelihood Estimator, which the literature considers the most precise for continuous dependent variables (Veroniki et al. 2016). Lastly, we run a series of meta-regressions to test possible sources of result heterogeneity. To recapitulate, our independent variables of interest are lower chamber size, the natural logarithm of lower chamber size, and upper chamber size. The dependent variables are public expenditure per capita, the natural logarithm of public expenditure per capita, and government expenditure as a percentage of GDP. Since the outcomes have different scales, we treat them separately in our models.

The binomial z-test evaluates whether the coefficient of our independent variables are positive or negative. The null hypothesis here states that the sign of the coefficient is equally likely to be positive or negative. We start with lower house size. Our results indicate that there is no correlation between the number of legislators in the lower house and public expenditure (successes = 13, trials = 26, $p_{success} = 0.5$, 95% CI = [0.299; 0.701], p-value = 1). Note that the "law of $1/n$" suggests that there is a positive association between both. The binomial test for the natural logarithm of lower chamber size also shows a non-statistically significant result (successes = 5, trials = 7, $p_{success} = 0.714$, 95% CI = [0.29; 0.963], p-value = 0.453). In contrast, we find a positive result for the number of legislators in the upper house, which is in line with the mainstream literature (successes = 10, trials = 12, $p_{success} = 0.833$, 95% CI = [0.516; 0.979], p-value = 0.039).

3.2 Meta-Analysis

We then proceed to the meta-analysis. We matched the house size variables with our measures of government spending and created a theoretical 3×3 matrix. Out of the 9 possible variable combinations, we found only 7 in the article pool. Our sample includes no papers that analyse the relationships between the log lower

Finances" and The Council of State Government's Book of the States.

chamber size and public expenditure per capita or between upper chamber size and the logarithm of public expenditure per capita. We standardized effect sizes by drawing the coefficients and standard errors from the articles. When the latter were not directly available, we used t-statistics to retrieve them.

Figure 1: Forest plots of the relationship between legislature size and government spending (reduced sample)

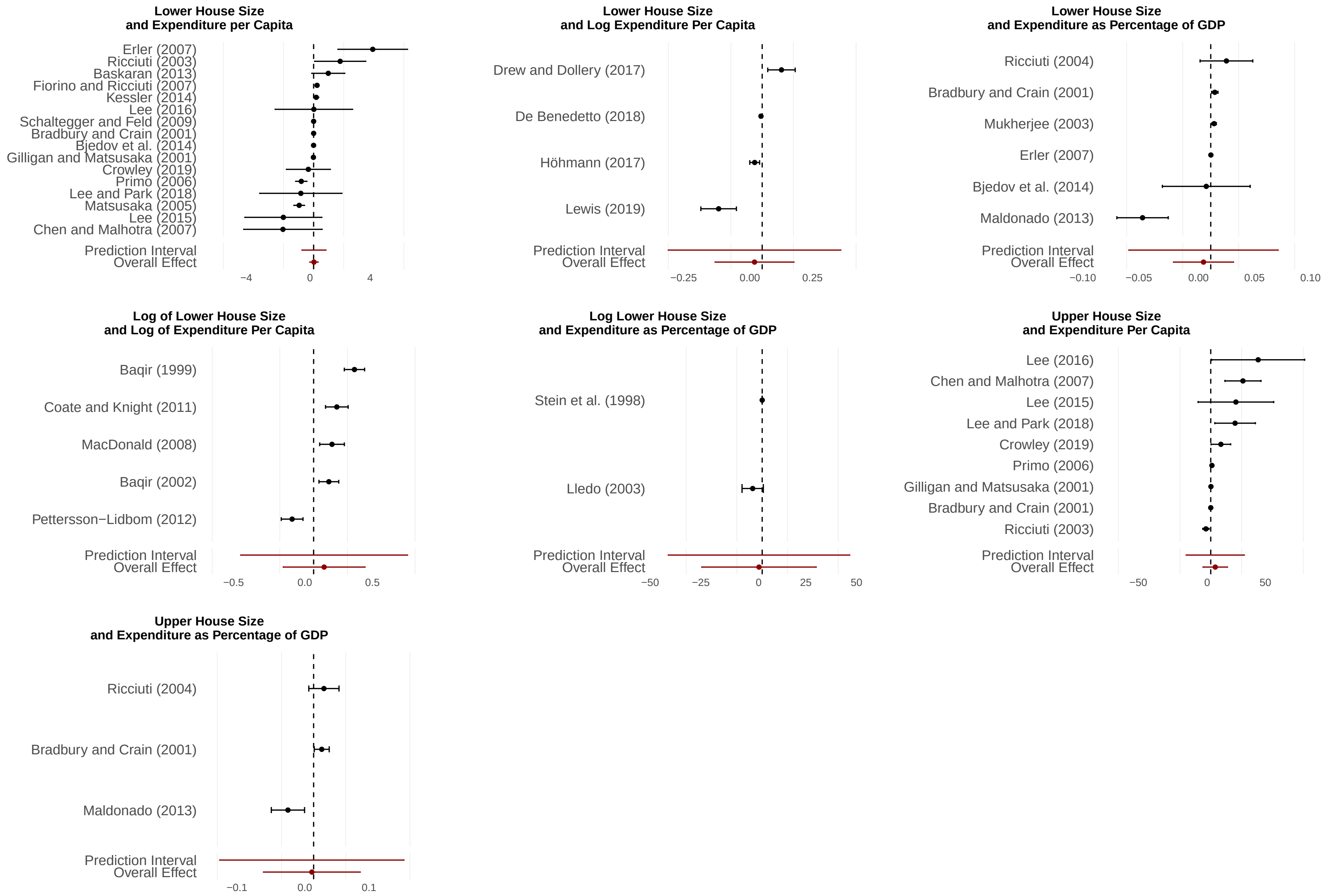


Figure 1 shows the forest plots for our restricted sample, which includes only the 45 main coefficients of the 30 selected papers. On the left side of the plots are the name of the study authors and the paper publication year. For unpublished studies, we included the first year the paper was available online. The bars in the middle show the reported effect sizes and the vertical lines indicate their average, weighted by standard errors. The length of the lines represent the precision of the estimates. The red line at the bottom of the figures displays the aggregate coefficients plus their respective confidence intervals.

The first line of graphs reports the results for lower chamber size. In the first model, which correlates lower chamber size and expenditure per capita, we find a standardised mean difference (SMD) of -0.044 and a standard error of 0.211 (studies = 16, 95% CI = [-0.494; 0.405], p-value = 0.836 , prediction interval = [-1.224; 1.135]). Therefore, we cannot reject the null hypothesis that the effect size is zero. The I^2 statistic, which quantifies the degree of heterogeneity among studies, is equal to 86.95%. I^2 values above 75% indicate very high study heterogeneity (Higgins et al. 2019).

We see similar results when we compare lower chamber size with log expenditure per capita. In this model, the average effect size is -0.031 and the standard error is 0.051 (studies = 4, 95% CI = [-0.192; 0.131], p-value = 0.59, prediction interval = [-0.499; 0.438]; I^2 = 91.73%). The coefficient is statistically indistinguishable from zero.

In our restricted sample, larger lower house size also does not increase government spending as a percentage of GDP (studies = 6, SMD = -0.006, SE = 0.011, 95% CI = [-0.034; 0.021], p-value = 0.571, prediction interval = [-0.079; 0.066], I^2 = 88.35%). In the extended sample the effect is negative, but it is also statistically insignificant.

XXXXX We find a positive effect in our extended sample and the coefficient is statistically significant at the 10% level (coefficients = 26, SMD = 0.009, SE = 0.003, 95% CI = [0.002; 0.015], p-value = 0.008, prediction interval = [-0.02; #0.038], I^2 = 99.23%). The result supports the "law of $1/n$", but the evidence is moderate as the prediction interval include zero. XXXXXXXXX

Next, we present the meta-analyses using the logarithm of lower house size. We start with the relationship between this variable and the logarithm of expenditure per capita. The result is positive, but the coefficient is not significant, and the prediction interval encompasses zero (studies = 5, SMD = 0.113, SE = 0.075, 95% CI = [-0.097; 0.322], p-value = 0.209, prediction interval = [-0.462; 0.687], I^2 = 94.32%). Results in the full sample are also null.

Our model that correlates log lower chamber size with public expenditures as a percentage of GDP fails to reach conventional levels of statistical significance (studies = 2, SMD = -1.576, SE = 2.223, 95% CI = [-29.82; 26.668], p-value = 0.607, prediction interval = [NA; NA], I^2 = 67.5%). The extended sample also gives us a null result.

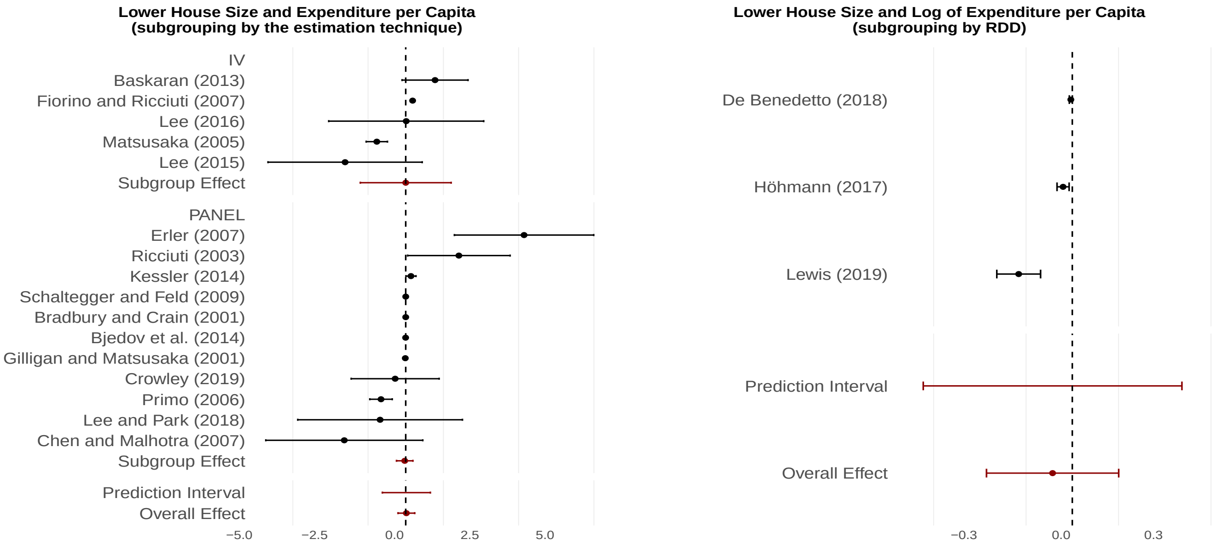
The third set of models uses upper house size as the main independent variable. We find a positive correlation between this variable and expenditure per capita but the coefficient is not significant (studies = 9, SMD = 6.68, SE = 3.914, 95% CI = [-2.345; 15.705], p-value = 0.126, prediction interval = [-16.774; 30.134], I^2 = 80.7%). But as with the other models, the prediction interval again includes zero. When we run the same analysis in the extended sample, we see a significant coefficient for the estimate, yet the prediction interval also contains zero (coefficients = 34, SMD = 4.788, SE = 1.299, 95% CI = [2.145; 7.431], p-value < 0.001, prediction interval = [-5.752; 15.328], I^2 = 83.85%).

Our last estimation analyses the relationship between upper chamber size and government spending as a percentage of GDP. The coefficient is not statistically significant, indicating a null effect (studies = 3, SMD = -0.003, SE = 0.018, 95% CI = [-0.079; 0.074], p-value = 0.891, prediction interval = [-0.428; 0.423], I^2 = 85.79%). The result is very similar in the extended sample.

In a nutshell, we do not find strong evidence in favour of the "law of $1/n$". While some models do show a positive and statistically significant result, none of the prediction intervals are totally positive or negative. The studies also have considerable heterogeneity, what indicates that the original coefficients do not point consistently towards the same direction.

One reason why we have not detected any strong effects may be due to the identification strategy authors use in their models. On the one hand, OLS and panel data models require too many controls to make units comparable, and they are vulnerable to omitted variable bias or post-treatment bias (Cinelli and Hazlett 2020; Pearl 2015). On the other hand, estimation methods such as instrumental variables and regression discontinuity designs have become popular because of their high internal validity (Angrist and Pischke 2008). Figure 2 shows the disaggregated effects for two sets of models that employ causal estimation techniques. They measure the impact of lower house size on expenditure per capita (left) and on the natural logarithm of expenditure per capita (right).

Figure 2: Forest plots of the relationship between legislature size and government spending with regression method heterogeneity (restricted sample)



Papers that employed instrumental variables show some interesting variation: out of the four coefficients listed, two are positive and two are negative. Two of these four coefficients are significant, again one positive and one negative. The subgroup analysis presents a SMD which is negative but insignificant. In contrast, all papers that use regression discontinuity designs show negative and statistically significant results. Since only three papers in our sample use RDDs, we are cautious about predicting an overall negative relation, but they do indicate that better identification strategies yield a zero-to-negative impact of legislature size on expenditure, in support of the reverse "law of $1/n$".

3.3 Meta-Regressions

In this section, we run a series of meta-regressions with covariates that may account for differences across the selected papers. The first variable indicates whether the study uses lower chamber size, log lower chamber size, or upper chamber size as a main explanatory variable. We included the individual effect sizes for upper and lower chamber sizes when papers analyzed both. The second variable shows the study publication year, which we included to capture temporal variation in the study coefficients. We also add a dummy variable to assess whether published articles report effect sizes that are higher or lower than those from working papers. The fourth variable measures whether studies focusing on non-majoritarian electoral systems report coefficients that are smaller or larger than those from majoritarian countries. The fifth covariate is a categorical variable indicating the statistical procedure used in the original models (panel data, instrumental variables, OLS, or regression discontinuity design). In our last variable, we separate coefficients that use samples from unicameral or bicameral systems, and code papers using polities with different institutional designs as “mixed”.

Table {tabregressions} presents the meta-regression results for our restricted and extended samples. Each column represents one of the three measures of public spending we discuss in this paper. To reduce the risk of false positives in our analyses, we use permutation tests to calculate significance levels for the meta-regressions (Higgins and Thompson 2004).

The first two models show the results for public expenditure per capita. No variable reaches conventional levels of statistical significance in the restricted sample. In the extended sample, we find that models that use lower chamber size as an independent variable have lower effects when compared to upper chamber size. This suggests that an additional member in the lower house has a smaller impact on public spending than a member in the upper house. Moreover, the results for the extended sample point out that recent studies find larger effects than older ones.

The third and fourth columns use the natural logarithm of expenditure per capita as the dependent variable. None of the covariates are statistically significant in our smaller sample, but two moderators are negatively associated with the outcome in our larger study pool. They both refer to estimation methods. Studies that employ panel/fixed effects or regression discontinuity designs (RDDs) have lower coefficients for log expenditure per capita if we take OLS as the reference category.

Two variables are statistically significant in the last set of meta-regressions, which include public expenditures as a percentage of GDP as the dependent variable. Both in our restricted and in our extended samples, recent studies have smaller coefficients than early papers, which stands in contrast with our previous models. Non-majoritarian voting systems are also associated with lower levels of public spending, what is against the theoretical expectations of the "law of $1/n$". The results, however, do not replicate in the first set of estimations.

Overall, our results suggest that study coefficients are highly sensitive to research design choices. The same study samples may produce different outcomes depending on the response variables scholars decide to analyse. Moreover, we find evidence that results vary considerably if the study employs different measures of legislature size or use causal research methods. The impact of factors such as the electoral system or year of publication also appear to be conditional on the selected model.

4 Discussion

In this article, we assess the empirical validity of the "law of $1/n$". Based on a sample of 30 publications on the topic, our meta-analyses show that there is no strong evidence that an increase in the number of legislators has a significant effect on public expenditures. If such effect exists, it is likely driven by an increase in the size of the upper legislature, as suggested by several studies in the literature (Baqir 2002; Bradbury and Crain 2001; Bradbury and Stephenson 2003; **?**; Gilligan and Matsusaka 2001; Primo 2006). Instead, we find better evidence for the "reverse law of $1/n$", which posits that larger legislatures lead to lower government spending. This is mainly because studies using regression discontinuity designs, a method that has robust internal validity, consistently indicate a negative relationship between lower house size and the logarithm of expenditure per capita (Höhmann 2017; Lewis 2019; Pettersson-Lidbom 2012).

The meta-regressions show that study characteristics have a considerable influence on reported results. Electoral system affects the relationship between legislature size and public expenditure, but the results are not replicable in all estimations. Publication year generates conflicting findings in our models. Nevertheless, the meta-regressions confirm that RDDs produce negative effects more frequently than OLS regressions.

The literature explores many mediating and alternative explanations for how or why the number of legislators in a chamber relates to their choice of commmon pool resource use. Crowley (2019) argues that a variable that better translates how large legislatures decrease the efficiency of public spending is fragmentation, which also expresses the and that its effect is actually non-linear. Other studies echo this argument and develop other frgamentation mechanisms that explain relationships that are linear and non-linear. For instance, when it comes to district fragmentation, Baqir (1999) and Drew and Dollery (2017) support the "law of $1/n$"'s positive effect on public spending when one considers the amount of districts that share a common pool of resources. Many studies demonstrate how partisan fragmentation is a bigger predictor of increased spending, and analyze how majorities and veto powers respectively boost and curtail these effects (Baqir 2002, cite all the papers). These findings dialogue directly with Weingast et al. (1981)'s *norm of universalism* within US legislatures, which is the assumption that, when drawing from common pool resources, chambers will always approve of any singular legislators' projects.

Applying the "law of $1/n$" in contexts too far removed from the US attests against it, as, for instance, public spending more strongly correlates to cabinet than legislature size in Swiss cantons and Malaysian (states or municipalities?), where decision-making power is concentrated in the executive.

Why is there no clear-cut evidence in favour or against the "law of $1/n$"? A plausible reason may be that there are few incentives for the pure accumulation of knowledge in the social sciences, at least when compared to the benefits scholars may accrue when they challenge or add features to existing theories (Geddes 2003). This leads to a reduced number of replication studies in the field, although we have seen some positive changes in this respect, such as EGAP's *Metaketa Initiative*.[7]

For instance, in our sample, papers added supermajority rules (Lee 2015, 2016), redistricting (Baqir 2002; Lee and Park 2018), party ideology (Bjedov et al. 2014), coalition sizes (Baskaran 2013), term limits (Erler 2007), bicameralism (Ricciuti et al. 2004), and the interplay between upper and lower houses (?) to the main theory, but a comprehensive procedural replication of the findings using different samples is yet to be written.

The addition of new features has the benefit of enriching the original theory with useful details, although

[7] See https://egap.org/our-work/the-metaketa-initiative for further information.

it has the disadvantage of not providing a conclusive test to the “law of $1/n$”.

Our analyses suggest three areas for further research. First, our study sample did not include articles that evaluate the association between the log lower chamber size and public expenditure per capita or between upper chamber size and log expenditure per capita. New work on that area might clarify some of the inconsistencies we find here. Second, despite the inclusion of several moderators in our models, aggregate results still show considerable heterogeneity. Domestic factors such as party dynamics or gerrymandering (Lee 2015; Mukherjee 2003; Gilligan and Matsusaka 2006) may prove useful in this regard. Finally, we highlight the need for more causal inference studies in the literature. Whenever possible, authors should leverage natural and quasi-experiments to assess whether the current results hold when tested with such research designs. These suggestions may help scholars and policy-makers to reach an optimal balance between sound fiscal policy and the demands for increased political representation.

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