Supplementary Materials for "The Effect of Legislature Size on Public Spending: A Meta-Analysis"

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Contents

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A A Brief Introduction to the Law of *1/n* and the Reverse Law of *1/n*

In this section, we present the intuition behind the *law of 1/n*, as well as the alternative *reverse law of 1/n* proposed by Primo and Snyder (2008).

In their seminal paper, Weingast et al. (1981) argue that a high number of legislators will increase public spending beyond the optimal economic benchmark. They suggest that politicians have an incentive to over-provide concentrated benefits to their constituencies, spreading the costs across all constituencies through generalised taxation. The corollary of their model is that larger legislatures generate more public spending.

In their model, every local public goods project of size x generates a concave benefit $b(x)$, and there are convex costs associated with the project.[1] The first type of cost, $c_1(x)$, comprises the expenses within the constituency (e. g., hiring a local company for the project). The second type of cost, $c_2(x)$, captures the expenses outside the constituency (e. g., hiring a company from another state). Finally, the third cost, $c_3(x)$, captures the externalities generated by the project (e. g., how much prices shift because local economic factors are being used to provide the project). The total cost is equal to $c(x) = c_1(x) + c_2(x) + c_3(x)$. The tax burden generated by the project is equal to $T(x) = c_1(x) + c_2(x)$.

Projects are economically efficient when the marginal costs are equal to the marginal benefits of the project size. This leads to the economic optimal project size, x^E. The optimal project size is $b'(x^E) - c_1'(x^E) - c_2'(x^E) - c_3'(x^E) = 0$. However, the projects that are actually implemented have a different structure. First, assume that the constituency in question has a tax burden $t = 1/n$, where n represents the number of constituencies. Also, suppose that benefits are distorted by the fact that costs within the constituency ($c_1(x)$) become investments in local firms. Therefore, the costs and benefits of implementing a project with size x have the following structure:

$$N(x) = b(x) + c_1(x) - \frac{1}{n}[c_1(x) + c_2(x)] - c_3(x)$$

Differentiating $N(x)$ with respect to x gives us the first order condition for an optimal project implementation.

$$b'(x) + c_1'(x) - \frac{1}{n}[c_1'(x) + c_2'(x)] - c_3'(x) = 0$$

Totally differentiating x with respect to n gives us the following:

$$b''(x)\frac{dx}{dn} + c_1''(x)\frac{dx}{dn} - \frac{1}{n}[c_1''(x) + c_2''(x)]\frac{dx}{dn} + \frac{1}{n^2}[c_1'(x) + c_2'(x)] - c_3''(x)\frac{dx}{dn} = 0$$

[1]Concave means that $b' > 0$ and $b'' < 0$. Convex means that $c' > 0$ and $c'' > 0$. We assume that the derivatives are well defined throughout the analysis. Moreover, we drop the constituency index to make the model more intuitive, so the reader should assume that we always employ a symmetric Nash equilibrium.

And rearranging the terms, we find the following expression for $\frac{dx}{dn}$:

$$\frac{dx}{dn} = -\frac{n^{-2}[c_1'(x) + c_2'(x)]}{b''(x) + c_1''(x) - n^{-1}[c_1''(x) + c_2''(x)] - c_3''(x)}$$

Note that the numerator is always positive, as the marginal investment costs inside and outside the district increase according to the project size. The *law of 1/n* holds when the denominator is negative. $b''(x) < 0$ by assumption, and $-n^{-1}[c_1''(x) + c_2''(x)] - c_3''(x) < 0$ as $c_1'', c_2'', c_3'' > 0$. Then, the *law of 1/n* is true when $c_1''(x)$ is smaller than $n^{-1}[c_1''(x) + c_2''(x)] + c_3''(x) - b''(x)$.

As the above condition suggests, the *law of 1/n* holds only in specific situations. Primo and Snyder (2008) advance that theory by considering other situations where the *law* may not hold, and they also argue that there are cases in which a *reverse law of 1/n* holds, that is, larger legislatures may lead to lower public expenditures.

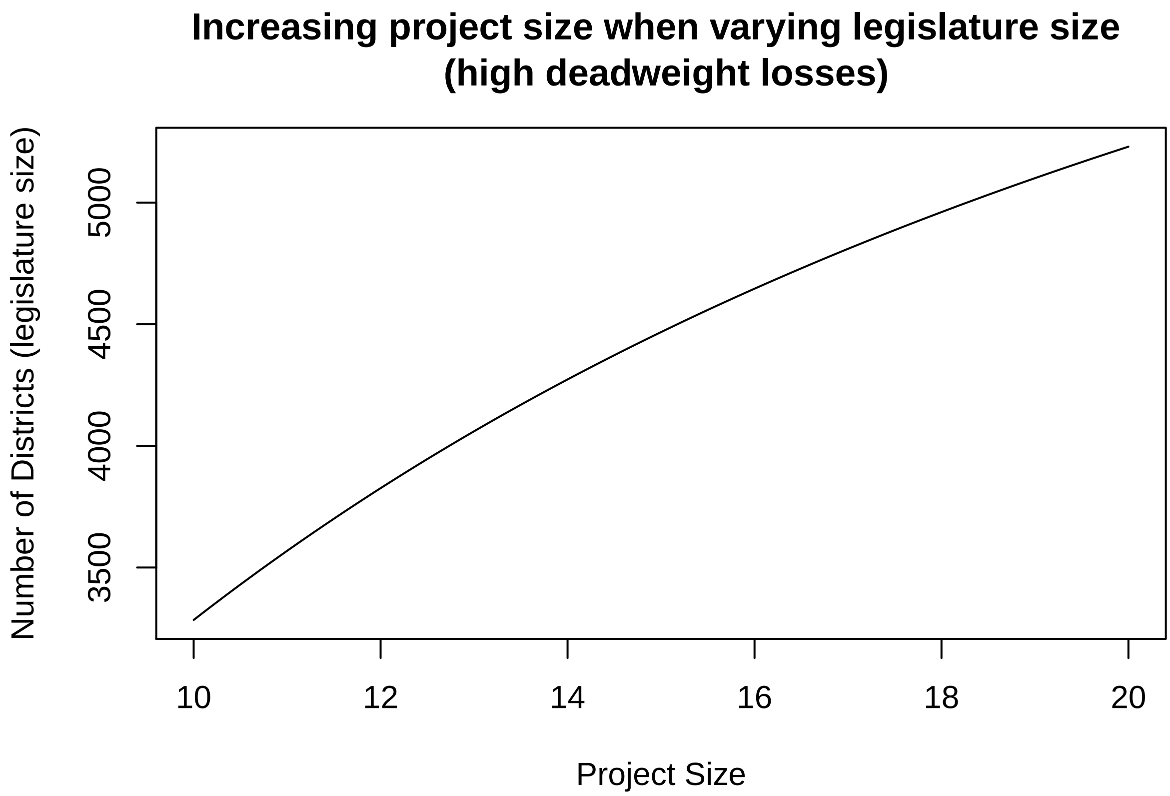
Following Primo and Snyder (2008), let n be the number of districts, m the number of citizens in each district, and nm is the total population in the country. Consider a local public good that generates a per capita benefit of $b(x, m) = x^{\alpha} m^{\beta-1}$ according to size x, where β is the degree of congestion of the public good, that is, how much the addition of individuals reduce the benefits for other individuals (note that the lower the β, the higher the congestion). In terms of costs, consider a linear cost function $C(x) = x$, and in terms of taxation, assume that the people in the district pay both local and federal government taxes. The degree that taxes are shared is denoted by s. Moreover, there is a deadweight loss of the taxes $\theta \geq 1$. The tax then becomes: $t = \left(\frac{(n\breve{\ }ns + s)x + (ns\breve{\ }s)X}{nm}\right)^{\theta}$. Therefore, the citizens receive the following net benefit of a project with size x:

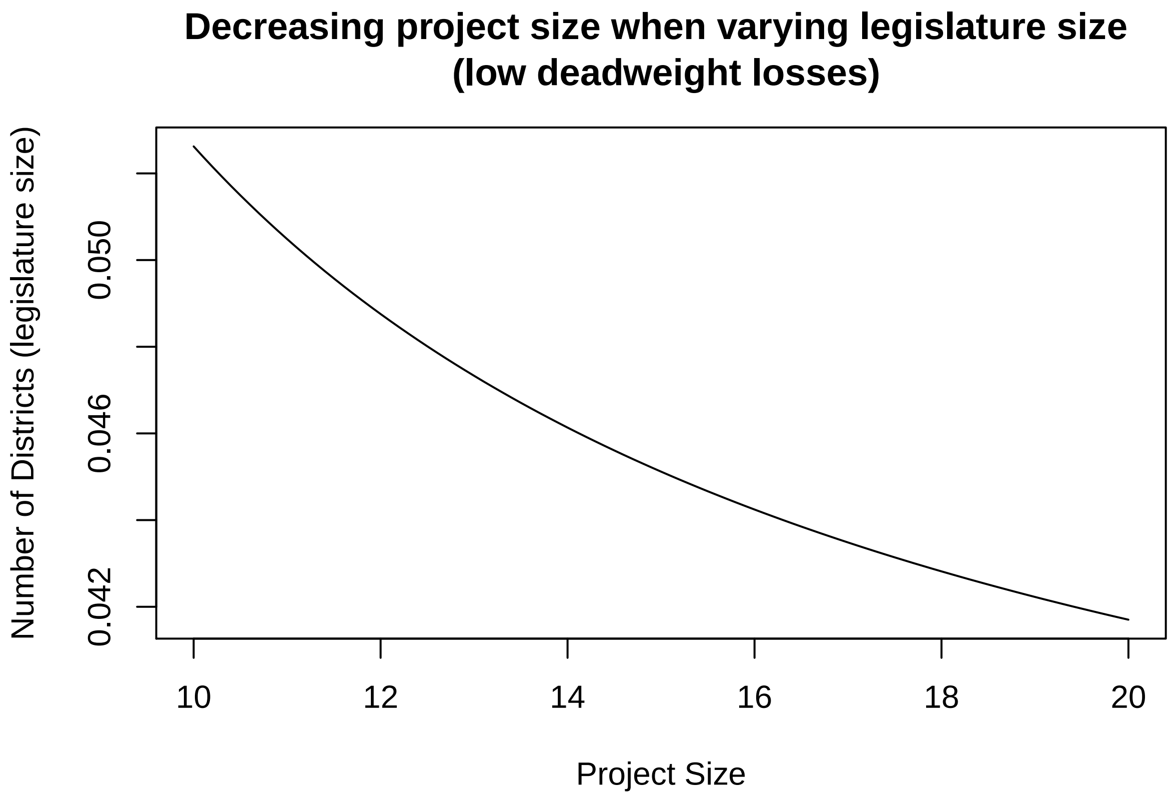
$$\pi = x^{\alpha} m^{\beta-1} - \left(\frac{(n\breve{\ }ns + s)x + (ns\breve{\ }s)X}{nm}\right)^{\theta}$$

Maximising this function, and solving for the symmetric Nash equilibrium where $x = X$ for all projects, we find the following optimal project size:

$$x^* = \left[\left(\frac{\alpha}{\theta}\right)^{\dfrac{1}{\theta-\alpha}}\right]\left[(nm)^{\dfrac{\beta+\theta-1}{\theta-\alpha}}\right]\left[\left(\frac{n^{2-\beta-\theta}}{n-ns+s}\right)^{\dfrac{1}{\theta-\alpha}}\right]$$

And in the graph below, we show simulations for n varying from 10 to 20, holding constant $\beta = 0.35$, $\theta \in \{0.65, 0.75\}$, $s = 0.5$, $m = 100$, and $\alpha = 0.7$.





Thus, we see that both the *law of 1/n* and its reverse formulation are equally plausible. Here we show how the results change just by changing the levels of deadweight losses, but authors have suggested other reasons why the *law of 1/n* may not apply, such as bicameralism (Chen and Malhotra 2007), popular initiatives (Matsusaka 2005), type of government (Coate and Knight 2011), supermajorities (Lee 2015), political fragmentation (Lledo 2003), and ideology (Bjedov et al. 2014).

B Search Criteria

The first step in our systematic review consisted in gathering a study sample. We started our data collection with a manual search based on a set of keywords we scouted from the distributive politics literature. This search produced a database with many entries that were unrelated to our subject of investigation. To reduce the number of false positives in our sample, we restricted our search to studies that cited Weingast, Shepsle and Johnsen's 1981 paper "*The Political Economy of Benefits and Costs: A Neoclassical Approach to Distributive Politics*", which is the fundamental contribution to the field. Although Google Scholar reports the article has received 2,180 citations, our search resulted in 2,664 records on the 21st of November 2019.

We webscraped three large academic databases: Google Scholar (n = 1001); Microsoft Academic (n = 927); and Scopus (n = 736). The `R` script we wrote extracted the article title, abstract, authors, year, journal of publication, and database from which the record originated. Our code is available in the `R` script available in this repository. We screened these results with an English language and article restriction, that is, we excluded all records written in other languages and all that were not academic papers, such as book chapters or doctoral theses. We set no restriction to unpublished articles.

We complemented this process by doing a term search on Google Scholar after having finished the entire eligibility procedure in the first sample. We formulated the search string based on the terms and expressions that appeared most frequently in the articles included in our meta-analysis. The choice of string translates the central point of our inquiry: the relationship between legislature size and public spending. The search string was as follows: `("upper chamber size" OR "lower chamber size" OR "council size" OR "parliament size" OR "legislature size" OR "number of legislators" OR "legislative size") AND ("spending" OR "expenditure" OR "government size")`. We scraped Google Scholar on March 5th, 2021. Using the titles of this new database's records, we did a fuzzy matching with the database of Weingast et al. (1981) citations mentioned previously. We then performed the exact same eligibility procedures, further explained below. This resulted in 3,041 additional records. Combining the two search strategies, we assessed a total of 5,705 records.

C Article Selection

The selection process was conducted by two authors in three phases. In the first phase, we excluded all titles that were clearly unrelated to our topic of interest. This was only a preliminary step, as we were not able to eliminate a large number of entries. Then, we read all abstracts. We kept all publications whose main topics were either government expenditure or legislative structures. Abstracts that indicated that the paper discussed or estimated the impacts of representative institutions, elections, or chamber dynamics were included. This allowed us to significantly reduce our sample.

In the second phase, we assessed full texts. To remain in our sample, the paper should (i) conduct a quantitative analysis, (ii) report data on the number of legislators, and (iii) also include data on public expenditure. If the publication had all three, we kept it in our sample. Disagreements in this phase were discussed among the authors, and a third investigator was consulted when needed.

The third phase consisted of filling out tables for each of the remaining 47 articles to systematically evaluate their eligibility. Since authors use different measures for government spending and the number of lower/upper house members, we extracted all coefficients that provided this information. In this phase, we also collected information on whether the paper had been published, and if it explicitly discussed the *law of 1/n*. Upon choosing the variables, we excluded two studies from the first sample, as they did not have the dependent/independent variables we collected for our meta-analysis. We then included the 3 papers we found in the second search, as both conformed to our criteria, and compiled our final sample of 30 articles.

C.1 Exclusion Analysis

We selected the final pool of articles based on two criteria, namely the treatment and the outcome variables employed in the paper. The categories follow below:

1. Treatment variables:

   - *N*: Number Legislators in the Lower House
   - *logN*: Log Number Legislators in the Lower House
   - *K*: Number Legislators in the Upper House

2. Outcome variables:

   - *ExpPC*: Expenditure Per Capita
   - *logExpPC*: Log Expenditure Per Capita
   - *PCTGDP*: Percent GDP Public Expenditure

If a paper did not use a combination of these variables, we excluded it from the meta-analysis.

C.2 Flow Chart

The diagram below shows each step of our article selection process. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement to conduct our study[2]. The column to the right depicts the amount of articles excluded in each phase, and the one to the left shows the number of records evaluated.

[2]More information about the PRISMA statement is available at `http://www.prisma-statement.org`.

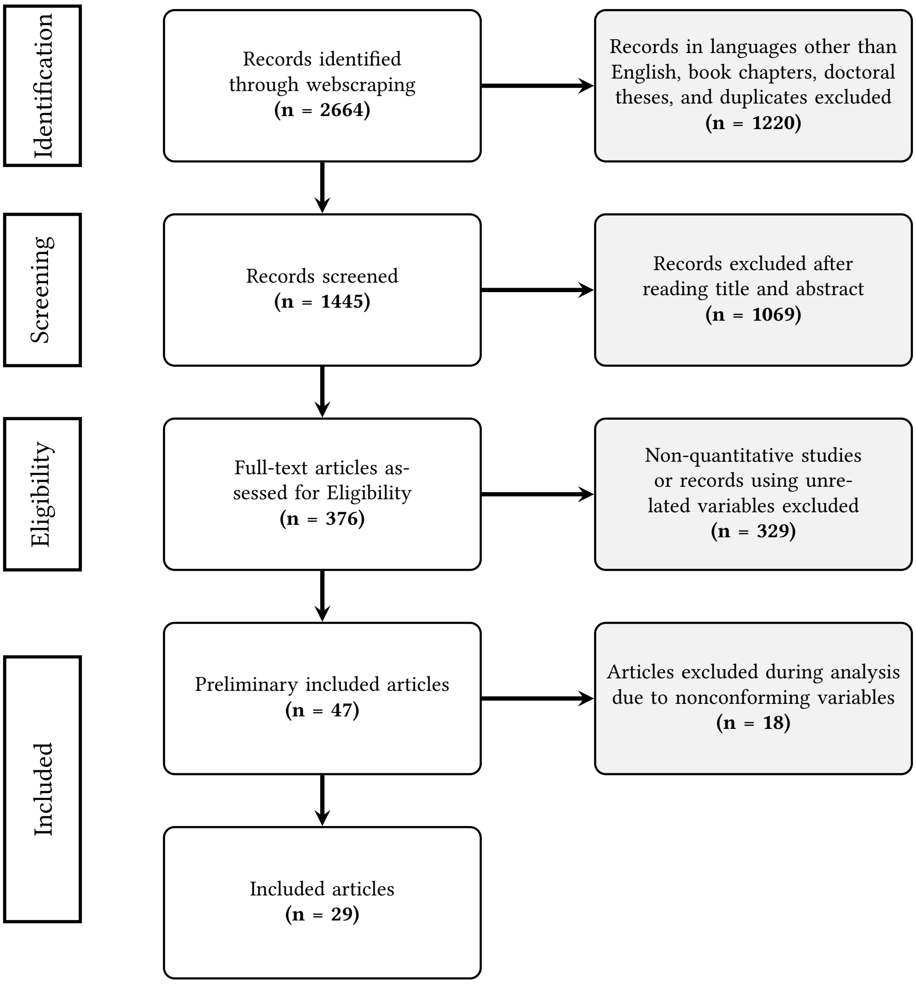


Figure 1: PRISMA Flow Chart for First Search Strategy: Weingast et al. Citations

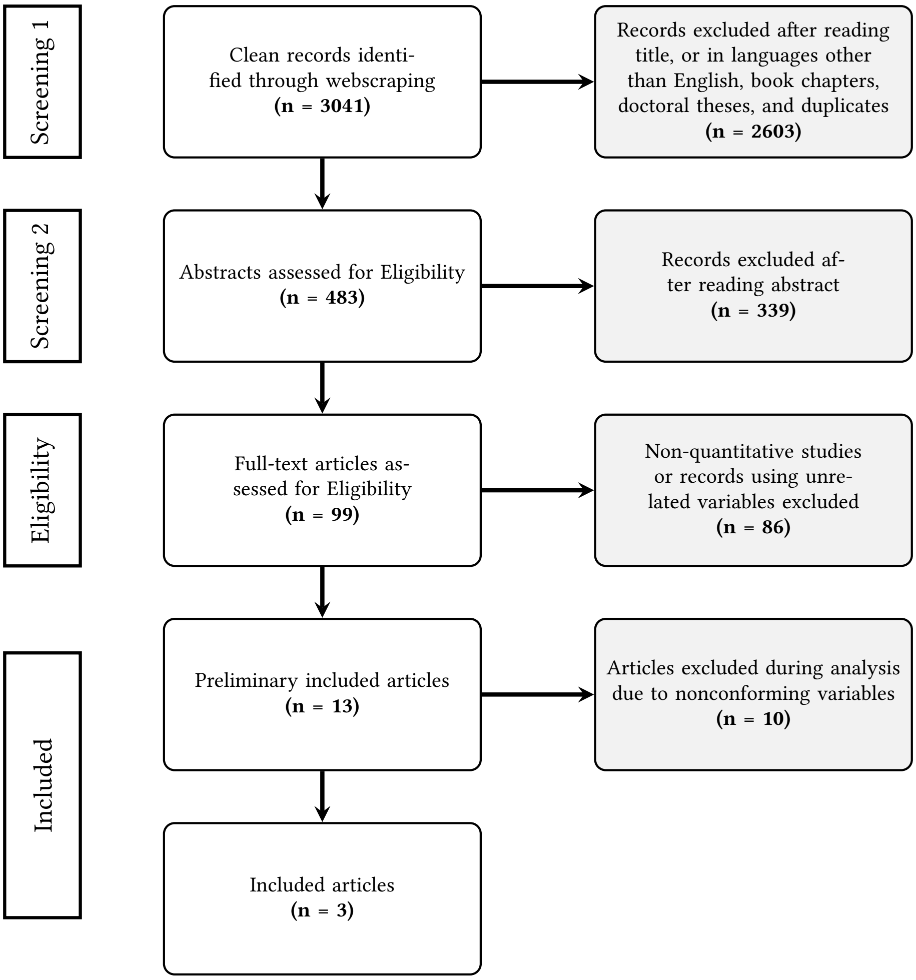


Figure 2: PRISMA Flow Chart for First Search Strategy: Search String with Terms

D Meta-Analysis Dataset

Our meta-analytic data are comprised of two datasets. The first dataset has the main coefficients reported in the selected studies. These data include only the most rigorous model from each paper, that is, those estimated with the largest sample size, 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 12 articles analysed two dependent or independent variables of interest. Our second sample, in contrast, contains all the 163 effect sizes reported in the 30 papers.

In the main text, 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 dataset. Here we present the results of all tests performed in both reduced and full samples.

E Descriptive Statistics

Here we show the descriptive statistics for our sample. We focus on the following paper characteristics: study year; paper publication; the electoral system mentioned in the publication; and the distribution of the dependent and independent variables of interest.

E.1 Study Year

The average year of publication in our sample is 2009 with standard deviation of 6.54. The oldest study included in the paper is from 1998, while the most recent paper was written in 2019. Therefore, we cover 21 years of tests of the *law of 1/n*.

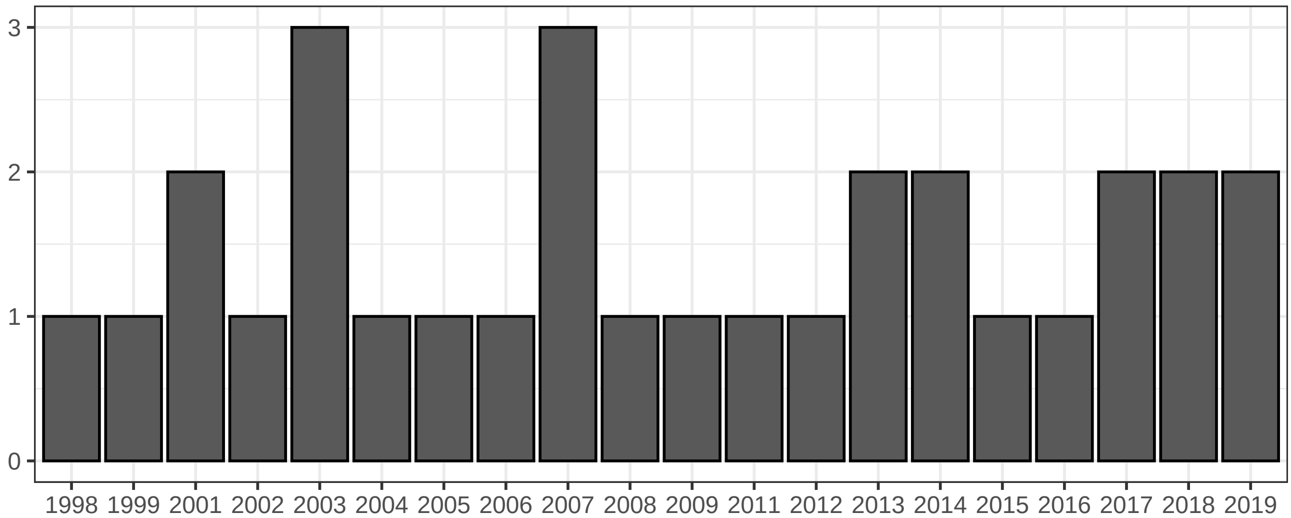


Figure 3: Study Year Frequencies

E.2 Frequency of Published Papers

Studies were included in our sample regardless of their publication status. From the 30 papers in the sample, 25 were published while 5 were not published.

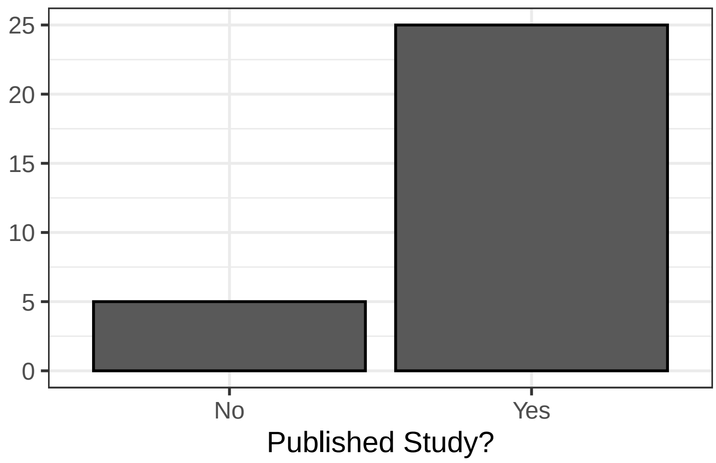


Figure 4: Was the study published?

E.3 Electoral System

Our sample differs considerably in regards to research design. One remarkable difference is that several authors apply the logics of the *law of 1/n*, which was built with majoritarian systems in mind, to non-majoritarian democracies. In the sample, 14 of the papers study *Majoritarian* systems while 16 study *Non-Majoritarian* electoral systems.[3]

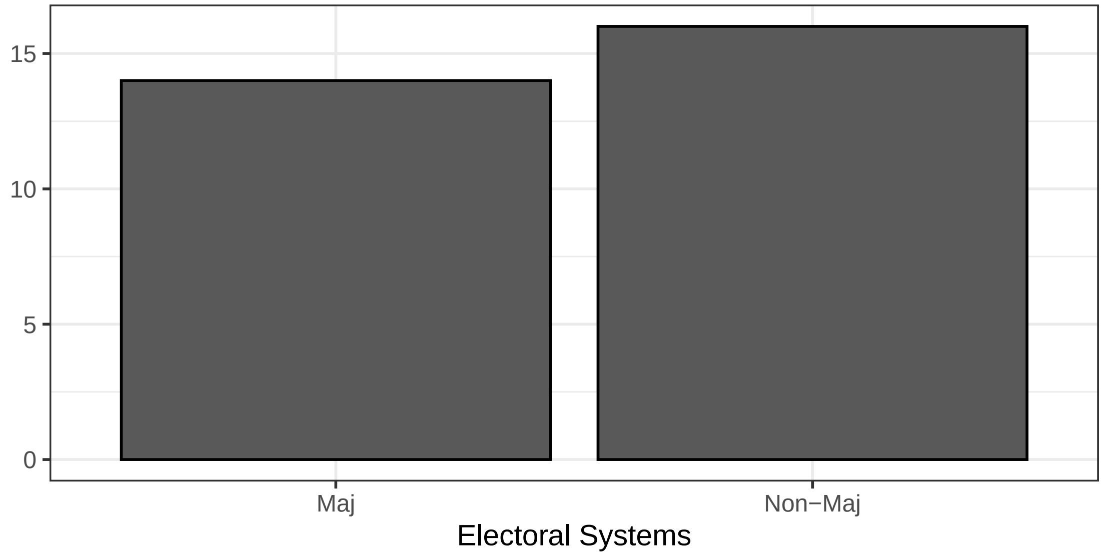


Figure 5: Electoral Systems

E.4 Dependent Variables

The outcome variables included in the paper are:

- 16 Per Capita Expenditure papers
- 9 Expenditure as a Percentage of the GDP papers
- 8 Natural Log of Per Capita Expenditure papers

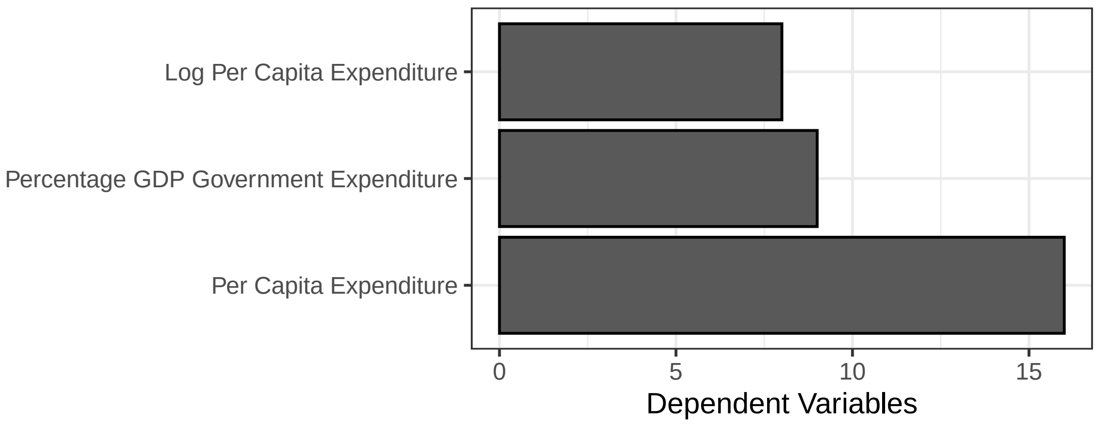


Figure 6: Dependent variables across the law of 1/n studies

[3]Note that for the *law of 1/n* to be valid in a non-majoritarian system, we need to assume that despite the fact that politicians are able to campaign in every place in the district, votes are geographically concentrated. The concentration facilitates politicians to use pork-barrel projects to captivate their electoral supporters.

E.5 Independent Variables

Most papers in our sample analyse the number of legislators in the lower house (26). The second most frequent independent variable is the number of legislators in the upper house (12). Finally, the minority of papers use the natural log of the number of legislators in the lower house as an independent variable (7). As we noted above, some papers had multiple coefficients, and thus the total number of coefficients is 45, while the number of papers is only 30.

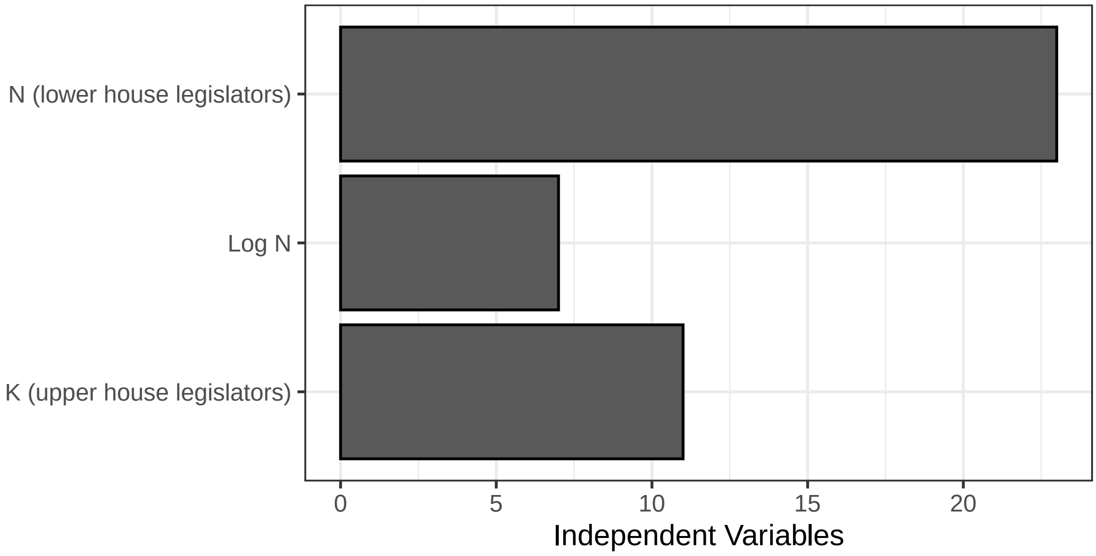
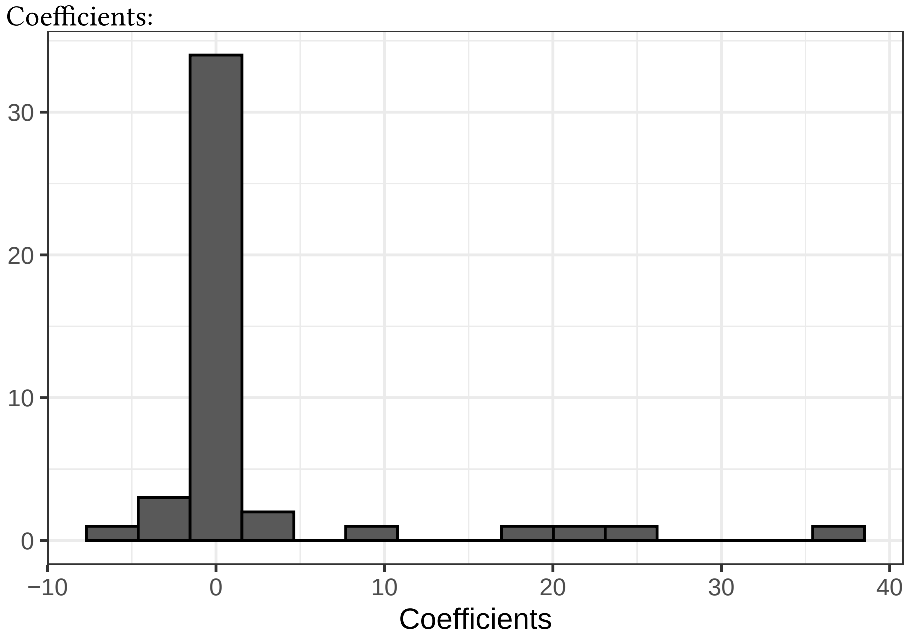


Figure 7: Independent variables across the law of 1/n studies

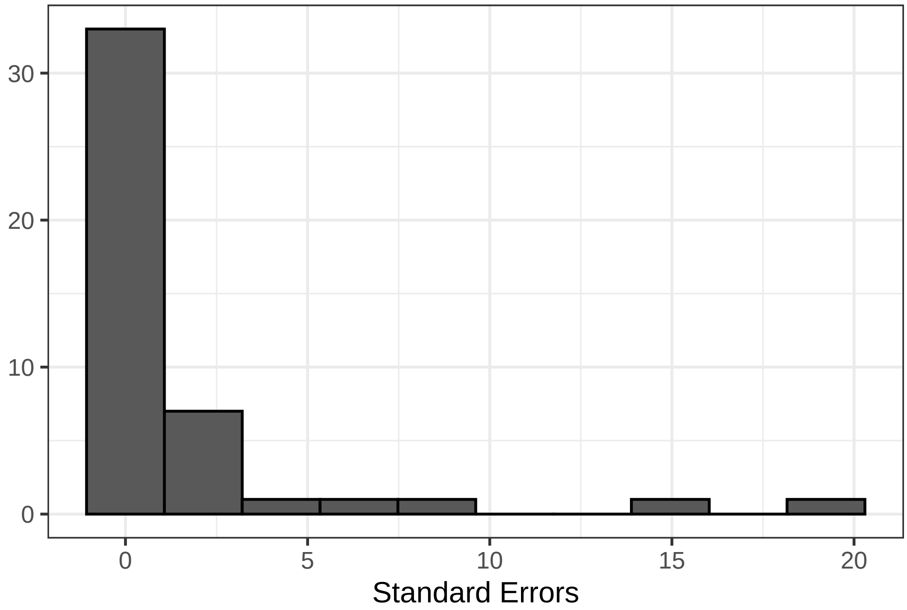
E.6 Histogram of the Coefficients and the Standard Errors

The coefficients in the papers vary considerably. We plot a histogram of the coefficients for all measurements included in the meta-analytic dataset. Most coefficients and standard deviations are close to zero.

Coefficients:



Standard errors:



E.7 Sign Coefficients

One simple statistic that we can compute to assess the validity of the *law of 1/n* is the frequency of positive and negative estimates in the study sample. Below we plot the frequency for all the papers included in the meta-analytic dataset.

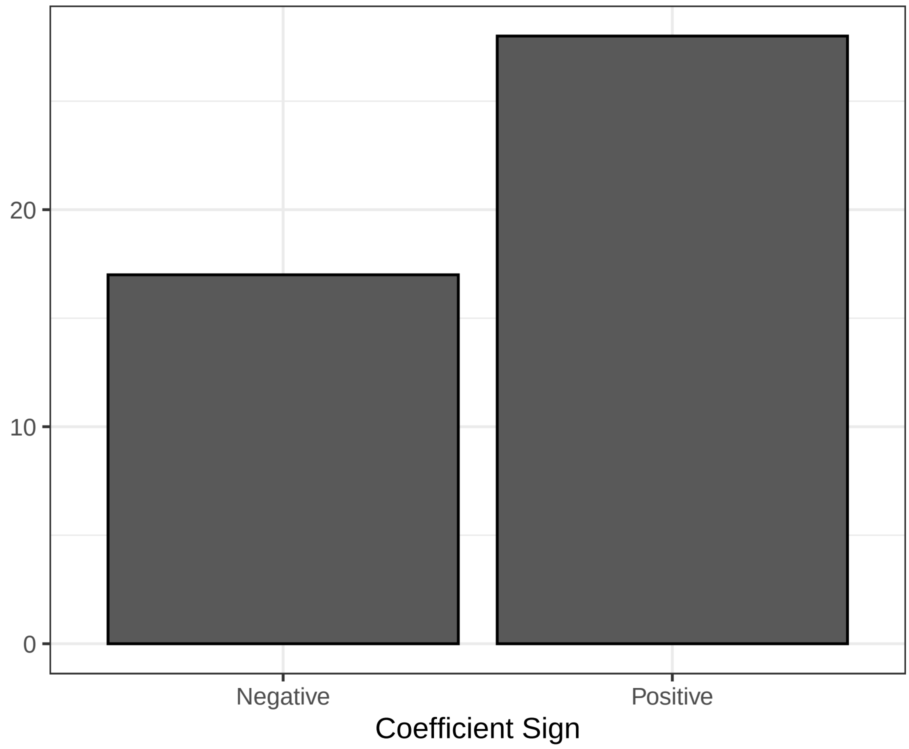


Figure 8: Coefficient Sign

F Descriptive Statistics of Moderators

We chose a set of moderators that frequently appear in the literature and may help us interpret our results. We included them in our meta-regressions alongside an indicator for the type of independent variable used in the original study (n, $\log(n)$, or k). The additional moderators are: electoral system; estimation method; publication year; paper publication in an academic journal.

Table 1: Descriptive Statistics of Moderators

	[ALL] N=163	Extended Sample N=118	Main Sample N=45
Independent Variables:			
K	47 (28.8%)	35 (29.7%)	12 (26.7%)
logN	34 (20.9%)	27 (22.9%)	7 (15.6%)
N	82 (50.3%)	56 (47.5%)	26 (57.8%)
Electoral system:			
Maj	74 (45.4%)	52 (44.1%)	22 (48.9%)
Non-Maj	89 (54.6%)	66 (55.9%)	23 (51.1%)
Estimation method:			
OLS	50 (30.7%)	41 (34.7%)	9 (20.0%)
PANEL	83 (50.9%)	58 (49.2%)	25 (55.6%)
IV	19 (11.7%)	12 (10.2%)	7 (15.6%)
RDD	11 (6.75%)	7 (5.93%)	4 (8.89%)
Year	2008 (6.17)	2007 (5.99)	2009 (6.54)
Published work:			
No	18 (11.0%)	12 (10.2%)	6 (13.3%)
Yes	145 (89.0%)	106 (89.8%)	39 (86.7%)

G Binomial Tests for Coefficient Signs

The *law of 1/n* posits that we should expect a positive influence of legislature size on public expenditures. A general test of the theory could investigate whether the papers tend to find a higher frequency of positive coefficients in their estimations. In statistical terms, consider a random variable representing the coefficient sign for the papers. As each sign of the paper is a Bernoulli trial, the aggregate result for all papers follows a Binomial distribution with parameters n equals the number of papers, and p the chance of a positive sign. The *law of 1/n* can be reformulated as the chance of $p > 0.5$, which facilitates the testing of the theory. The null hypothesis for such a test is that:

- H_0: the proportion of positive and negative signs are statistically equal ($p = 0.5$).

As we are taking an agnostic approach, we acknowledge that either the *law of 1/n* ($p > 0.5$), or the *reverse law of 1/n* ($p < 0.5$) may be true. In this case, the alternative hypothesis is $p \neq 0.5$. To perform this test, we run binomial tests in `R`, using the function `binom.test(.)`.

This test has two advantages. First, it is robust to the design of the paper. This is an important feature as papers analyse different countries, samples, and have distinct characteristics, such as whether they were published or not. The binomial test ignores the design discrepancies and focuses on the overall reported effect. Second, this test has the advantages of requiring few assumptions and being easy to interpret. The disadvantage is that the test is not as informative as the meta-regressions, as we shall see in the next sections.

For the number of legislators in the lower house (N), the results follow below.

method	alternative	estimate	p.value
Exact binomial test	two.sided	0.5	1

Under the null hypothesis of $p = 0.5$, we find that 13 out of 26 studies have a positive sign. The chance of a distribution with $p = 0.5$ generate this sample is equal to p-value = 1. Thus, we reject the hypothesis that $p \neq 0.5$.

For the log of the number of legislators in the lower house ($\log(N)$), the results are as follows:

method	alternative	estimate	p.value
Exact binomial test	two.sided	0.7143	0.4531

Out of 7 studies, 5 have a positive sign. The chance of a distribution with $p = 0.5$ generate this sample is equal to p-value = 0.453. So we reject the hypothesis that $p \neq 0.5$.

Finally, for the number of legislators in the upper house (K), the results are:

method	alternative	estimate	p.value
Exact binomial test	two.sided	0.8333	0.03857

Here we see that 10 out of 12 studies have a positive sign. The p-value for this test is 0.039. Therefore, we accept the hypothesis that $p \neq 0.5$. This is the only test that presents evidence of an association between the legislature size and expenditure.

H Meta-Analysis

H.1 Estimation Method

In general terms, there are two main ways to conduct a meta-analysis, either by using fixed effects or by employing random effects models. The fixed effects model assumes that there exists a single true effect and all estimates are an attempt to uncover this effect. The random effects model, in contrast, assumes that there is a distribution of true effects, and that the coefficients vary based on sampling and tests characteristics.

In this paper, we employ a random effects model. The empirical papers testing the *law of 1/n* are very diverse. We tried to capture some of this diversity by considering the main dependent and independent variables separately, but they have at least three other important sources of dispersion:

1. **Study sample**: Counties, Municipalities, States, Provinces, Countries.
2. **Electoral systems**: Majoritarian, PR, Mixed.
3. **Modelling strategies**: Panel data, Standard OLS, IV, RDD.

These sources of heterogeneity have two implications. First, they make our estimates notably disperse. Second, the amount of heterogeneity makes fixed effects estimates unrealistic and biased. Thus, we opt for random effects model.

Assume that each study has an effect of T_i. In a random effects model, we can decompose this effect into two components, the true effect that the study with the same specifications as i comes from, θ_i, and a within-study error ε_i:

$$T_i = \theta_i + \varepsilon_i$$

And the random effects model assumes that the θ_i varies from study to study, having a true parameter μ, plus a between-study error, ξ_i:

$$T_i = \mu + \xi_i + \varepsilon_i$$

And the random effects model estimates the parameter μ, under the challenge of estimating both the within-and-between-study sampling errors.

Another crucial assumption in meta-analysis is that the coefficients should be independent (Harrer et al. 2019; Cheung 2019; Veroniki et al. 2016; Borenstein et al. 2011). This assumption states that for our findings to be consistent, the coefficients must come from different sources of variation. However, in the political economy literature, authors frequently use similar datasets, and almost all papers fit more than one model with similar variables. While our restricted dataset contains 45 estimates, our full dataset has 163 coefficients.

This is because the papers report an average of 5.43 coefficients. To correct for the violation of the independent assumption, we use a multilevel random effects model (Cheung 2014). We add two extra levels to the regular random effects model, one that indicates the publication ID and another that indicates the data used in the original article. These levels are assumed to remove dependence structures in the data, therefore improving the estimates of our coefficient of interest, which is the effect of legislature size on public spending.

There are two levels in the main models. First, we build a common index for papers that share the same data specifications. The papers with common indexing are:

Publication ID	Source of Dependence
3, 42, 132, 165, 439, 441, 467, 505	US States Data
408, 208, A258	US Municipalities Data
849, 578	US Municipalities Data and Same Author in Two Different Studies

All the remaining papers received a unique index. As the number of the papers with these dependencies is not very high, and many characteristics within papers vary (e. g., state-wise ad-hoc exclusions, start and end points variations, region selection, etc), we show that it makes little difference to change from this index to the paper IDs. In regard to the full dataset, the results change considerably, because authors fit several models within the same paper. In any case, we use multilevel random effects for all the estimated models in this paper.

To study the possibility of of publication bias, we add a funnel plot and an Egger et al. (1997) test for distribution asymmetry for every model. Funnel plots display the possibility of having a file-drawer effect, meaning that null results are under-represented in our sample. In this type of plot, under the assumption of no file-drawer effect, the coefficients are expected to lie symmetrically around the mean observed outcome. If they are asymmetric, it provides evidence for a file-drawer effect.

We use the `R` packages `meta` and `dmetar` in all estimates (Harrer et al. 2019). We employ the *Restricted Maximum Likelihood Estimator* to assess the variance of the true effect size (τ^2), which in our formulation represents the variance of ξ_i. The literature regards this estimator as the most precise when analysing continuous measures, such as the ones we have in our data (Veroniki et al. 2016).

We combine the three independent variables (n, $\log(n)$, and k) with our dependent variables of interest (Expenditure Per Capita, Log of Expenditure Per Capita, Expenditure as a Percentage of the GDP). This formed a 3×3 table, yet not all combinations are available in the data. The results are shown below.

H.2 Lower House Size and Expenditure per Capita

The results for the meta-analysis that compares lower house size (n) and expenditure per capita is available below.

```
## Warning in rma.mv(coef, VAR, data = aux, slab = paste(authoryear), test = "t", : Ratio of largest to smallest sampling
## variance extremely large. May not be able to obtain stable results.

##
## Multivariate Meta-Analysis Model (k = 16; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.1228  0.3504      9     no           id_level1
## sigma^2.2  0.0000  0.0000     16     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 15) = 114.9561, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.0217  0.1302  0.1666  0.8699  -0.2559  0.2992
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot:

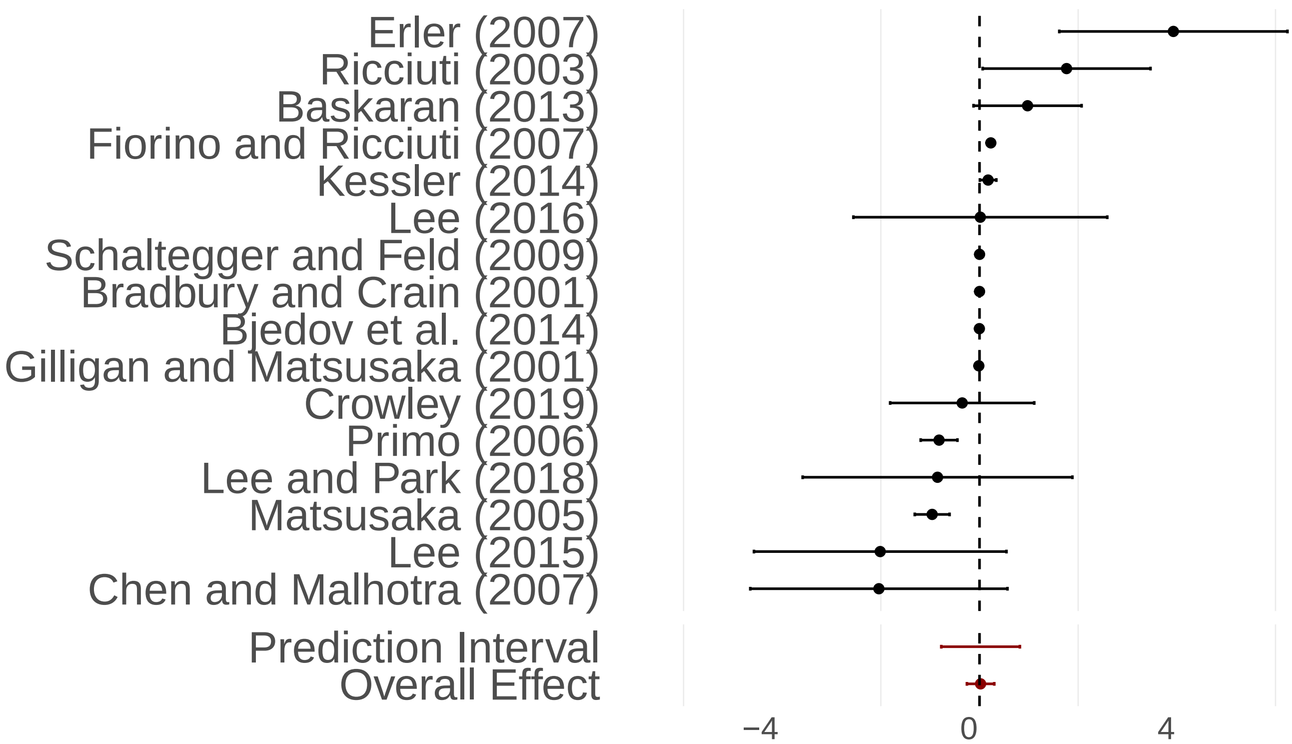


Figure 9: Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

And to assess the possibility of publication bias, we add the funnel plot below:

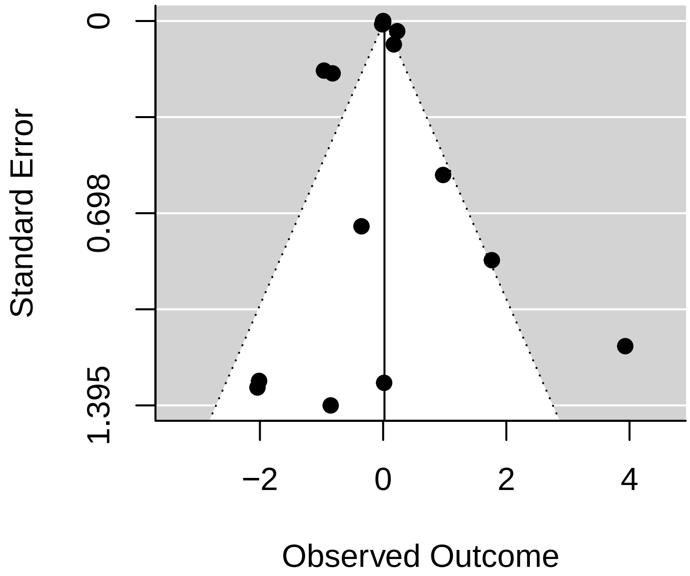


Figure 10: Funnel Plot – Effect of Lower House Size (N) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 114.96$.
2. The estimated SMD in the random effects model is $g = 0.02$ ($SE = 0.13$).
3. The prediction interval ranges from -0.77 to 0.82. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.2.1 Electoral System Subgroup Analysis

The *law of 1/n* was introduced to describe majoritarian systems, but the theory has also been applied to non-majoritarian electoral systems. We estimated a subgroup analysis using a binary indicator for electoral system. The results may be seen below.

We find little evidence that either majoritarian or non-majoritarian systems produce systematically positive effects on expenditure per capita. Both coefficients are not statistically significant, and they reassure us that the absense of effect is not caused by pooling multiple types of electoral systems.

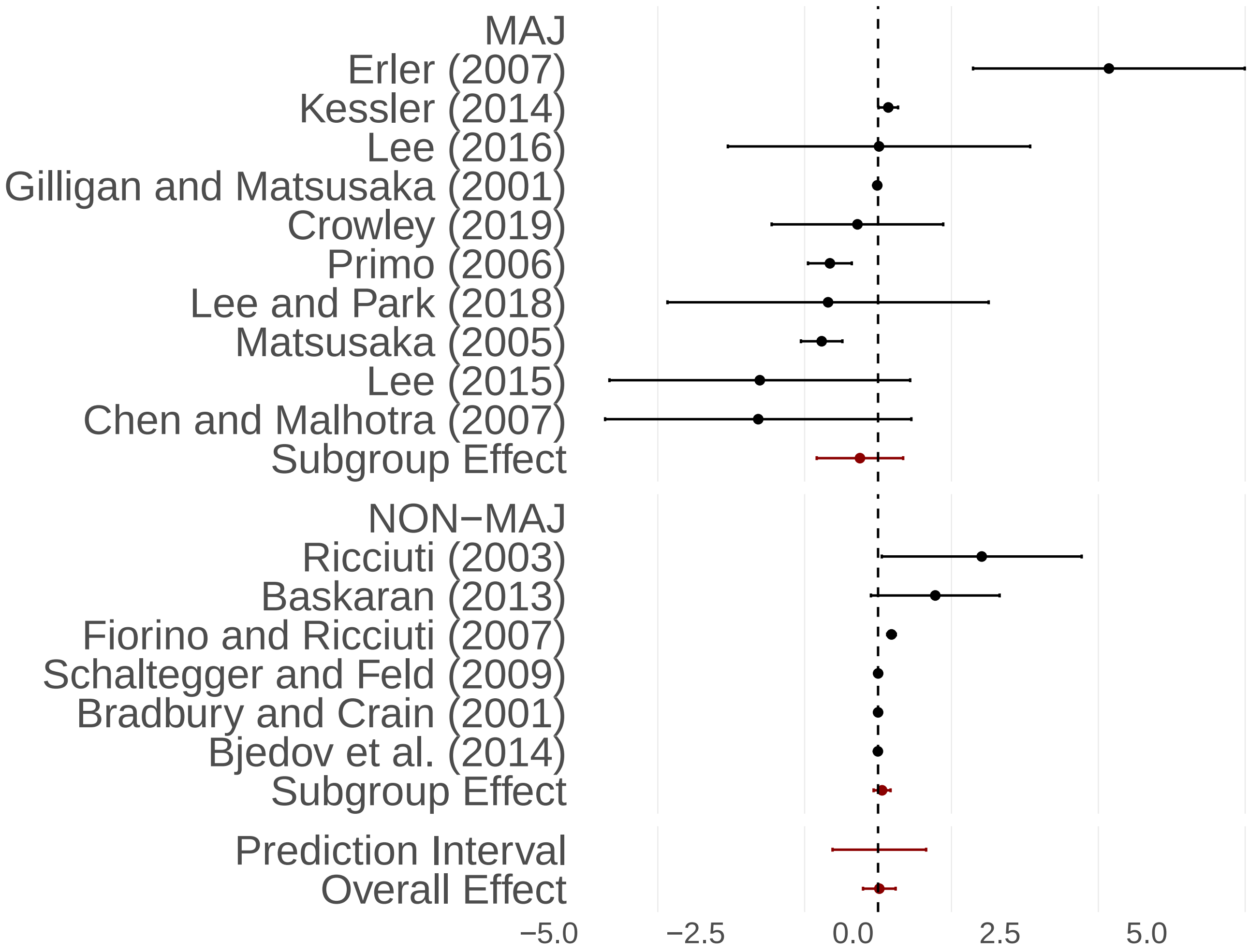


Figure 11: Subgroup Analysis of Lower House Size x Expenditure Per Capita, controlling by Electoral System

H.3 Log of Lower House Size and Expenditure per Capita

There are no studies that have per capita expenditure as the dependent variable and log of lower house size as the treatment variable.

H.4 Upper House Size and Expenditure per Capita

Now we look into the upper house size (k). In this model, we investigate the effect of upper house size on expenditure per capita (ExpPC).

```
## Warning in rma.mv(coef, VAR, data = aux, slab = paste(authoryear), test = "t", : Ratio of largest to smallest sampling
## variance extremely large. May not be able to obtain stable results.
```

```
##
## Multivariate Meta-Analysis Model (k = 9; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed              factor
```

```
## sigma^2.1   33.6704  5.8026      4     no           id_level1
## sigma^2.2   52.3772  7.2372      9     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 8) = 41.4521, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb    ci.ub
##   3.6581  4.2989  0.8509  0.4195  -6.2553  13.5714
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

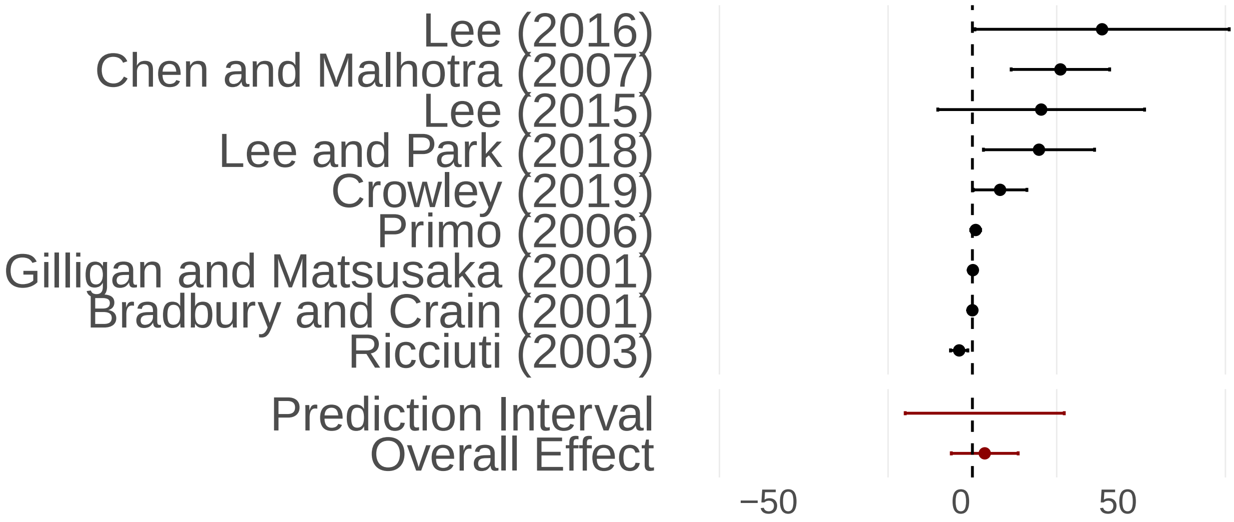


Figure 12: Effect of upper house size (K) on the per capita government expenditure (ExpPC)

We see no evidence of publication bias:

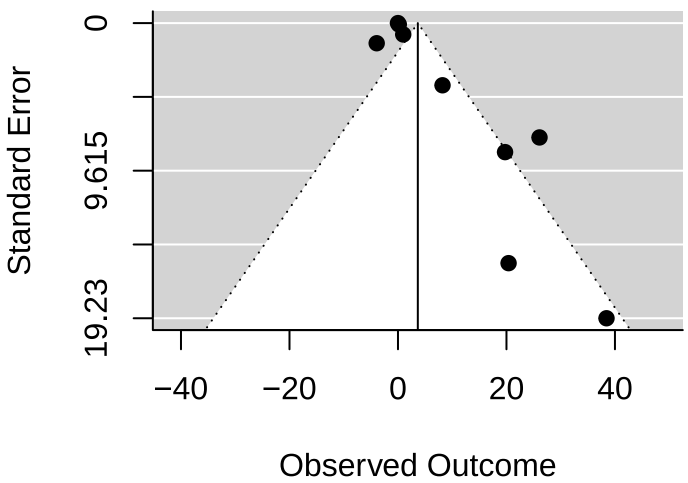


Figure 13: Funnel Plot – Effect of upper house size (K) on per capita government expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 41.45$.
2. The estimated SMD in the random effects model is $g = 3.66$ ($SE = 4.299$).
3. The prediction interval ranges from -19.92 to 27.23. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.5 Lower House Size and Log Expenditure Per Capita

This model estimates the Log of Per Capita Expenditure as the dependent variable, and the number of lower house legislators as the treatment variable.

```
##
## Multivariate Meta-Analysis Model (k = 4; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0046  0.0681      4     no            id_level1
## sigma^2.2  0.0046  0.0681      4     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 3) = 36.2575, p-val < .0001
##
## Model Results:
##
## estimate      se     tval    pval    ci.lb   ci.ub
##  -0.0306  0.0495  -0.6188  0.5799  -0.1880  0.1268
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot is as follows:

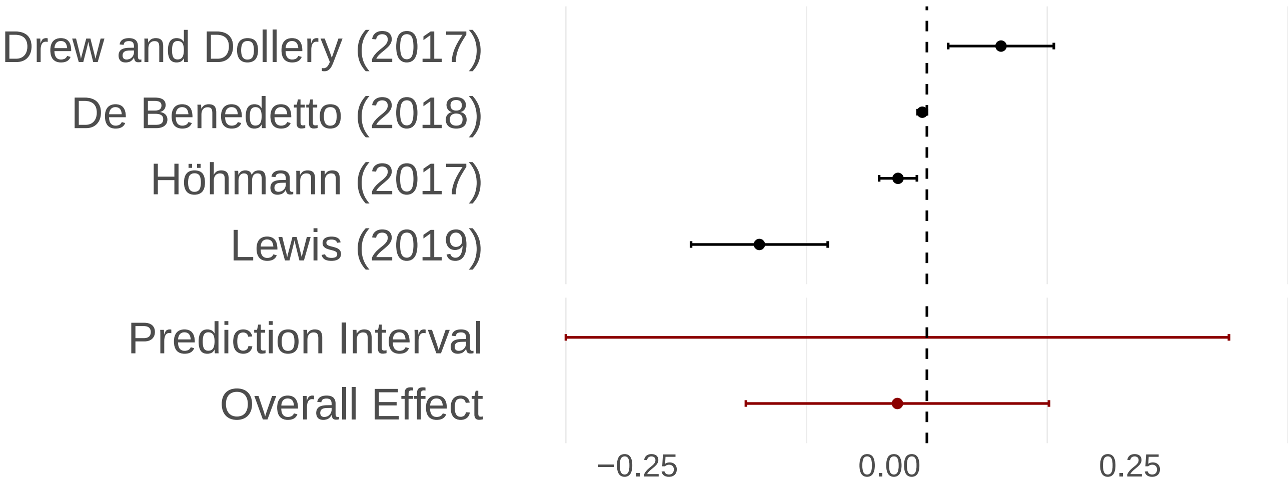


Figure 14: Effect of lower houses size (N) on log of per capita expenditure (logExpPC)

The funnel plot shows no evidence of publication bias.

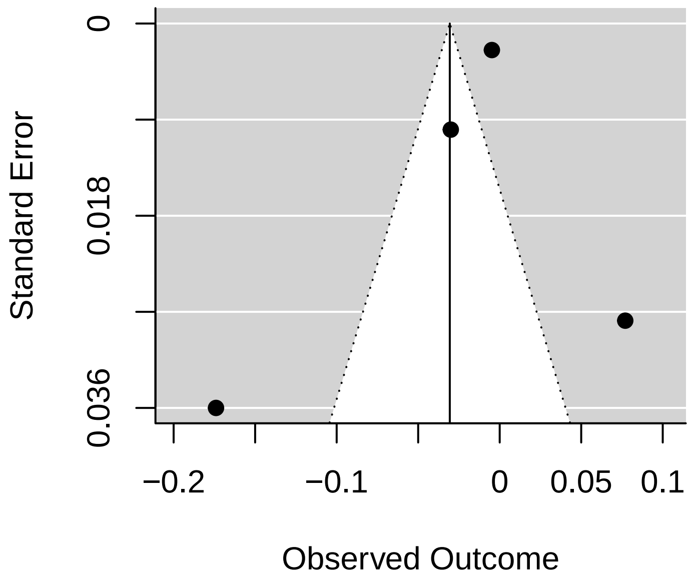


Figure 15: Funnel Plot – Effect of lower houses size (N) on log of per capita expenditure (logExpPC)

Highlights:

1. The results are highly heterogeneous: Q = 36.26.
2. The estimated SMD in the random effects model is g = -0.03 (SE = 0.049).
3. The prediction interval ranges from -0.37 to 0.31. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.6 Log of Lower House Size and Log of Expenditure Per Capita

In this specification, we study the log of per capita expenditure (logExpPC) as a function of the log of lower house size (logN).

```
##
## Multivariate Meta-Analysis Model (k = 5; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.0289  0.1701      3     no           id_level1
## sigma^2.2  0.0085  0.0924      5     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 4) = 70.4596, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.0777  0.1089  0.7132  0.5151  -0.2248  0.3802
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot is available below:

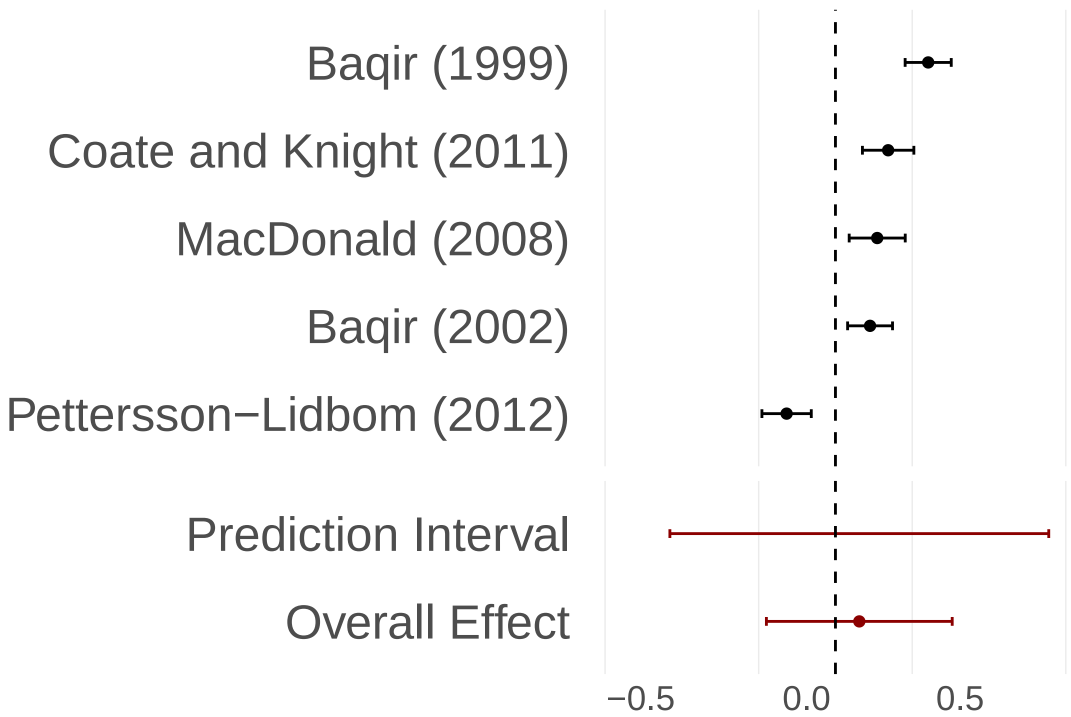


Figure 16: Effect of log lower houses size (logN) on the log of per capita government expenditure (logExpPC)

The funnel plot:

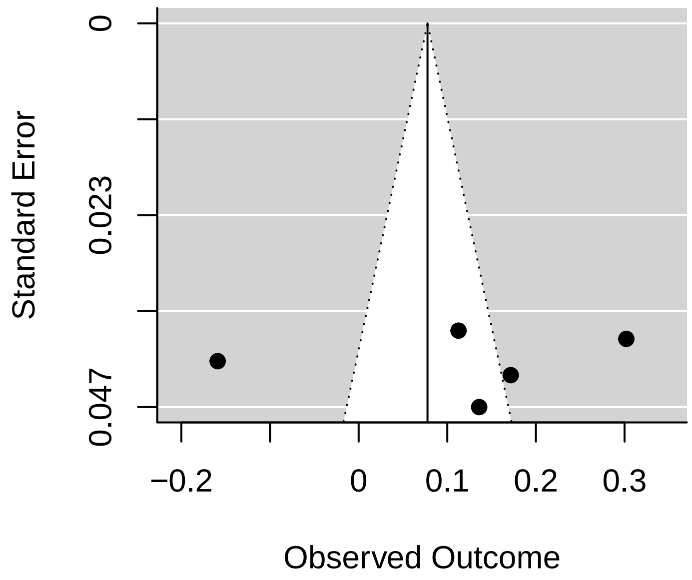


Figure 17: Funnel Plot – Effect of log lower houses size (N) on log of per capita government expenditure (logExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 70.46$.
2. The estimated SMD in the random effects model is $g = 0.08$ ($SE = 0.109$).
3. The prediction interval ranges from -0.54 to 0.69. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.7 Upper House Size and Log of Expenditure Per Capita

No studies correlate the log of per capita expenditure with the size of upper house (K).

H.8 Lower House Size and Expenditure as Percentage of GDP

This model fits the random effects for the percentage of GDP as public expenditure as the main outcome, and the size of lower house as the treatment variable.

```
##
## Multivariate Meta-Analysis Model (k = 6; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0003  0.0168      6     no            id_level1
## sigma^2.2  0.0003  0.0168      6     no  id_level1/id_level2
##
## Test for Heterogeneity:
```

```
## Q(df = 5) = 42.9051, p-val < .0001
##
## Model Results:
##
## estimate      se     tval    pval    ci.lb   ci.ub
##  -0.0065  0.0104  -0.6194  0.5628  -0.0333  0.0204
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Below, you may find the forest plot:

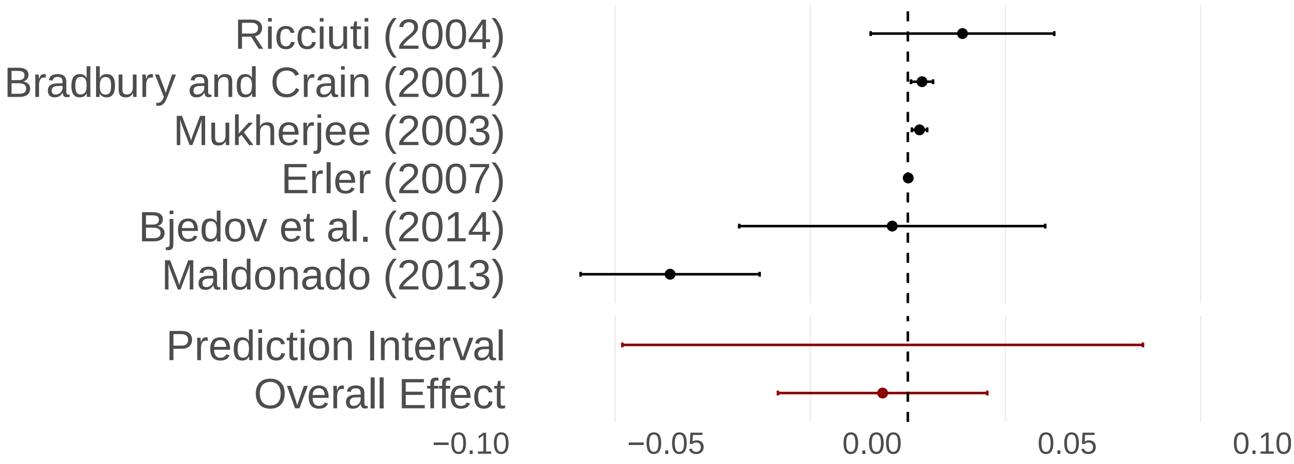


Figure 18: Effect of lower houses size (N) on percentage of public expenditure GDP (PCTGDP)

The funnel plot to test for publication bias:

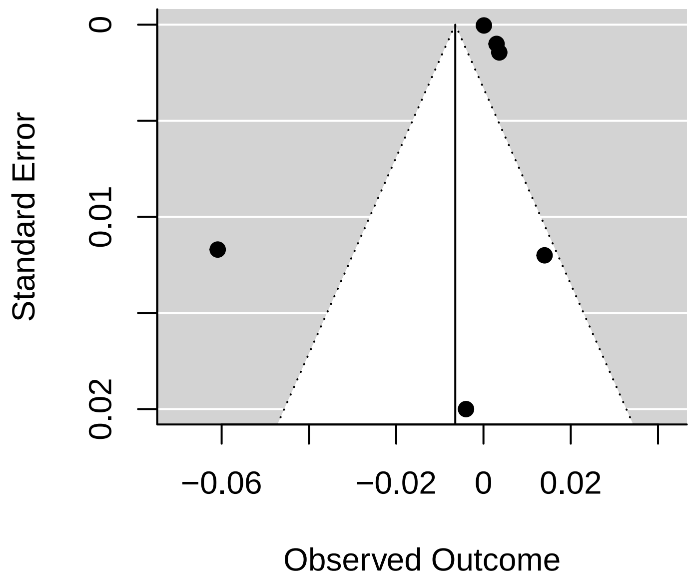


Figure 19: Funnel Plot – Effect of lower houses size (N) on percentage of public expenditure GDP (PCTGDP)

Highlights:

1. The results are highly heterogeneous: Q = 42.91.
2. The estimated SMD in the random effects model is g = -0.01 (SE = 0.01).
3. The prediction interval ranges from -0.07 to 0.06. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.9 Log Lower House Size and Expenditure as Percentage of GDP

This model investigates the percentage of GDP as public expenditure as the dependent variable and the log lower house size (logN) as the treatment variable.

```
##
## Multivariate Meta-Analysis Model (k = 2; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1   3.7290  1.9311      2     no            id_level1
## sigma^2.2   3.7290  1.9311      2     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 1) = 3.0767, p-val = 0.0794
##
## Model Results:
##
## estimate      se     tval    pval     ci.lb    ci.ub
##  -1.5756  2.2228  -0.7088  0.6074  -29.8196  26.6683
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

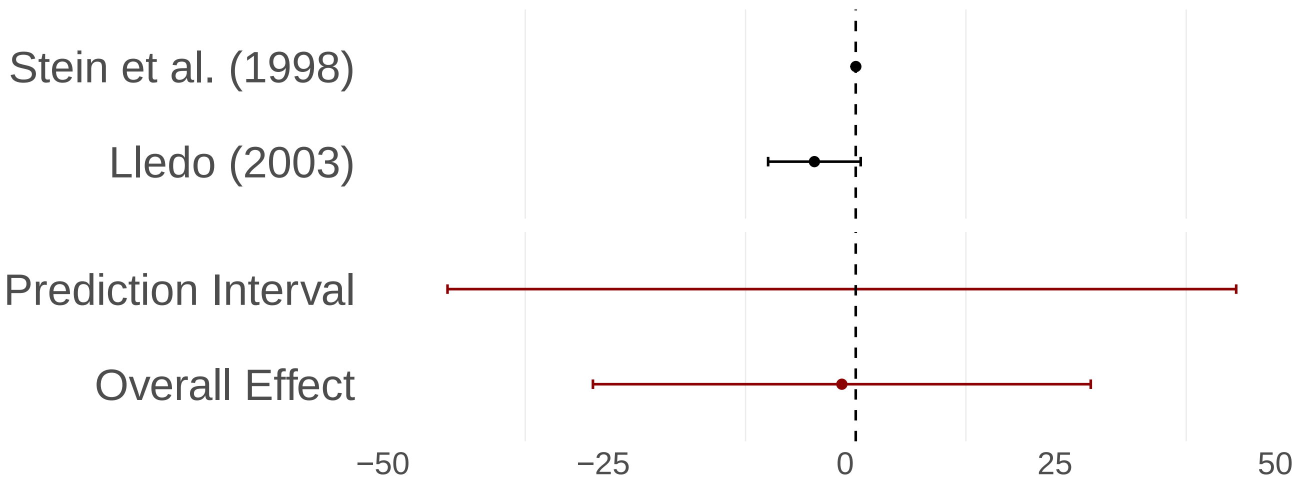


Figure 20: Effect of log lower houses size (logN) on the GDP share of public expenditure (PCTGDP)

The funnel plot is available below:

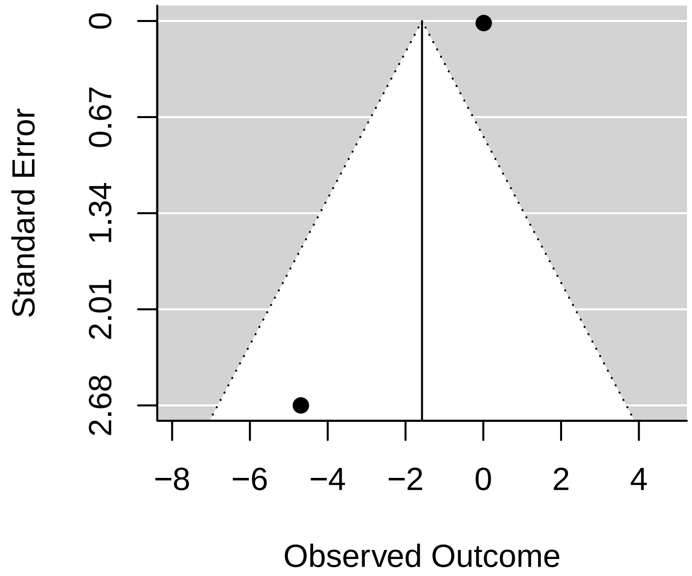


Figure 21: Funnel Plot – Effect of log lower houses size (N) on the GDP share of public expenditure (PCTGDP)

Highlights:

1. The results are highly heterogeneous: Q = 3.08.
2. The estimated SMD in the random effects model is g = -1.58 (SE = 2.223).
3. The prediction interval ranges from -46.32 to 43.17. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.10 Upper House Size and Expenditure as Percentage of GDP

This model looks into the effect of upper house size (K) on the public expenditure share of the GDP (PCTGDP).

```
##
## Multivariate Meta-Analysis Model (k = 3; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.0004  0.0201      3     no           id_level1
## sigma^2.2  0.0004  0.0201      3     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 2) = 14.0739, p-val = 0.0009
##
## Model Results:
##
```

```
## estimate      se      tval     pval     ci.lb    ci.ub
##  -0.0027  0.0175  -0.1570  0.8896  -0.0781  0.0726
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

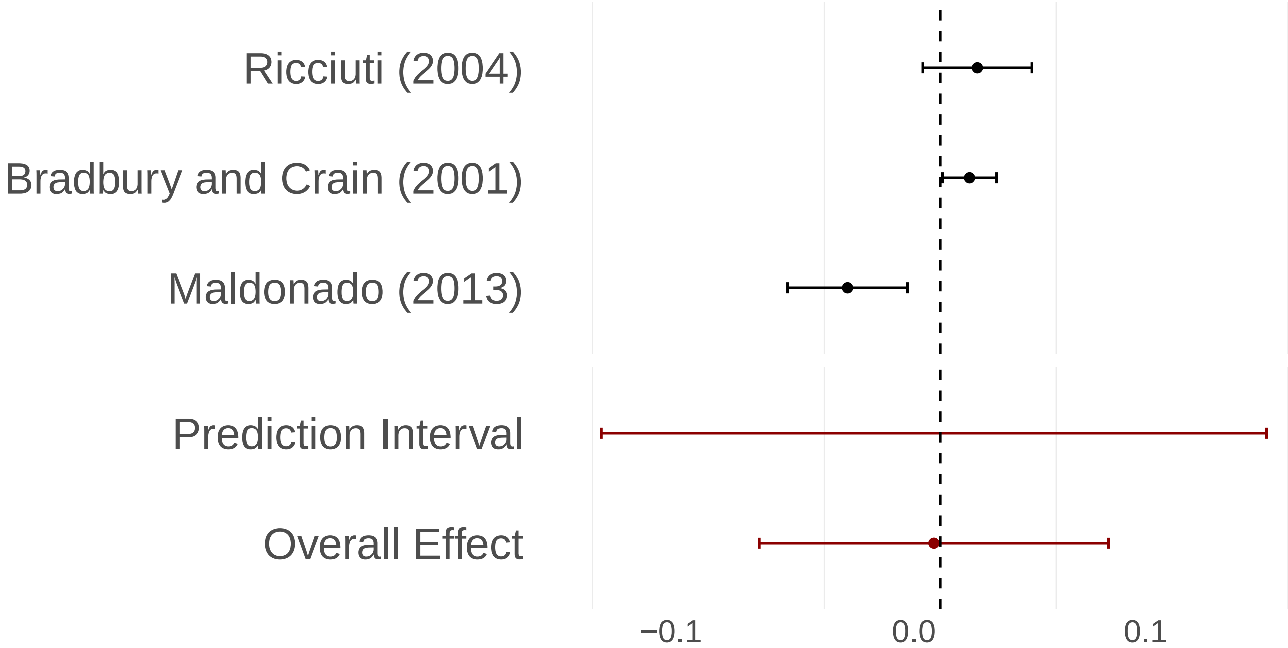


Figure 22: Effect of upper house size (K) on the public expenditure share of the GDP (PCTGDP)

As in our previous estimations, we find no evidence of file-drawer effect.

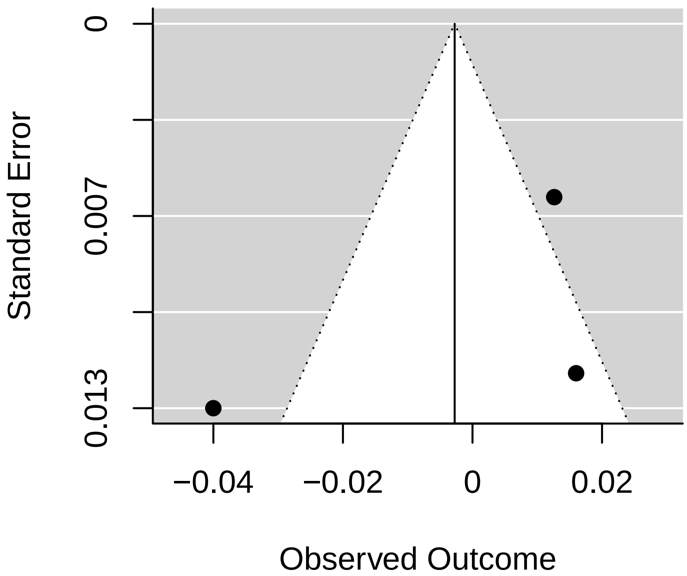


Figure 23: Funnel Plot – Effect of upper house size (K) on the public expenditure share of the GDP (PCTGDP)

Highlights:

1. The results are highly heterogeneous: $Q = 14.07$.

2. The estimated SMD in the random effects model is $g = 0$ ($SE = 0.018$).
3. The prediction interval ranges from -0.15 to 0.14. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.11 Lower House Size and Expenditure per Capita (IV)

Here we estimate a meta-analysis of the papers which use instrumental variables. The results may be seen below.

```
##
## Multivariate Meta-Analysis Model (k = 5; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1   0.7896  0.8886      3     no            id_level1
## sigma^2.2   0.0000  0.0000      5     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 4) = 46.7149, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.0006  0.5431  0.0011  0.9992  -1.5074  1.5085
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

And the forest plot:

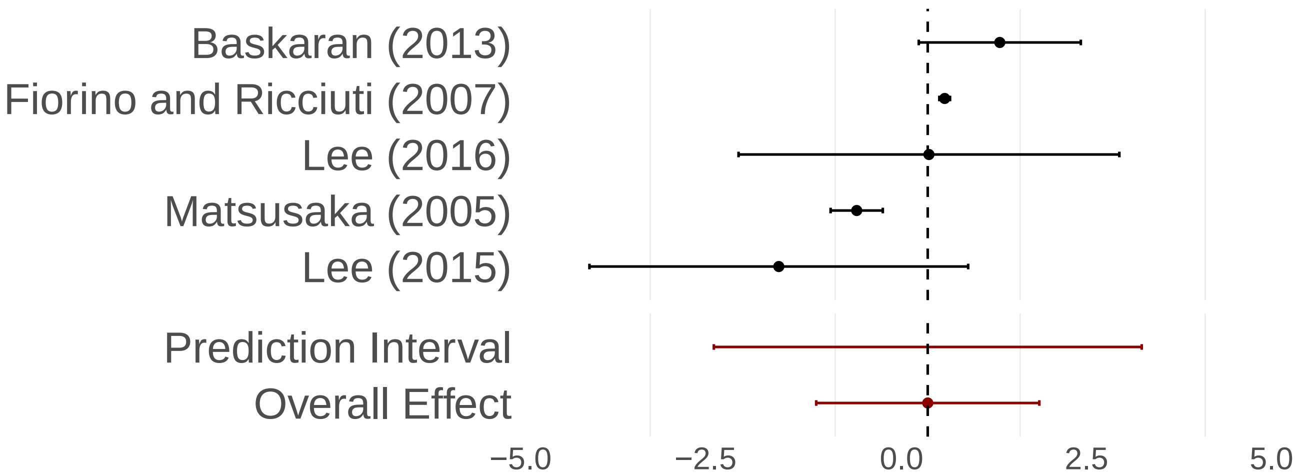


Figure 24: Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

No evidence of publication bias, as shown in the following tunnel plot:

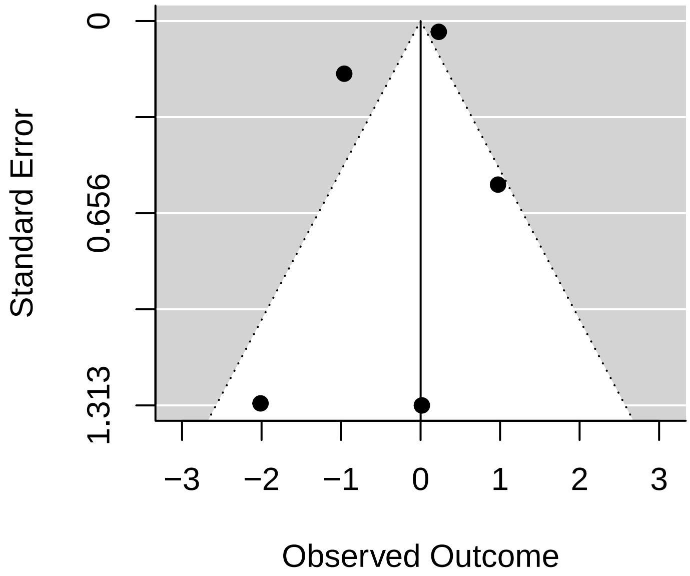


Figure 25: Funnel Plot – Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 114.96$.
2. The estimated SMD in the random effects model is $g = 0.02$ ($SE = 0.13$).
3. The prediction interval ranges from -0.77 to 0.82. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

H.11.1 Regression Method Subgroup Analysis

Over time, the literature evolved to use causally identified techniques for determine the effect of legislature size on the expenduture per capita. To study whether the method had an effect on the estimated coefficients, we fit a subgroup analysis using the method employed in each paper.

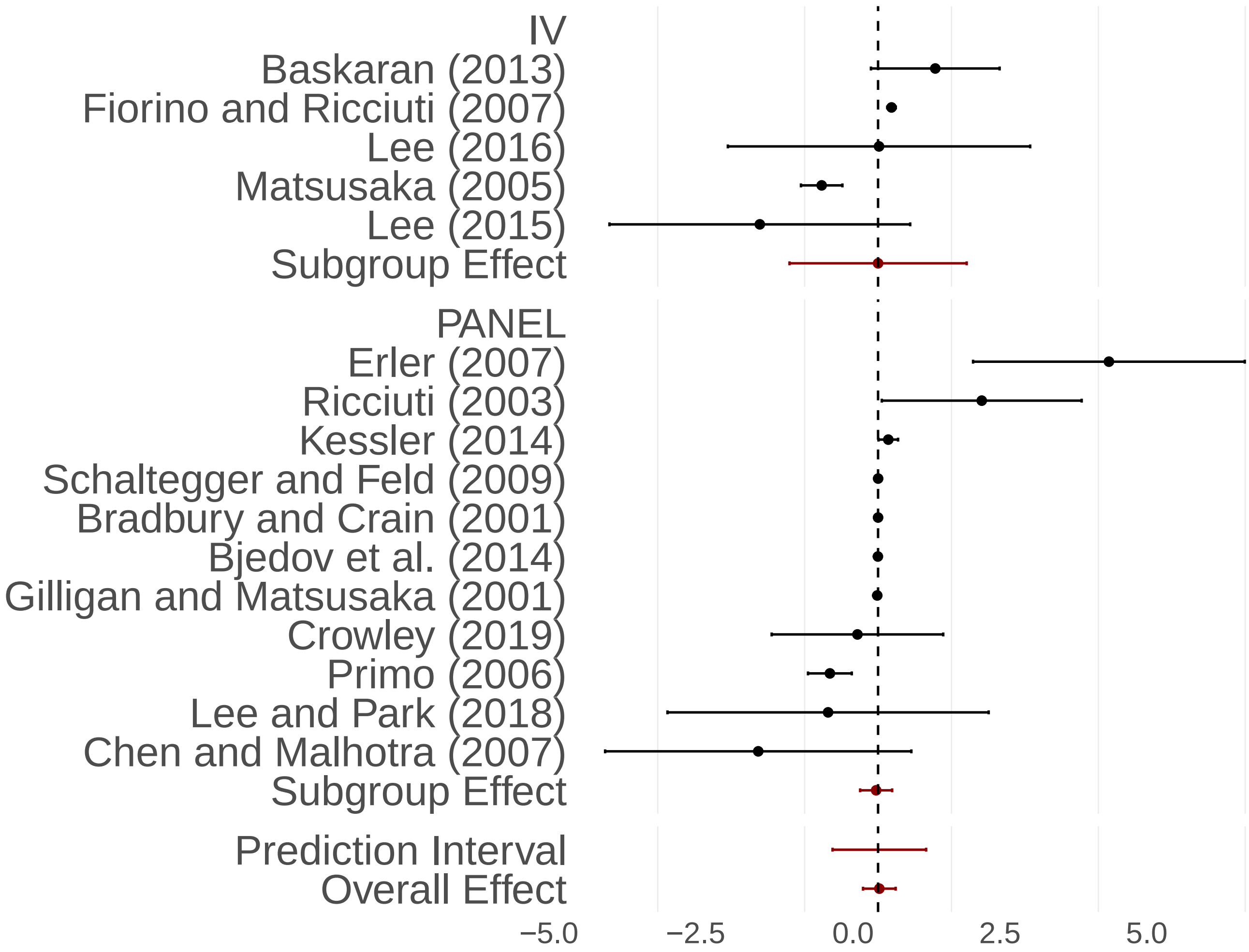


Figure 26: Subgroup Analysis of (N) x (ExpPC), controlling by regression methods

Although all methods generate a null effect, the IV method seems to be well distributed, with two papers with positive effects and two papers negative displaying negative effects. The random effects model for the subgroup is 0.22, which is negative but non-significant. Improve the estimation technique, for the case of IVs, render still a null effect of legislature size on per capita government expenditure.

H.12 Lower House Size and Log of Expenditure per Capita (RDD)

In this subsection, we run a meta-analysis with papers that include regression discontinuity designs.

```
##
## Multivariate Meta-Analysis Model (k = 3; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed             factor
## sigma^2.1  0.0035  0.0593      3     no           id_level1
## sigma^2.2  0.0035  0.0593      3     no  id_level1/id_level2
##
```

```
## Test for Heterogeneity:
## Q(df = 2) = 27.3176, p-val < .0001
##
## Model Results:
##
## estimate      se     tval    pval    ci.lb   ci.ub
##  -0.0640  0.0499  -1.2838  0.3279  -0.2785  0.1505
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Forest plot:

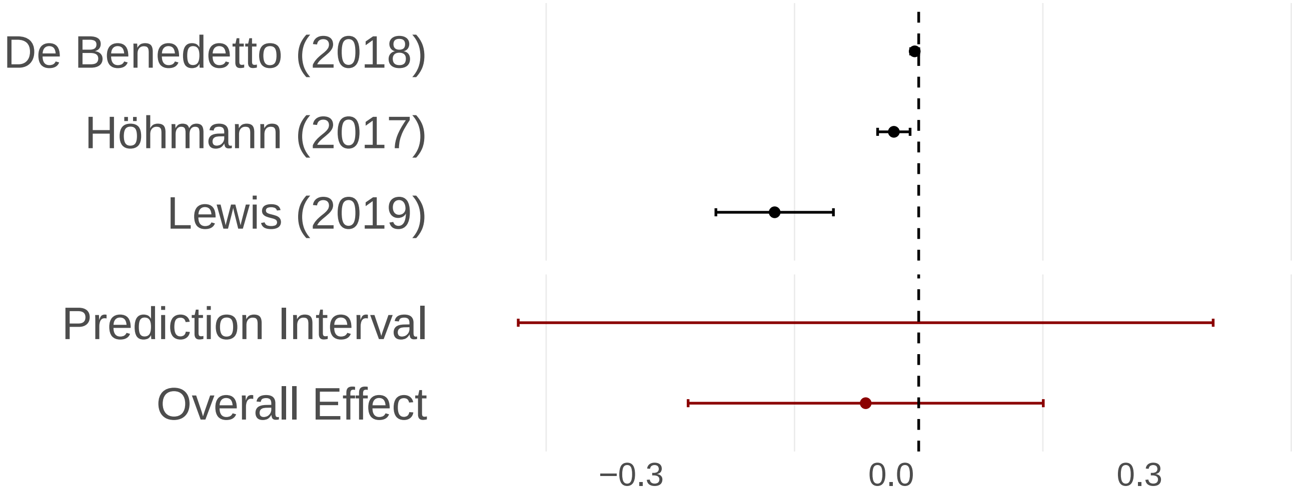


Figure 27: Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 27.32$.
2. The estimated SMD in the random effects model is g = -0.06 (SE = 0.05).
3. The prediction interval ranges from -0.48 to 0.36. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I Meta-Analysis (All Coefficients)

I.1 Lower House Size and Expenditure Per Capita

Here we estimate the relationship between expenditure per capita as a dependent variable, and the lower house size as the independent variable.

```
##
```

```
## Multivariate Meta-Analysis Model (k = 48; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.3624  0.6020      9     no           id_level1
## sigma^2.2  0.0031  0.0555     48     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 47) = 798.6513, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.1074  0.2128  0.5048  0.6160  -0.3206  0.5355
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot:

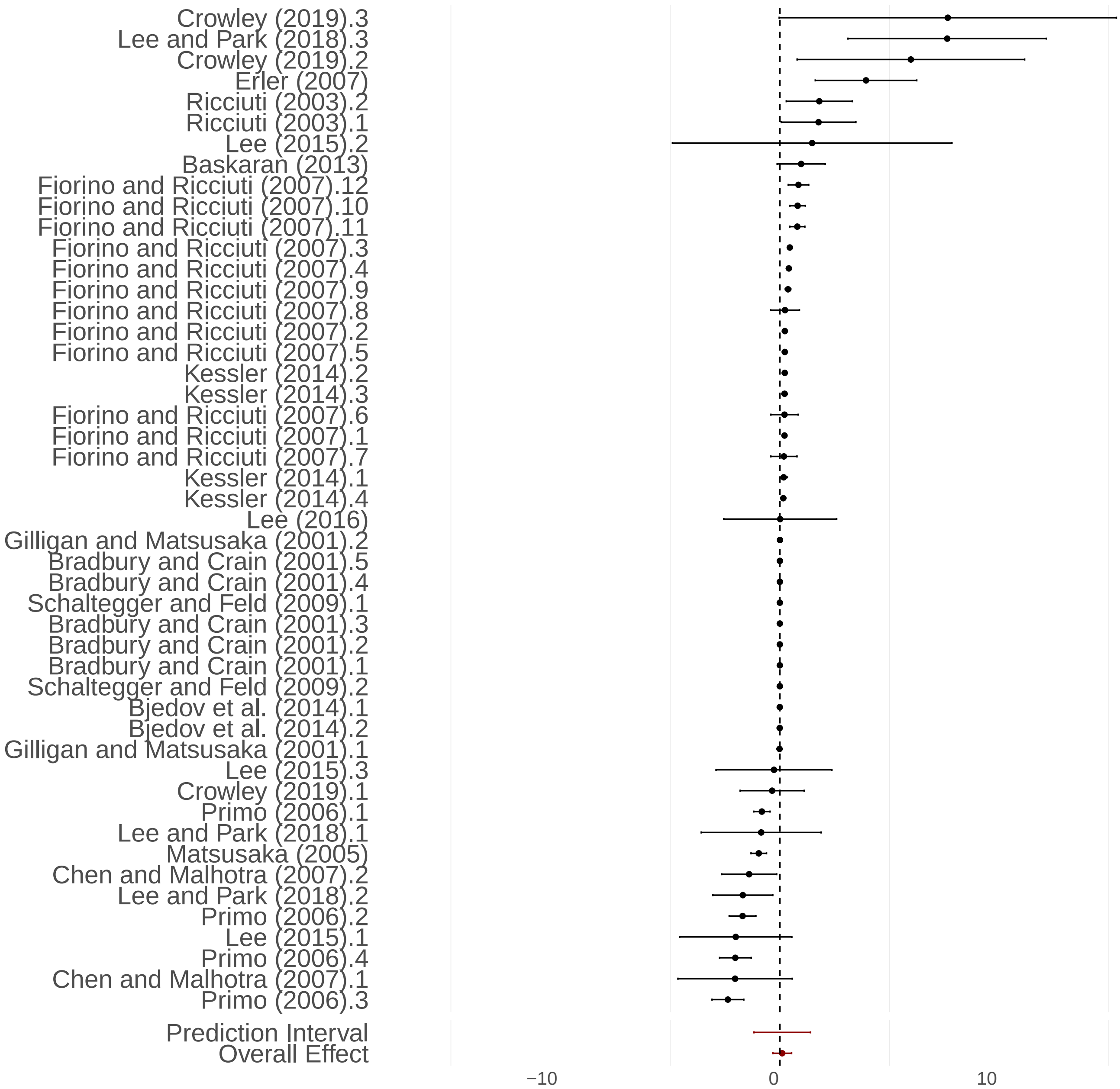


Figure 28: Effect of Lower House Size (N) on Per Capita Expenditure (ExpPC)

And to assess the possibility of publication bias, we add the funnel plot below:

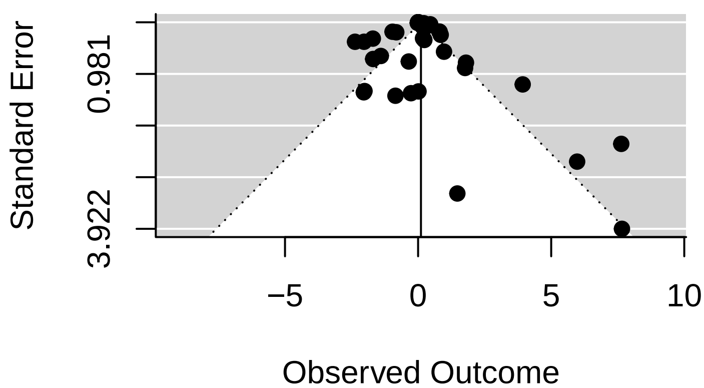


Figure 29: Funnel Plot – Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 798.65$.
2. The estimated SMD in the random effects model is $g = 0.11$ ($SE = 0.213$).
3. The prediction interval ranges from -1.18 to 1.4. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.1.1 Electoral System Subgroup Analysis

The *law of 1/n* was formulated to analyse the budgetary allocation in majoritarian systems. In the theoretical section below, we explain why the argument have potential issues when applied to non-majoritarian electoral systems. We estimated a subgroup analysis using a dummy variable indicating the electoral system included in each model.

We see that majoritarian systems do not have a clear positive effect on budgetary spending. The majoritarian systems in the sample had a random effects model estimate of -0.25, while the random effects model in the non-majoritarian subgroup fitted a value of 0.08. Both are not statistically significant, but they reassure us that the absence of effect is not caused by pooling multiple types of electoral systems.

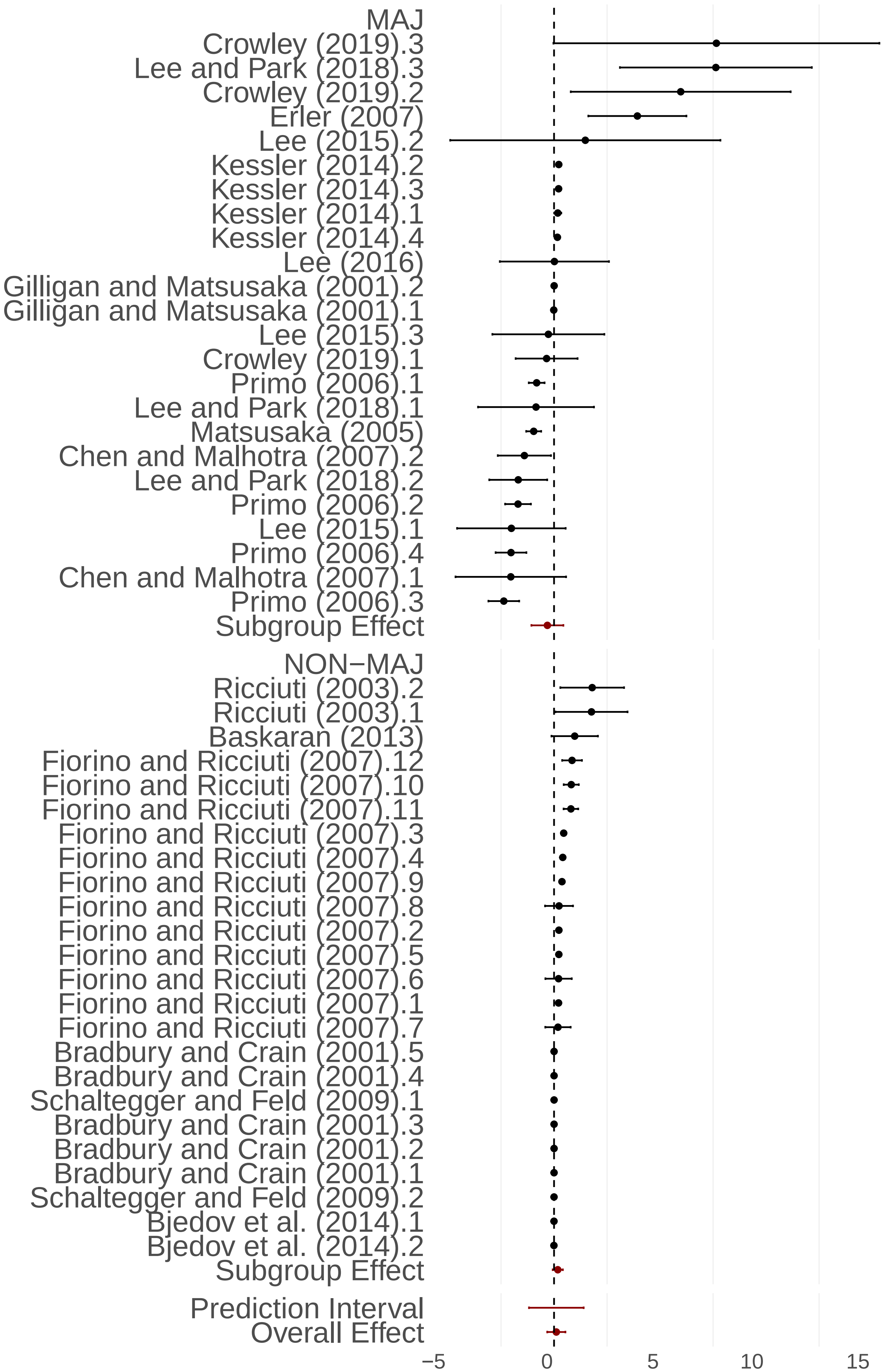


Figure 30: Subgroup Analysis of (N) x (ExpPC), controlling by electoral system

I.2 Log of Lower House Size and Expenditure Per Capita

There are no studies that have per capita expenditure as the dependent variable and log of lower house size as the treatment variable.

I.3 Upper House Size and Expenditure Per Capita

Now we investigate the effect of the upper house size (K) on government spending. In the model below, we evaluate the relationship between upper house size and expenditure per capita (ExpPC).

```
##
## Multivariate Meta-Analysis Model (k = 34; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed              factor
## sigma^2.1  16.3711  4.0461      4     no           id_level1
## sigma^2.2   2.5825  1.6070     34     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 33) = 204.3490, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.7372  2.0935  0.3522  0.7270  -3.5219  4.9964
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot:

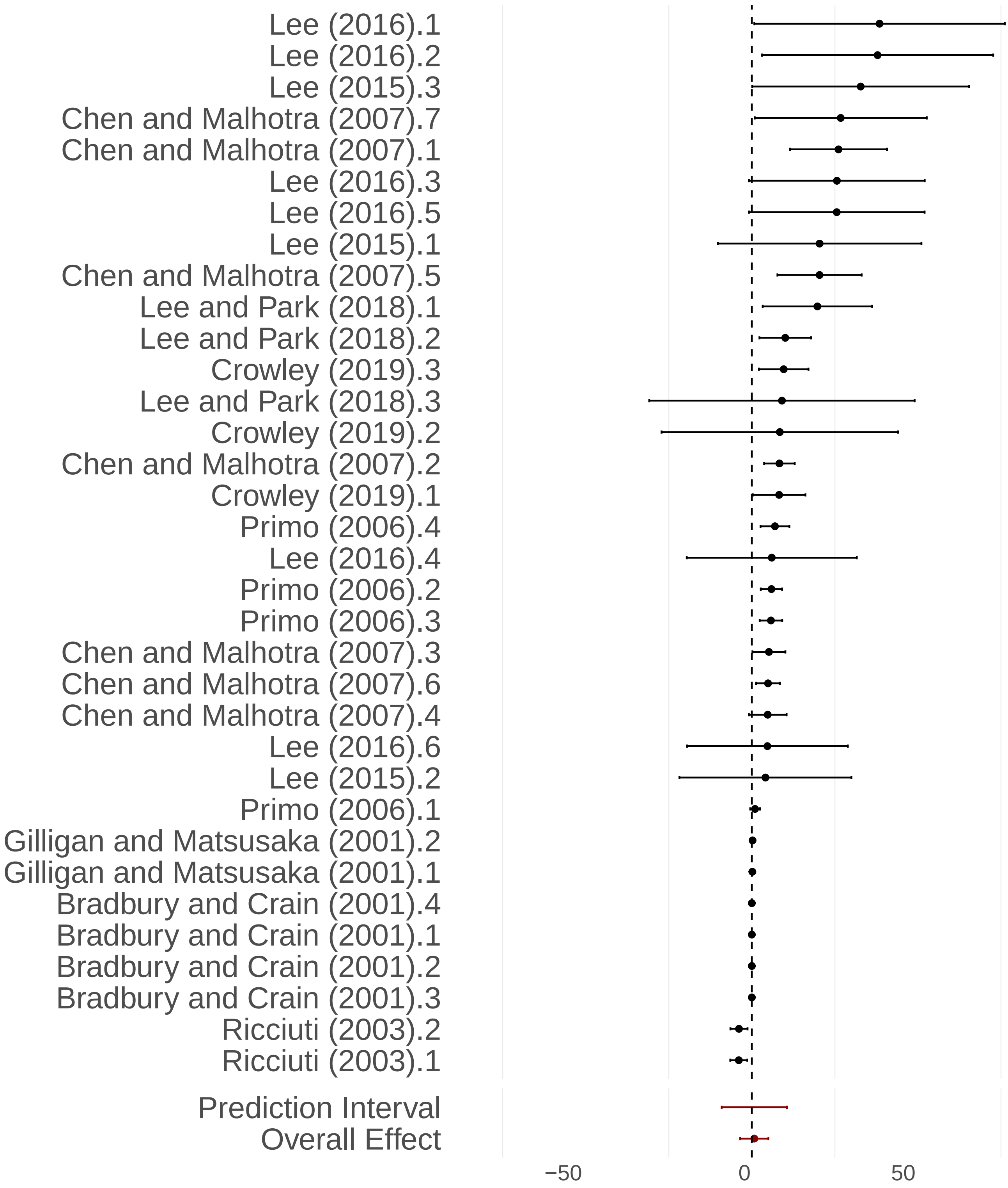


Figure 31: Effect of upper house size (K) on the per capita government expenditure (ExpPC)

The funnel plot suggests no publication bias.

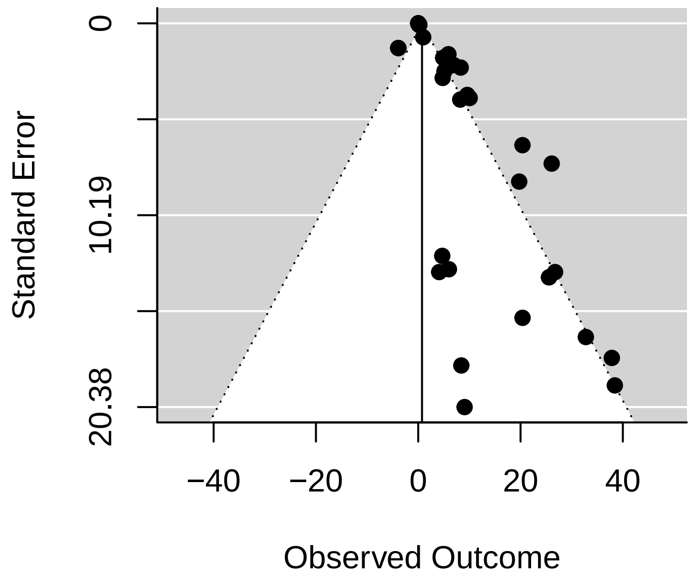


Figure 32: Funnel Plot – Effect of upper houses size (K) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 204.35$.
2. The estimated SMD in the random effects model is $g = 0.74$ ($SE = 2.093$).
3. The prediction interval ranges from -9.09 to 10.57. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.4 Lower House Size and Log of Expenditure Per Capita

This model estimates the log of per capita expenditure as the dependent variable, and the number of lower house legislators as the treatment variable.

```
##
## Multivariate Meta-Analysis Model (k = 8; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1   0.0075  0.0867      4     no             id_level1
## sigma^2.2   0.0000  0.0000      8     no   id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 7) = 48.0890, p-val < .0001
##
## Model Results:
##
```

```
## estimate      se     tval     pval    ci.lb    ci.ub
##  -0.0360  0.0444  -0.8105  0.4443  -0.1410  0.0690
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot is shown below:

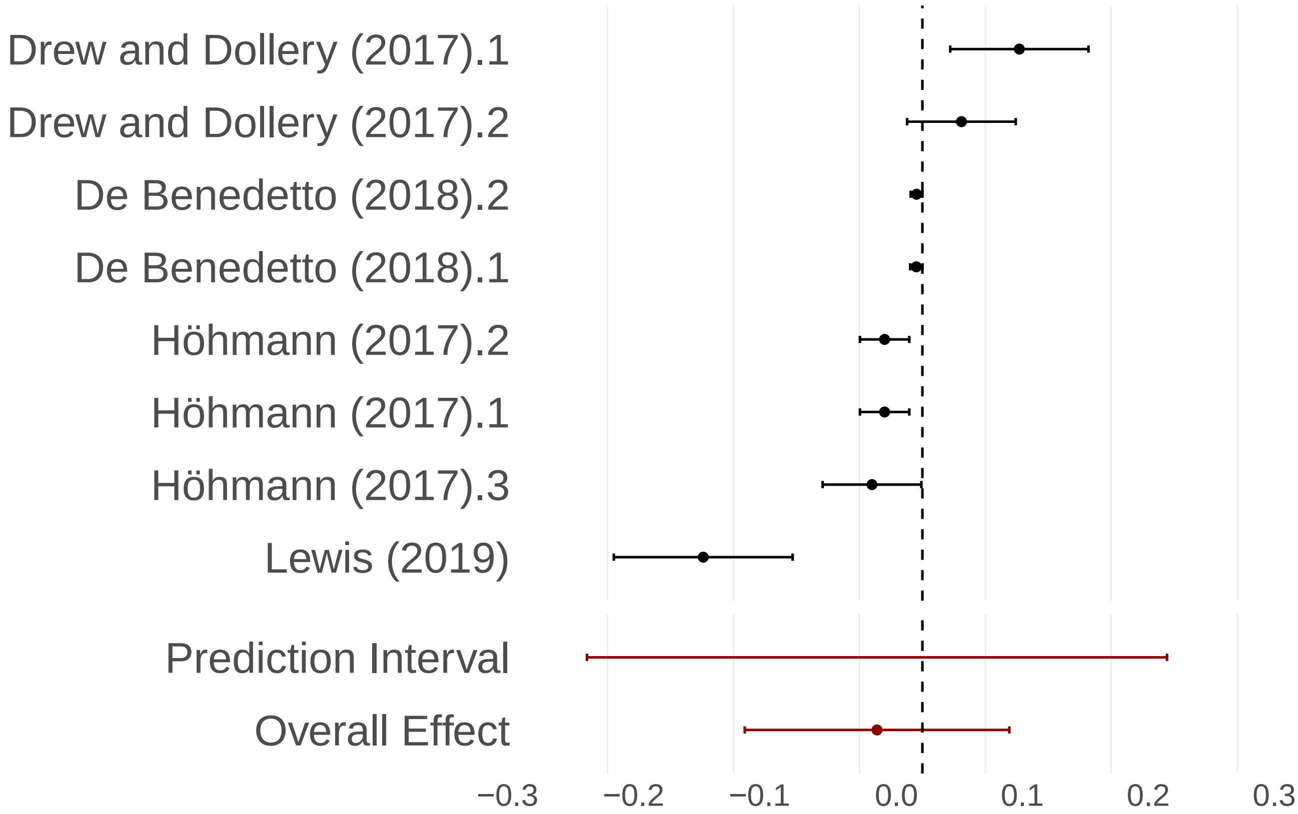


Figure 33: Effect of lower houses size (N) on log of per capita expenditure (logExpPC)

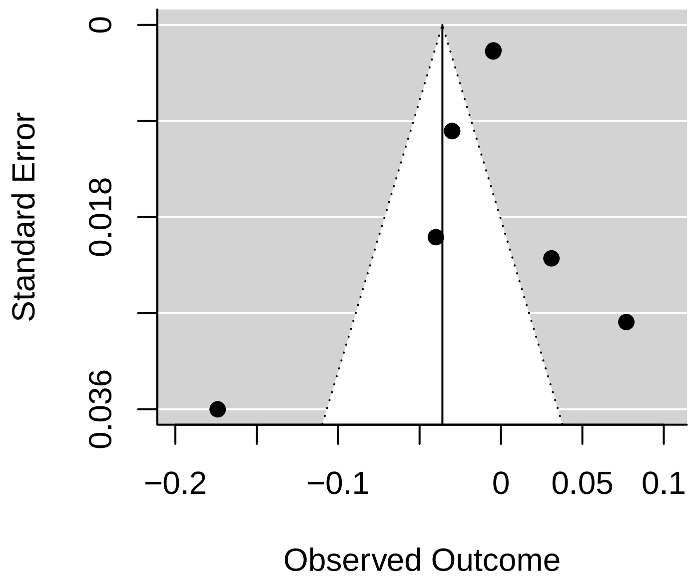


Figure 34: Funnel Plot – Effect of lower houses size (N) on log of Per Capita Expenditure (logExpPC)

Highlights:

1. The results are highly heterogeneous: Q = 48.09.
2. The estimated SMD in the random effects model is g = -0.04 (SE = 0.044).
3. The prediction interval ranges from -0.27 to 0.19. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.5 Log of Lower House Size and Log of Expenditure Per Capita

In this specification, we study the log of per capita expenditure (logExpPC) as a function of the log of lower house size (logN).

```
##
## Multivariate Meta-Analysis Model (k = 29; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0241  0.1553      3     no            id_level1
## sigma^2.2  0.0089  0.0945     29     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 28) = 469.5613, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.1211  0.0918  1.3195  0.1977  -0.0669  0.3090
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot:

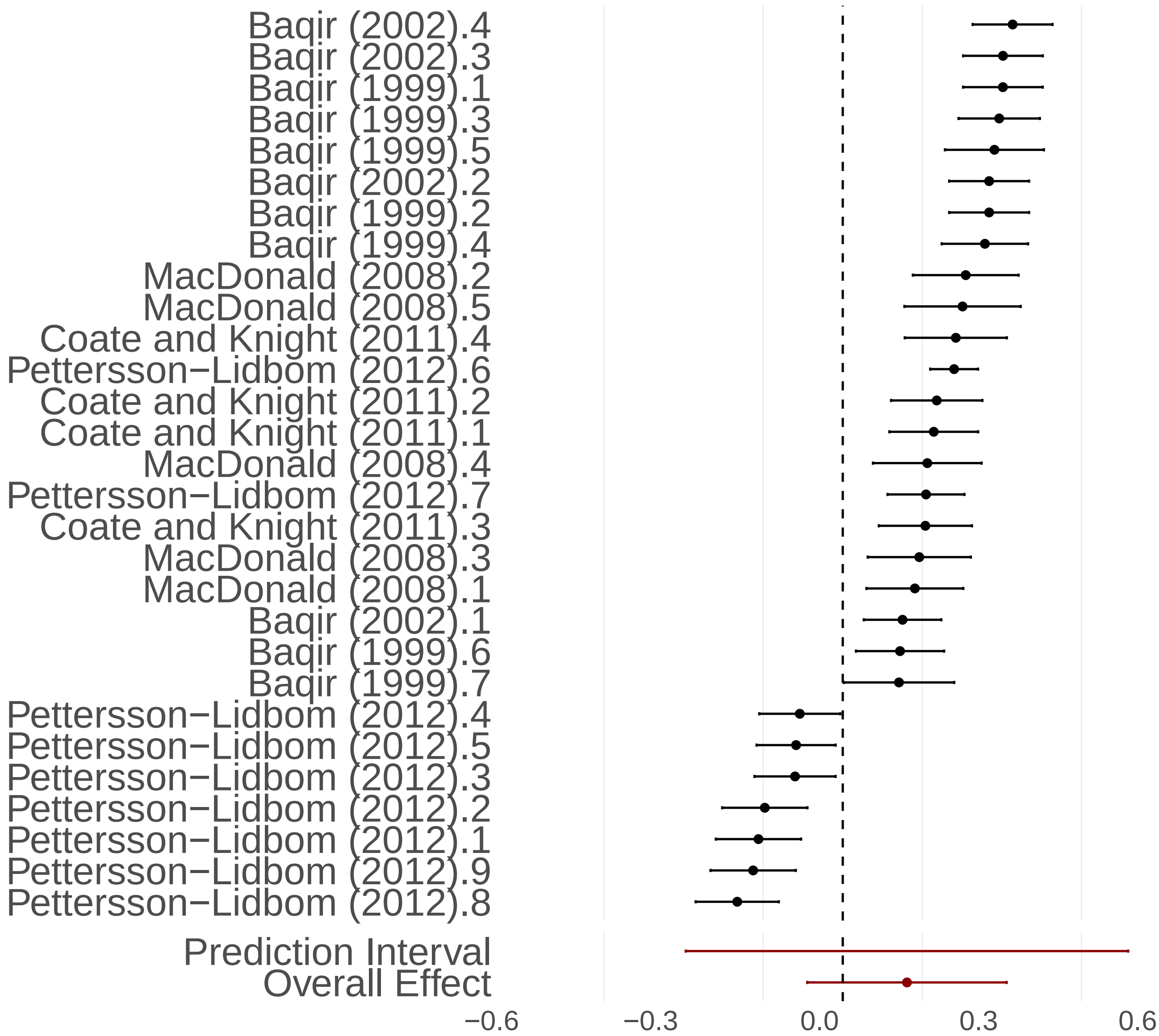


Figure 35: Effect of log lower houses size (logN) on the log of per capita government expenditure (logExpPC)

And the funnel plot:

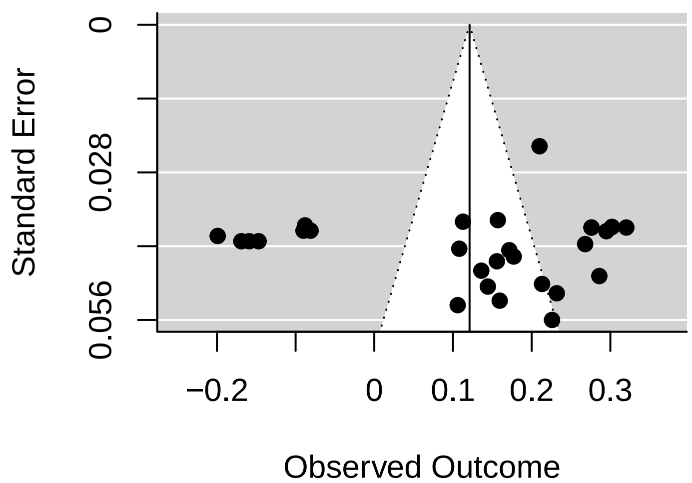


Figure 36: Funnel Plot – Effect of log of lower houses size (logN) on log of Per Capita Expenditure (logExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 469.56$.
2. The estimated SMD in the random effects model is $g = 0.12$ ($SE = 0.092$).
3. The prediction interval ranges from -0.3 to 0.54. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.6 Upper House Size and Log of Expenditure Per Capita

No studies related the log of per capita expenditure with the size of upper house (K).

I.7 Lower House Size and Expenditure as Percentage of GDP

This model fits the random effects for the percentage of GDP as public expenditure as the main outcome, and the size of lower house as the treatment variable.

```
##
## Multivariate Meta-Analysis Model (k = 26; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed              factor
## sigma^2.1   0.0001  0.0078      6     no           id_level1
## sigma^2.2   0.0002  0.0124     26     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 25) = 3255.2193, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.0058  0.0046  1.2666  0.2170  -0.0036  0.0152
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Here is the forest plot:

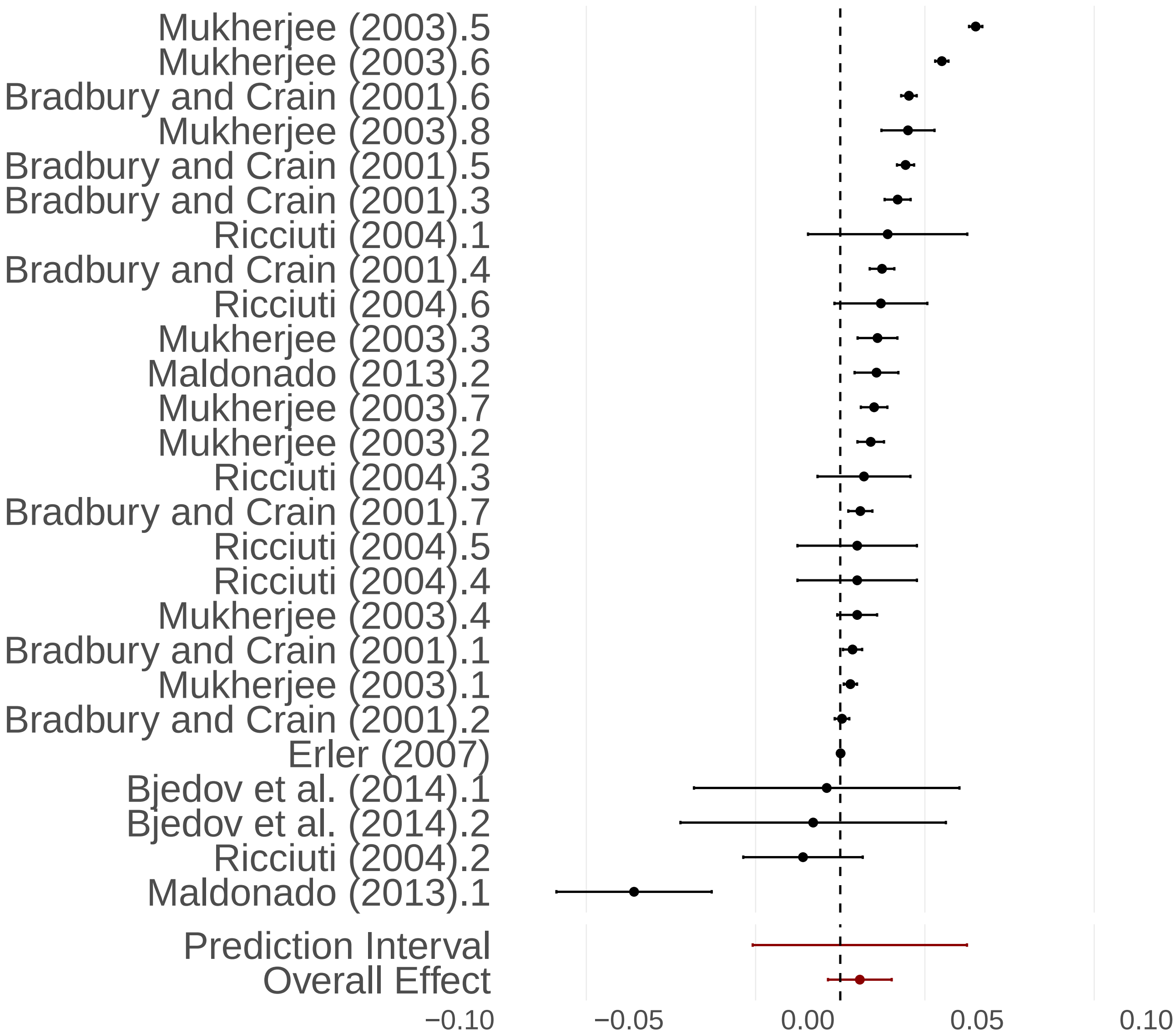


Figure 37: Effect of lower houses size (N) on percentage of public expenditure GDP (PCTGDP)

And here is the funnel plot to assess the possibility of publication bias:

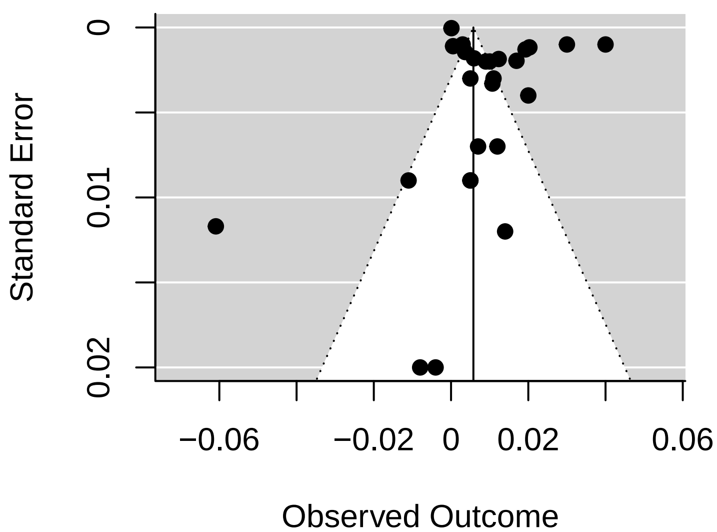


Figure 38: Funnel Plot – Effect of lower houses size (N) on percentage of public expenditure GDP (PCTGDP)

Highlights:

1. The results are highly heterogeneous: $Q = 3255.22$.
2. The estimated SMD in the random effects model is $g = 0.01$ ($SE = 0.005$).
3. The prediction interval ranges from -0.03 to 0.04. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test confirmed the hypothesis of publication bias.

I.8 Log of Lower House Size and Expenditure as Percentage of GDP

This meta-regression investigates the percentage of GDP as public expenditure as the dependent variable and the natural logarithm of lower house size ($\log(N)$) as the treatment variable.

```
##
## Multivariate Meta-Analysis Model (k = 5; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1  10.7199  3.2741      3     no            id_level1
## sigma^2.2   0.0000  0.0000      5     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 4) = 43.1179, p-val < .0001
##
## Model Results:
##
## estimate      se     tval    pval    ci.lb   ci.ub
##  -0.7685  1.9518  -0.3937  0.7139  -6.1876  4.6507
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The forest plot:

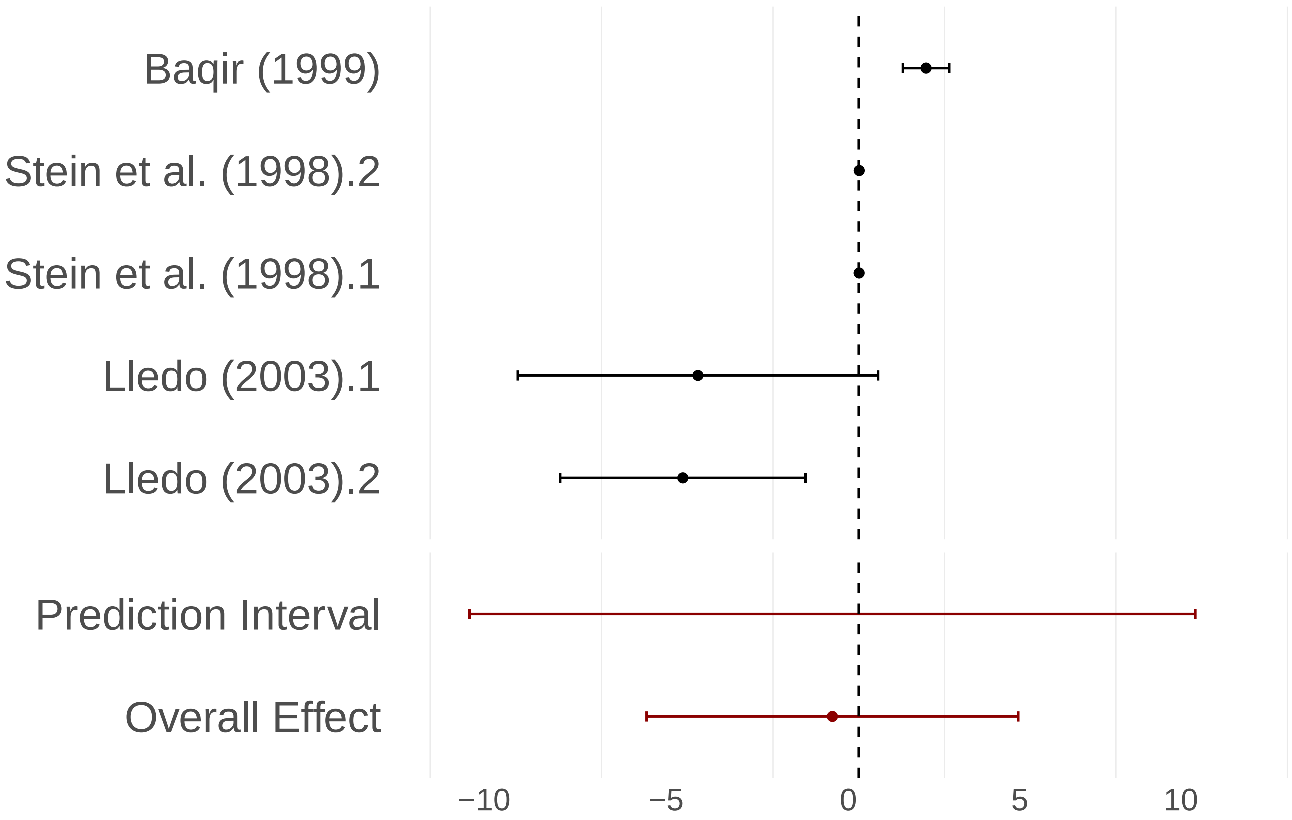


Figure 39: Effect of log lower houses size (logN) on the GDP share of public expenditure (PCTGDP)

And the funnel plot:

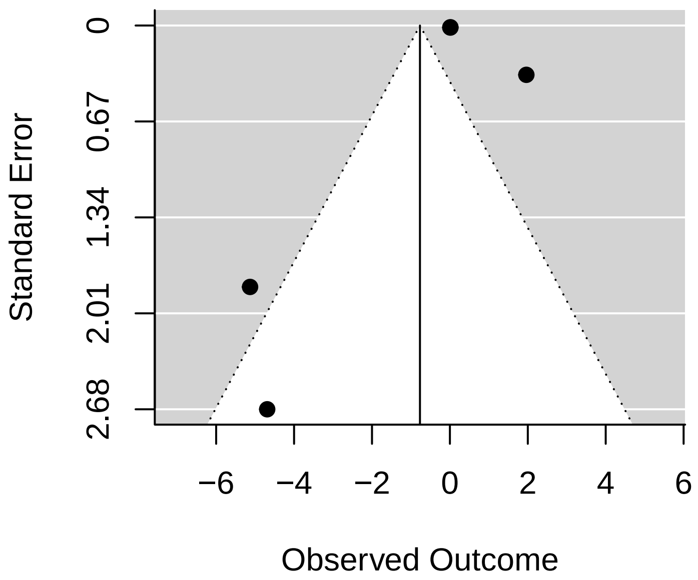


Figure 40: Funnel Plot – Effect of log of lower houses size (logN) on log of Per Capita Expenditure (logExpPC)

Highlights:

1. The results are highly heterogeneous: Q = 43.12.
2. The estimated SMD in the random effects model is g = -0.77 (SE = 1.952).
3. The prediction interval ranges from -11.35 to 9.81. Therefore, it emcompasses zero.

4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.9 Upper House Size and Expenditure as Percentage of GDP

This model looks into the effect of upper house size (K) on the public expenditure share of the GDP (PCTGDP).

```
##
## Multivariate Meta-Analysis Model (k = 13; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.0006  0.0238      3     no           id_level1
## sigma^2.2  0.0001  0.0080     13     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 12) = 63.1946, p-val < .0001
##
## Model Results:
##
## estimate      se     tval     pval    ci.lb   ci.ub
##  -0.0057  0.0147  -0.3848  0.7071  -0.0377  0.0264
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

And the forest plot:

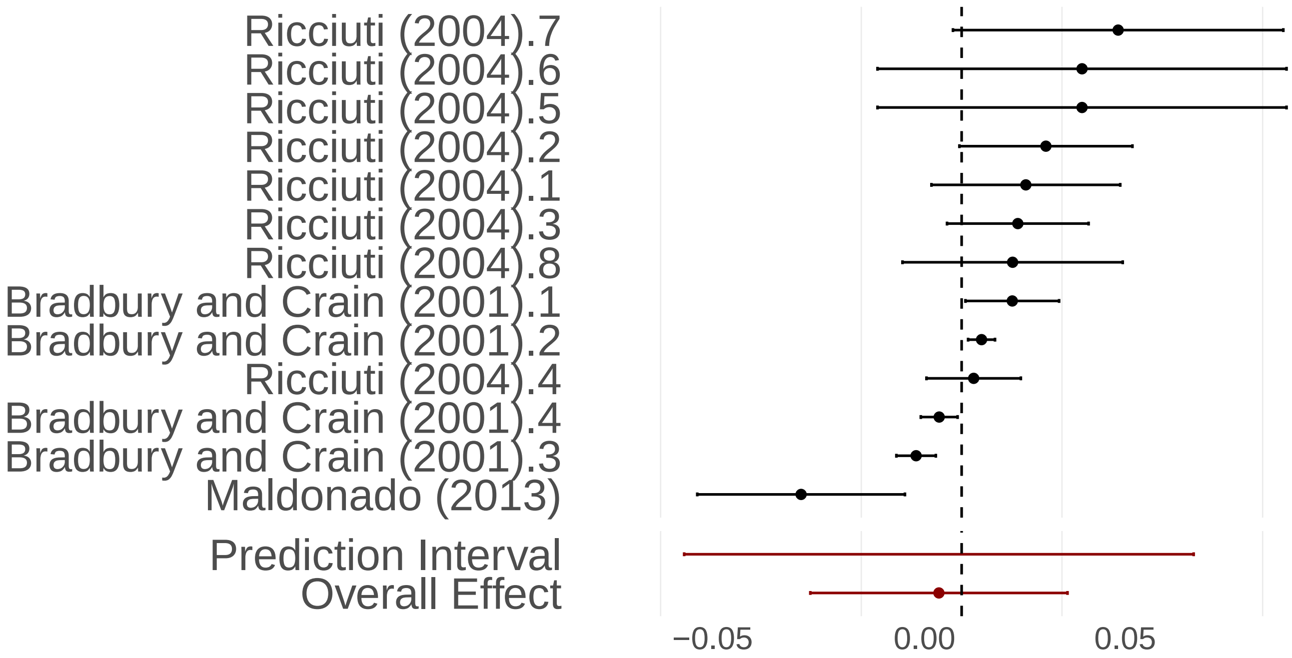


Figure 41: Effect of upper house size (K) on the public expenditure share of the GDP (PCTGDP)

And to assess the possibility of publication bias, we add funnel plot below:

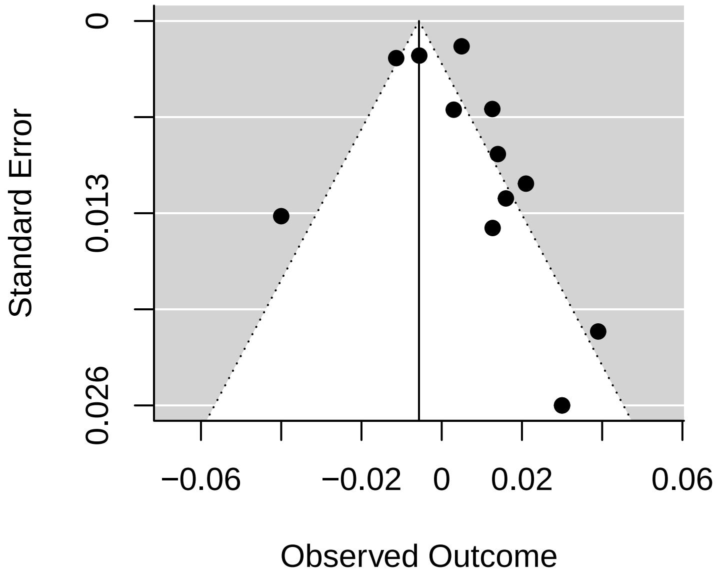


Figure 42: Funnel Plot – Effect of upper houses size (K) on the public expenditure share of GDP (PCTGDP)

Highlights:

1. The results are highly heterogeneous: Q = 63.19.
2. The estimated SMD in the random effects model is g = -0.01 (SE = 0.015).
3. The prediction interval ranges from -0.07 to 0.06. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.10 Lower House Size and Expenditure per Capita (IV)

```
##
## Multivariate Meta-Analysis Model (k = 9; method: REML)
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1   0.7962  0.8923      3     no            id_level1
## sigma^2.2   0.0141  0.1188      9     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 8) = 94.1278, p-val < .0001
##
## Model Results:
##
## estimate      se    tval    pval    ci.lb   ci.ub
##   0.0435  0.5478  0.0794  0.9386  -1.2197  1.3068
```

```
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

And the forest plot:

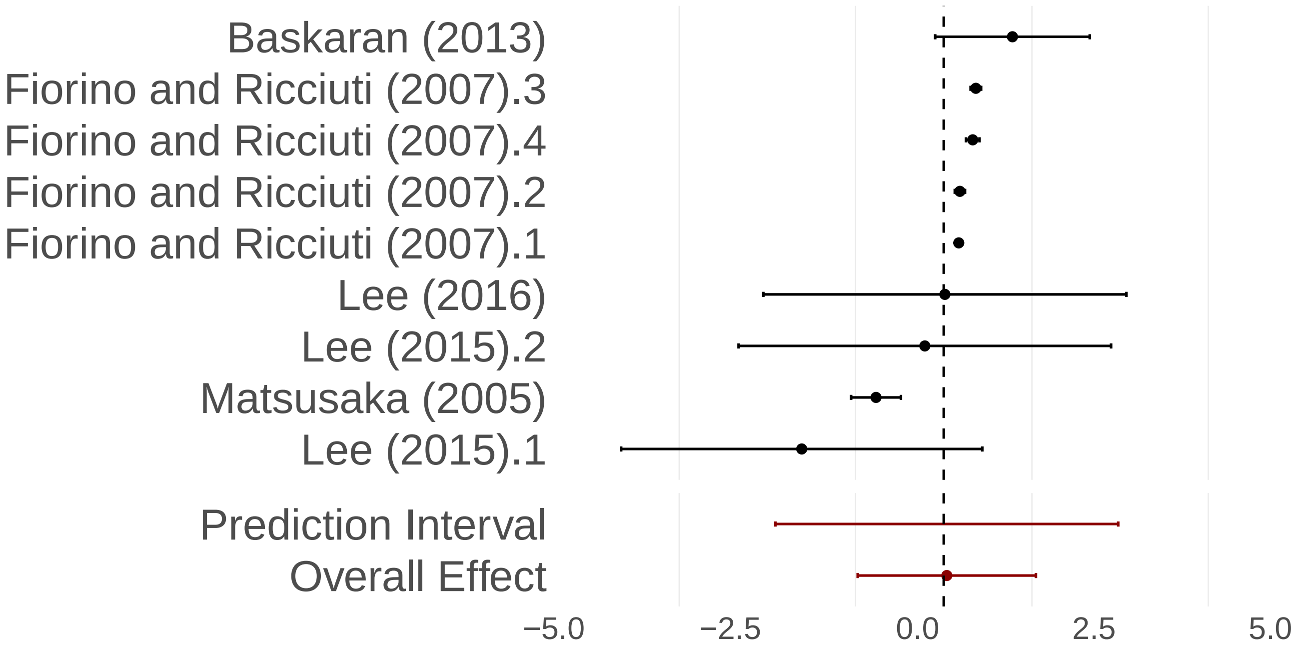


Figure 43: Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

And to assess the possibility of publication bias, we add funnel plot below:

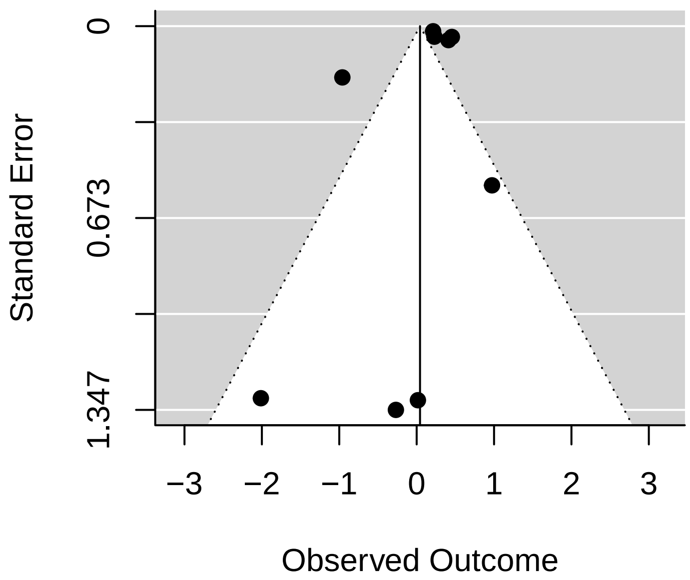


Figure 44: Funnel Plot – Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $Q = 94.13$.
2. The estimated SMD in the random effects model is $g = 0.04$ ($SE = 0.548$).

3. The prediction interval ranges from -2.39 to 2.47. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

I.11 Lower House Size and Log of Expenditure per Capita (RDD)

```
##
## Multivariate Meta-Analysis Model (k = 6; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0070  0.0836      3     no            id_level1
## sigma^2.2  0.0000  0.0000      6     no  id_level1/id_level2
##
## Test for Heterogeneity:
## Q(df = 5) = 36.3029, p-val < .0001
##
## Model Results:
##
## estimate      se     tval    pval    ci.lb   ci.ub
##  -0.0642  0.0496  -1.2939  0.2522  -0.1918  0.0634
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

And the forest plot:

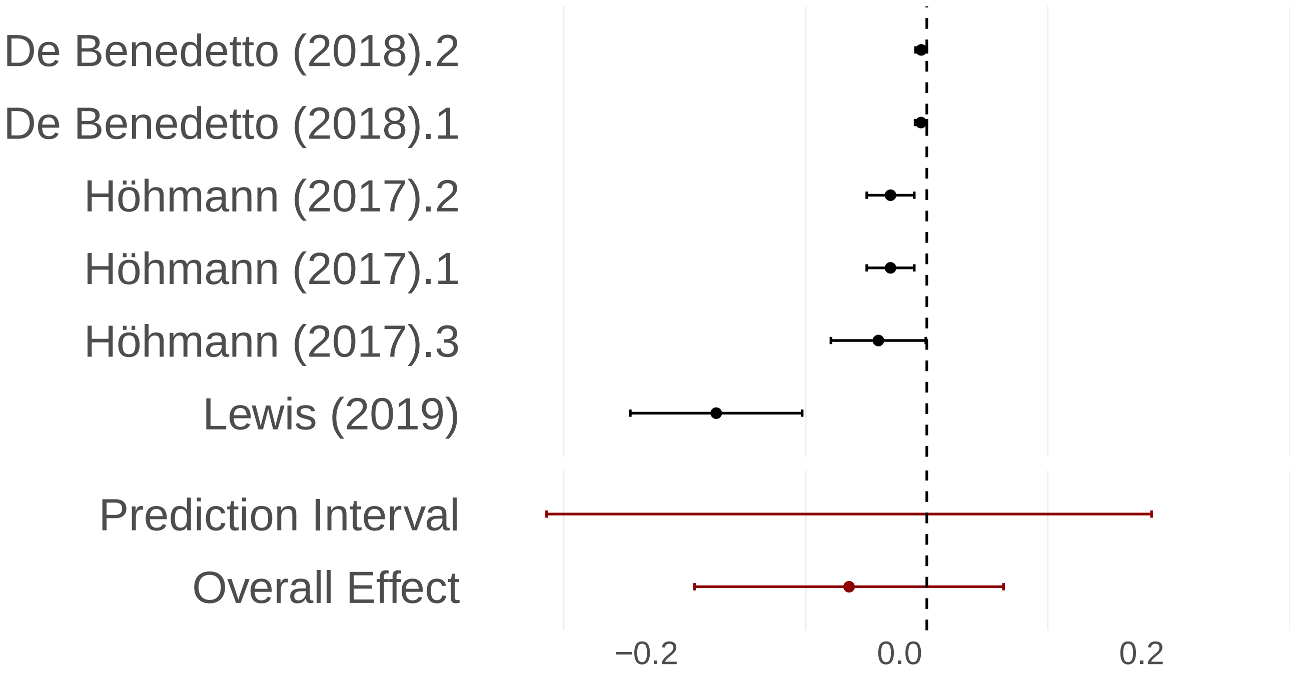


Figure 45: Effect of lower houses size (N) on log of Per Capita Expenditure (logExpPC)

And to assess the possibility of publication bias, we add funnel plot below:

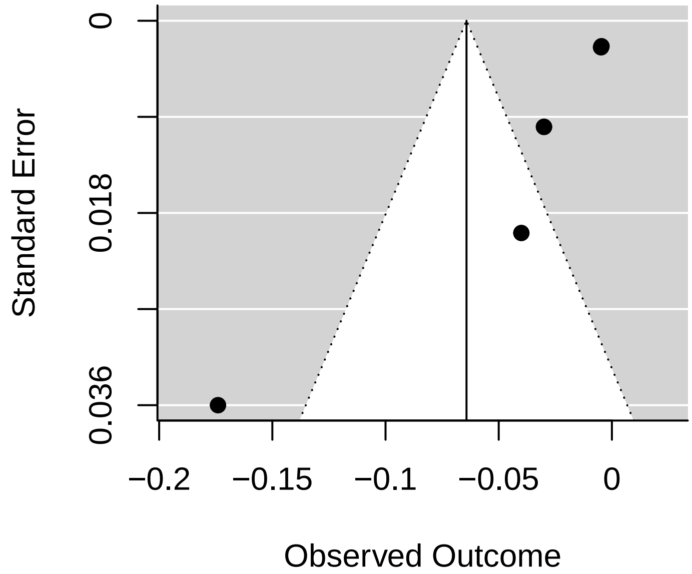


Figure 46: Funnel Plot – Effect of lower houses size (N) on log of Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: Q = 36.3.
2. The estimated SMD in the random effects model is g = -0.06 (SE = 0.05).
3. The prediction interval ranges from -0.31 to 0.19. Therefore, it emcompasses zero.
4. The Egger et al. (1997) test rejected the hypothesis of publication bias.

J Meta-Regressions

In the meta-regressions, we study the effects of a group of moderators on the reported government spending data. We select the following moderators:

1. The independent variable (variable `indepvar2`):

- `K`: Upper House Size
- `N`: Lower House Size
- `logN`: Log of Lower House Size

2. Year that the paper was published (for working papers, the year it was posted online; variable `year`)
3. A dummy indicating whether the paper was published or not (variable `published`).
4. A dummy for non-majoritarian electoral systems (variable `elecsys2`).
5. A institution design variable, with:

- `Unicameral` (e.g., US Municipalities)
- `Bicameral` (e.g., US States)
- `Mixed` (e.g., countries with unicameral and bicameral in the same dataset).

6. The estimation method used in the papers (variable `method`):

- `OLS`: Ordinary-Least Squares in Cross-Sectional data.
- `PANEL`: Time-Series Cross-Section models, with estimated fixed effects.
- `IV`: Instrumental Variables models.
- `RDD`: Regression Discontinuity Designs.

The results follows below, for the three combinations of dependent variables: Expenditure Per Capita, Log of Expenditure Per Capita, and Expenditure as a Percentage of the GDP.

J.1 Meta-Regressions for Expenditure Per Capita

Here we study the expenditure per capita as the main outcome, aggregating all types of independent variables.

```
##
## Multivariate Meta-Analysis Model (k = 25; method: REML)
##
##   logLik  Deviance       AIC       BIC      AICc
## -51.3600  102.7199  122.7199  131.0521  159.3866
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0000  0.0001      9     no            id_level1
## sigma^2.2  2.3627  1.5371     25     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 17) = 122.9315, p-val < .0001
##
## Test of Moderators (coefficients 2:8):
## F(df1 = 7, df2 = 17) = 0.2083, p-val = 0.9788
##
## Model Results:
##
##                       estimate        se     tval    pval      ci.lb     ci.ub
## intrcpt               -67.2913  163.0781  -0.4126  0.6850  -411.3560  276.7735
## indepvar2N             -0.7794    1.0446  -0.7461  0.4658    -2.9833    1.4245
```

```
## year                   0.0334    0.0812   0.4109  0.6862    -0.1379    0.2047
## publishedYes           0.7119    1.7248   0.4128  0.6849    -2.9270    4.3509
## elecsys2Non-Maj        0.4546    1.8140   0.2506  0.8051    -3.3726    4.2818
## methodPANEL            0.4907    0.9749   0.5033  0.6212    -1.5663    2.5476
## instdesignMixed       -0.7388    2.2327  -0.3309  0.7448    -5.4494    3.9718
## instdesignUnicameral  -0.1547    1.7178  -0.0901  0.9293    -3.7789    3.4694
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

For the meta-regressions of Expenditure Per Capita, we find no significant moderator. We also run the meta-regressions adding all coefficients in the papers. The results follow below:

```
##
## Multivariate Meta-Analysis Model (k = 82; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -200.3491   400.6982   422.6982   447.8932   427.0260
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0000  0.0003      9     no            id_level1
## sigma^2.2  2.8394  1.6851     82     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 73) = 622.3226, p-val < .0001
##
## Test of Moderators (coefficients 2:9):
## F(df1 = 8, df2 = 73) = 3.0605, p-val = 0.0050
##
## Model Results:
##
##                        estimate        se     tval    pval      ci.lb     ci.ub
## intrcpt               -282.7606  120.4731  -2.3471  0.0216  -522.8632  -42.6580    *
## indepvar2N              -2.5898    0.6428  -4.0287  0.0001    -3.8710   -1.3086  ***
## year                     0.1420    0.0600   2.3645  0.0207     0.0223    0.2616    *
## publishedYes             0.9456    1.1495   0.8226  0.4134    -1.3453    3.2366
## elecsys2Non-Maj          0.8185    1.1811   0.6930  0.4905    -1.5354    3.1724
## methodPANEL             -0.3606    0.9770  -0.3691  0.7131    -2.3078    1.5865
## methodIV                -0.5645    0.8940  -0.6314  0.5297    -2.3463    1.2172
## instdesignMixed         -1.2615    1.3882  -0.9087  0.3665    -4.0281    1.5051
```

```
## instdesignUnicameral    -0.9454    0.9997  -0.9457  0.3474    -2.9377    1.0469
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

With all coefficients, the results of the effect sizes on the Expenditure Per Capita regressions are the following:

1. Compared with `K`, models with `N` tend to detect significantly smaller effects.
2. Year has now a positive effect on coefficient sizes.
3. All other coeffients were not significant.

J.2 Meta-Regressions for Log of Expenditure Per Capita

```
##
## Multivariate Meta-Analysis Model (k = 9; method: REML)
##
##   logLik  Deviance       AIC       BIC      AICc
##   4.1666   -8.3333    7.6667    0.4556  151.6667
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0068  0.0825      7     no            id_level1
## sigma^2.2  0.0000  0.0000      9     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 3) = 18.7892, p-val = 0.0003
##
## Test of Moderators (coefficients 2:6):
## F(df1 = 5, df2 = 3) = 5.3057, p-val = 0.1001
##
## Model Results:
##
##                  estimate       se     tval    pval     ci.lb    ci.ub
## intrcpt           -0.0305  23.6518  -0.0013  0.9991  -75.3011  75.2402
## indepvar2logN     -0.0351   0.1338  -0.2621  0.8102   -0.4607   0.3906
## year               0.0002   0.0118   0.0157  0.9884   -0.0373   0.0376
## publishedYes      -0.1667   0.0577  -2.8883  0.0631   -0.3504   0.0170  .
## elecsys2Non-Maj   -0.2995   0.1338  -2.2388  0.1111   -0.7253   0.1263
```

```
## methodPANEL        0.2000   0.1039   1.9245  0.1500   -0.1307   0.5308
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The only significant result points that published papers tend to report a smaller coefficient than unpublished papers.

Below we also run the meta-regressions adding all coefficients in the papers. The results follow below:

```
##
## Multivariate Meta-Analysis Model (k = 37; method: REML)
##
##   logLik  Deviance       AIC       BIC      AICc
##  39.5224  -79.0448  -59.0448  -45.3718  -46.8226
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0083  0.0909      7     no            id_level1
## sigma^2.2  0.0014  0.0369     37     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 29) = 84.4113, p-val < .0001
##
## Test of Moderators (coefficients 2:8):
## F(df1 = 7, df2 = 29) = 11.3190, p-val < .0001
##
## Model Results:
##
##                  estimate       se     tval    pval     ci.lb    ci.ub
## intrcpt           10.4322  20.2150   0.5161  0.6097  -30.9122  51.7766
## indepvar2logN     -0.1280   0.1239  -1.0330  0.3102   -0.3813   0.1254
## year              -0.0050   0.0101  -0.5005  0.6205   -0.0256   0.0155
## publishedYes       0.0093   0.0451   0.2070  0.8375   -0.0829   0.1016
## elecsys2Non-Maj    0.0064   0.1335   0.0483  0.9618   -0.2665   0.2794
## methodPANEL       -0.3539   0.0497  -7.1205  <.0001   -0.4555  -0.2522  ***
## methodIV          -0.0517   0.0501  -1.0319  0.3106   -0.1542   0.0508
## methodRDD         -0.3076   0.0410  -7.5024  <.0001   -0.3915  -0.2237  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

With all coefficients, the results of the effect sizes on the Log of Expenditure Per Capita Regressions are the following:

1. In regard to the estimation method, papers that use `PANEL` data or `RDD` designs have smaller effects than articles that employ `OLS` estimations.
2. Having the log of lower house seats (`logN`) as the main independent variable increases the detected effect.

All other results are insignificant.

J.3 Meta-Regressions for Expenditure as a Percentage of the GDP

```
##
## Multivariate Meta-Analysis Model (k = 11; method: REML)
##
##    logLik  Deviance       AIC       BIC      AICc
##    7.3644  -14.7288    3.2712   -2.2522  183.2712
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0001  0.0095      8     no            id_level1
## sigma^2.2  0.0000  0.0000     11     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 4) = 22.8814, p-val = 0.0001
##
## Test of Moderators (coefficients 2:7):
## F(df1 = 6, df2 = 4) = 3.3089, p-val = 0.1334
##
## Model Results:
##
##                   estimate      se     tval    pval    ci.lb    ci.ub
## intrcpt            13.6215  3.8841   3.5070  0.0247   2.8374  24.4056  *
## indepvar2logN      -0.0471  0.0281  -1.6784  0.1686  -0.1250   0.0308
## indepvar2N         -0.0093  0.0055  -1.7007  0.1642  -0.0245   0.0059
## year               -0.0068  0.0019  -3.5111  0.0246  -0.0121  -0.0014  *
## elecsys2Non-Maj     0.0430  0.0276   1.5577  0.1943  -0.0336   0.1196
## methodPANEL        -0.0180  0.0170  -1.0621  0.3481  -0.0652   0.0291
## instdesignMixed    -0.0736  0.0327  -2.2500  0.0876  -0.1645   0.0172  .
##
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

All moderators are insignificant in the meta-regressions of Expenditure as a Percentage of GDP.

Below we also run the meta-regressions adding all coefficients in the papers. The results follow below:

```
##
## Multivariate Meta-Analysis Model (k = 44; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##   91.5028  -183.0057  -163.0057  -147.1705  -154.2057
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0001  0.0110      9     no            id_level1
## sigma^2.2  0.0001  0.0102     44     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 36) = 1314.1472, p-val < .0001
##
## Test of Moderators (coefficients 2:8):
## F(df1 = 7, df2 = 36) = 7.3005, p-val < .0001
##
## Model Results:
##
##                       estimate      se     tval    pval    ci.lb    ci.ub
## intrcpt                12.4965  3.3964   3.6794  0.0008   5.6083  19.3847  ***
## indepvar2logN          -0.0327  0.0237  -1.3790  0.1764  -0.0808   0.0154
## indepvar2N              0.0024  0.0050   0.4923  0.6255  -0.0076   0.0125
## year                   -0.0062  0.0017  -3.6838  0.0008  -0.0096  -0.0028  ***
## elecsys2Non-Maj        -1.8995  0.3453  -5.5014  <.0001  -2.5997  -1.1992  ***
## methodPANEL            -0.0103  0.0132  -0.7798  0.4406  -0.0371   0.0165
## instdesignMixed         1.8800  0.3460   5.4337  <.0001   1.1783   2.5816  ***
## instdesignUnicameral    1.9380  0.3454   5.6104  <.0001   1.2374   2.6385  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Even for all the coefficients, all moderators remain insignificant.

K Robustness: Meta-Regressions (All Coefficients)

In this section, we aggregate all the coefficients and run a multivariate meta-regression, controlling for:

1. The type of the dependent variable in the study (expenditure per capita, log of the expenditure per capita, and share of government expenditure in the GDP).
2. The type of the independent variable in the study (lower house size, upper house size, or log of lower house size).
3. The electoral system (Majoritarian versus Non-Majoritarian).
4. The year when the study was published.
5. Whether the study is a working paper or published work.
6. The institution design: whether the legislature in the analysis is unicameral, bicameral, or mixed.
7. The estimation method used in the paper (OLS, PANEL, IV, or RDD).

The results follow below, and show null effects for all variables, including the intercept.

```
##
## Multivariate Meta-Analysis Model (k = 45; method: REML)
##
##   logLik  Deviance       AIC       BIC      AICc
## -53.0989  106.1978  136.1978  158.1838  166.1978
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.0059  0.0771     20     no           id_level1
## sigma^2.2  0.0114  0.1070     45     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 32) = 177.8278, p-val < .0001
##
## Test of Moderators (coefficients 2:13):
## F(df1 = 12, df2 = 32) = 1.3602, p-val = 0.2353
##
## Model Results:
##
##                       estimate       se     tval    pval     ci.lb    ci.ub
```

```
## intrcpt               26.0315  18.8118   1.3838  0.1760  -12.2870  64.3499
## depvar2logExpPC        0.0500   0.1274   0.3923  0.6975   -0.2095   0.3095
## depvar2PCTGDP          0.0747   0.0738   1.0123  0.3190   -0.0756   0.2250
## indepvar2logN         -0.2221   0.1439  -1.5434  0.1326   -0.5151   0.0710
## indepvar2N            -0.0548   0.0668  -0.8195  0.4185   -0.1908   0.0813
## year                  -0.0130   0.0094  -1.3830  0.1763   -0.0321   0.0061
## publishedYes          -0.0845   0.0928  -0.9105  0.3694   -0.2734   0.1045
## elecsys2Non-Maj       -0.0815   0.1425  -0.5719  0.5714   -0.3717   0.2087
## methodPANEL           -0.0267   0.1137  -0.2349  0.8158   -0.2583   0.2049
## methodIV              -0.1595   0.1899  -0.8399  0.4072   -0.5463   0.2273
## methodRDD             -0.1684   0.1469  -1.1466  0.2600   -0.4677   0.1308
## instdesignMixed        0.1227   0.1962   0.6252  0.5363   -0.2770   0.5223
## instdesignUnicameral   0.3965   0.1619   2.4491  0.0200    0.0667   0.7263  *
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

In the restricted model, with only the main coefficients in the selected papers, no moderator has a significant effect. We also run the meta-regressions adding all coefficients in the papers. The results follow below:

```
##
## Multivariate Meta-Analysis Model (k = 163; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -152.1489   304.2978   334.2978   379.4574   337.8799
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed               factor
## sigma^2.1  0.0133  0.1154     20     no            id_level1
## sigma^2.2  0.0015  0.0390    163     no  id_level1/id_level2
##
## Test for Residual Heterogeneity:
## QE(df = 150) = 2423.0486, p-val < .0001
##
## Test of Moderators (coefficients 2:13):
## F(df1 = 12, df2 = 150) = 4.3514, p-val < .0001
##
## Model Results:
##
##                        estimate       se     tval    pval     ci.lb    ci.ub
## intrcpt                 -6.5819  12.3846  -0.5315  0.5959  -31.0528  17.8889
```

```
## depvar2logExpPC       -0.0977   0.0778  -1.2564  0.2109   -0.2513   0.0559
## depvar2PCTGDP          0.0230   0.0158   1.4546  0.1479   -0.0082   0.0543
## indepvar2logN         -0.0626   0.0971  -0.6448  0.5200   -0.2545   0.1293
## indepvar2N            -0.0126   0.0132  -0.9521  0.3426   -0.0388   0.0136
## year                   0.0033   0.0062   0.5410  0.5893   -0.0089   0.0156
## publishedYes          -0.0249   0.0369  -0.6762  0.5000   -0.0977   0.0479
## elecsys2Non-Maj       -0.1916   0.0960  -1.9969  0.0476   -0.3812  -0.0020    *
## methodPANEL           -0.1443   0.0335  -4.3073  <.0001   -0.2105  -0.0781  ***
## methodIV              -0.0755   0.0347  -2.1728  0.0314   -0.1442  -0.0068    *
## methodRDD             -0.1971   0.0375  -5.2590  <.0001   -0.2711  -0.1230  ***
## instdesignMixed        0.1786   0.1319   1.3546  0.1776   -0.0819   0.4392
## instdesignUnicameral   0.2662   0.1280   2.0806  0.0392    0.0134   0.5191    *
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

In the full model, we can see that:

1. For the dependent variable, models with Log of Per Capita Expenditure tend to report significantly smaller effects than models with Per Capita Expenditure.
2. For the independent variable, models with Log of Lower House Size tend to report significantly larger effects than models with Upper House Size.
3. Over time, the reported coefficients have been increasing in size.
4. Compared with `OLS`, `PANEL` and `RDD` report significantly smaller coefficients.
5. All other moderators are insignificant.

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