Appendix

Umberto Mignozzetti

12/25/2019

Search criteria

Search terms

XXXX

Searched databases

XXXX To Catarina: name and URL of database searched

Summary total results

XXXX To Catarina: put here results per database, cross-matching, anything else

Exclusion criteria

Exclusion title and abstract

XXXX To Catarina: what criteria for first round exclusions?

Exclusion reading

XXXX To Catarina: criteria second round exclusions

Exclusion analysis

For the articles that passed the first two filters, we looked into the tables and the reported coefficients. We kept articles in this step based on two criteria:

1. Matched treatment variable:

- N: Number Legislators Lower House
- logN: Log Number Legislators Lower House
- K: Number Legislators Upper House

2. Matched outcome variable:

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

PRISM

- Number of articles matching the search criteria: XXXX
- Number of articles excluded after title and abstract: XXXX
- Number of articles excluded after reading: XXXX
- Number of articles excluded before analysis: 3
- Number of articles excluded during the analysis: 0

Adding articles

Descriptive statistics

Study Year

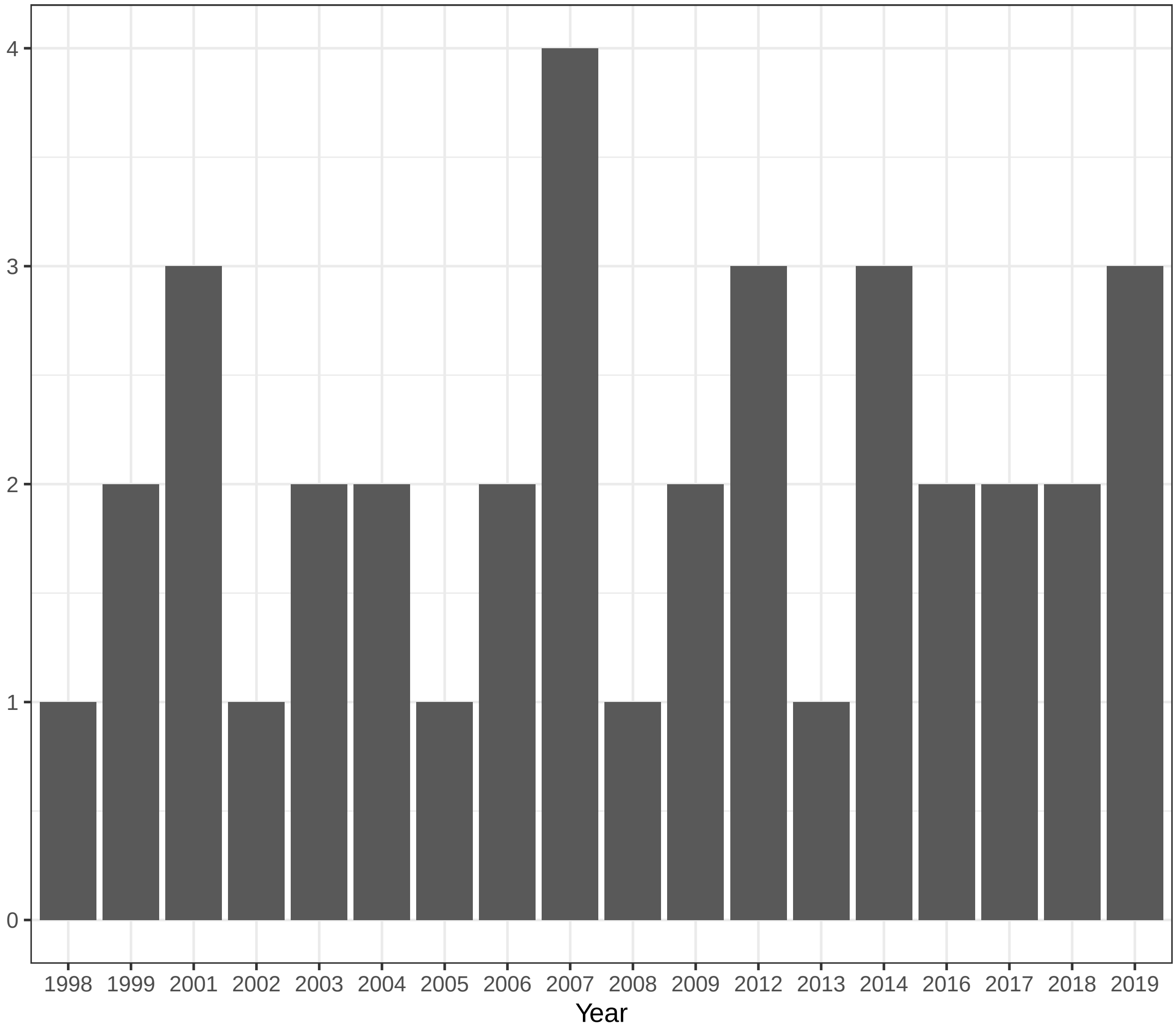


Figure 1: Study Year Frequencies

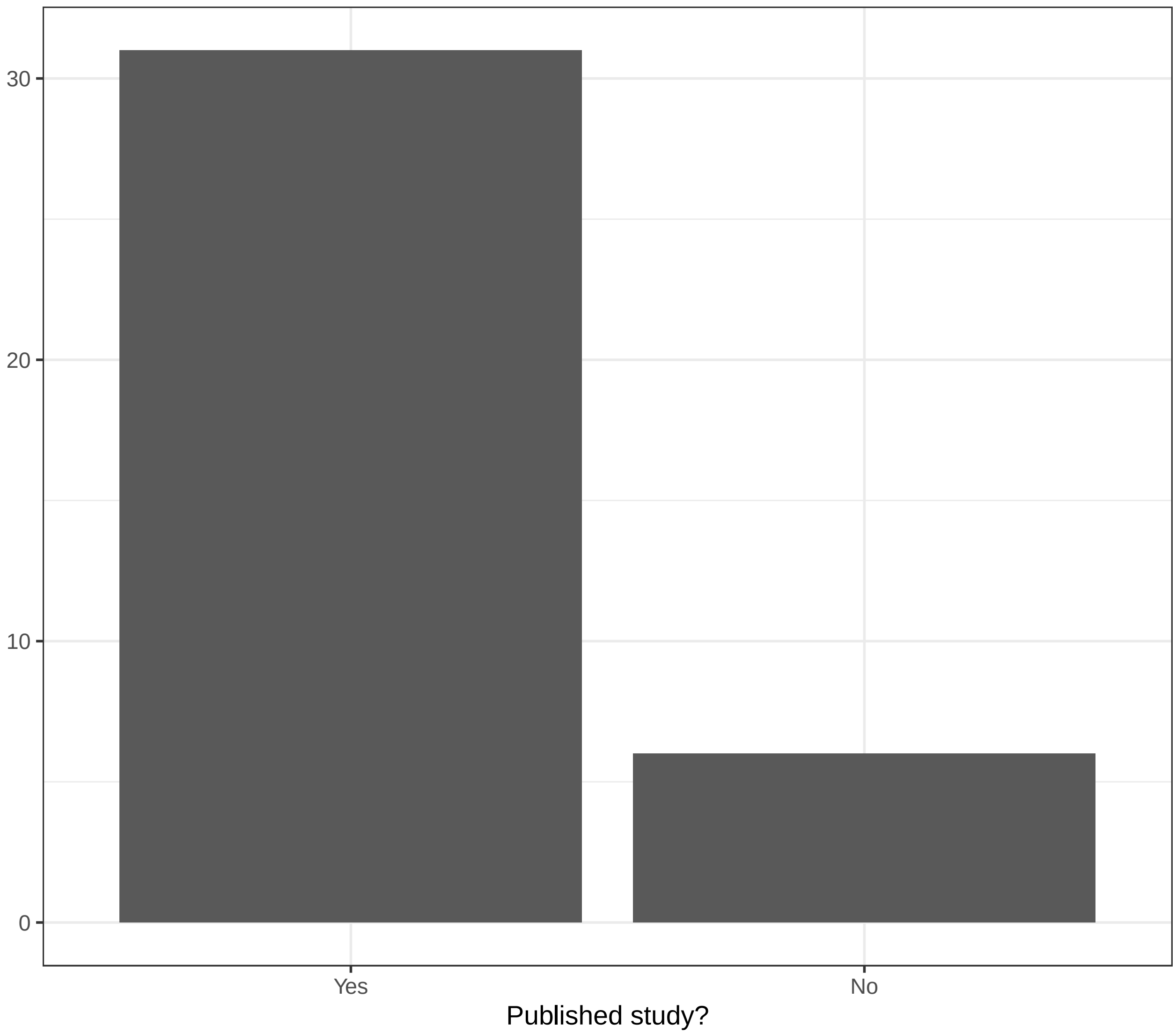


Figure 2: Was the study published?

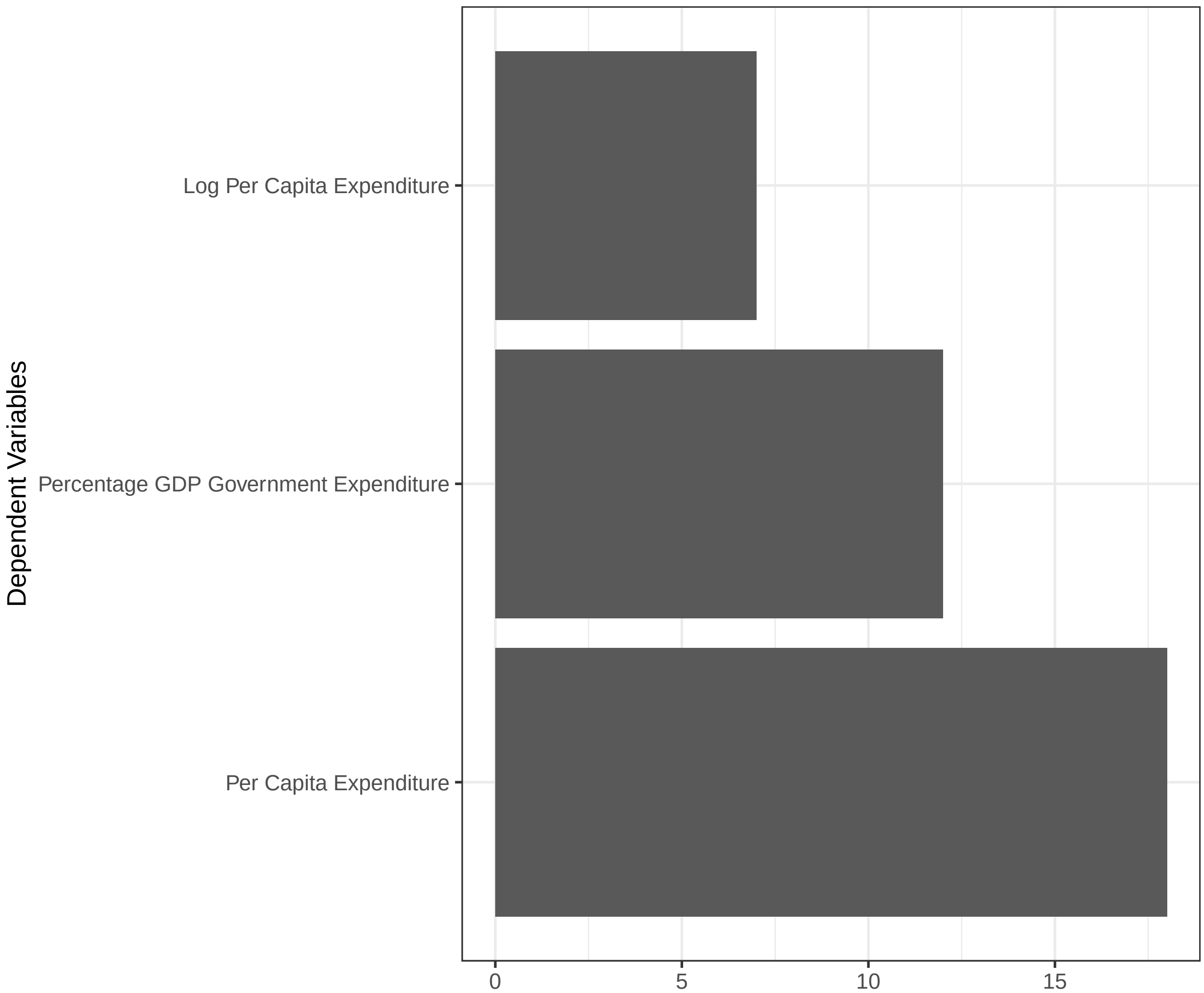


Figure 3: Dependent variables across the law of 1/n studies

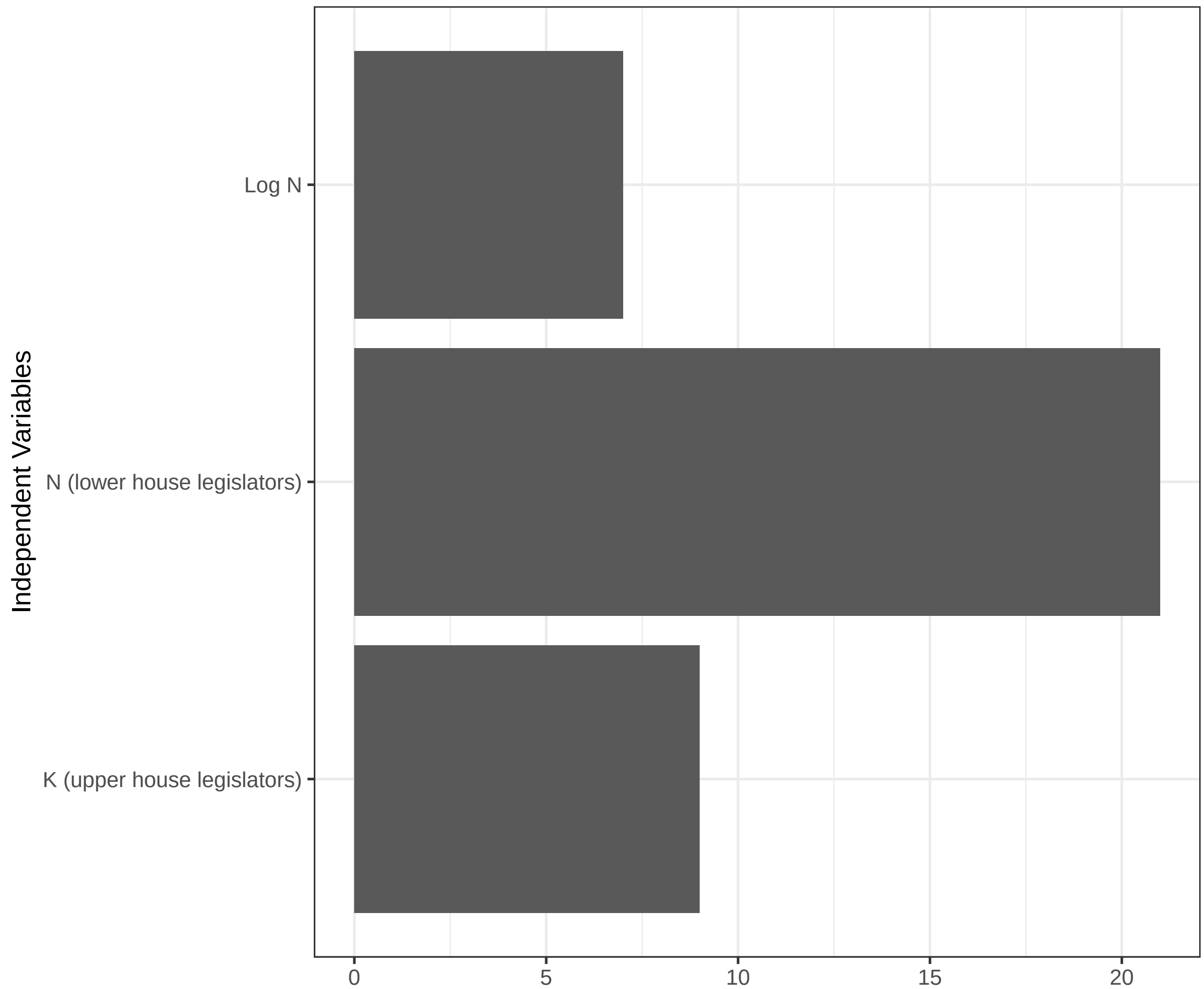


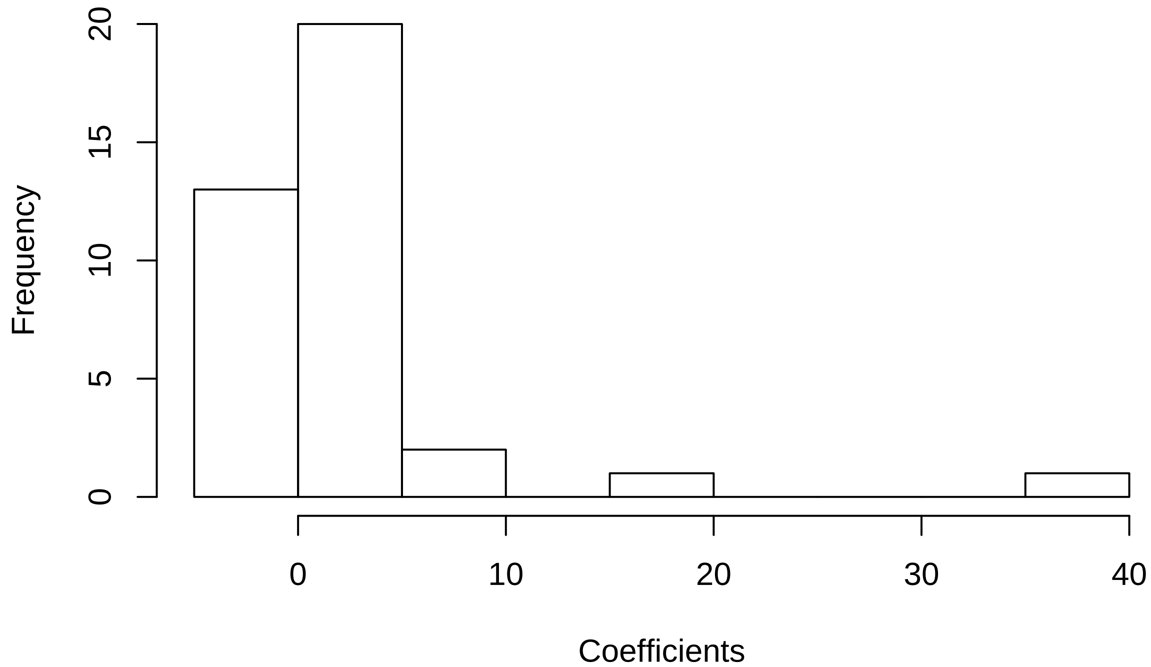
Figure 4: Independent variables across the law of 1/n studies

Published?

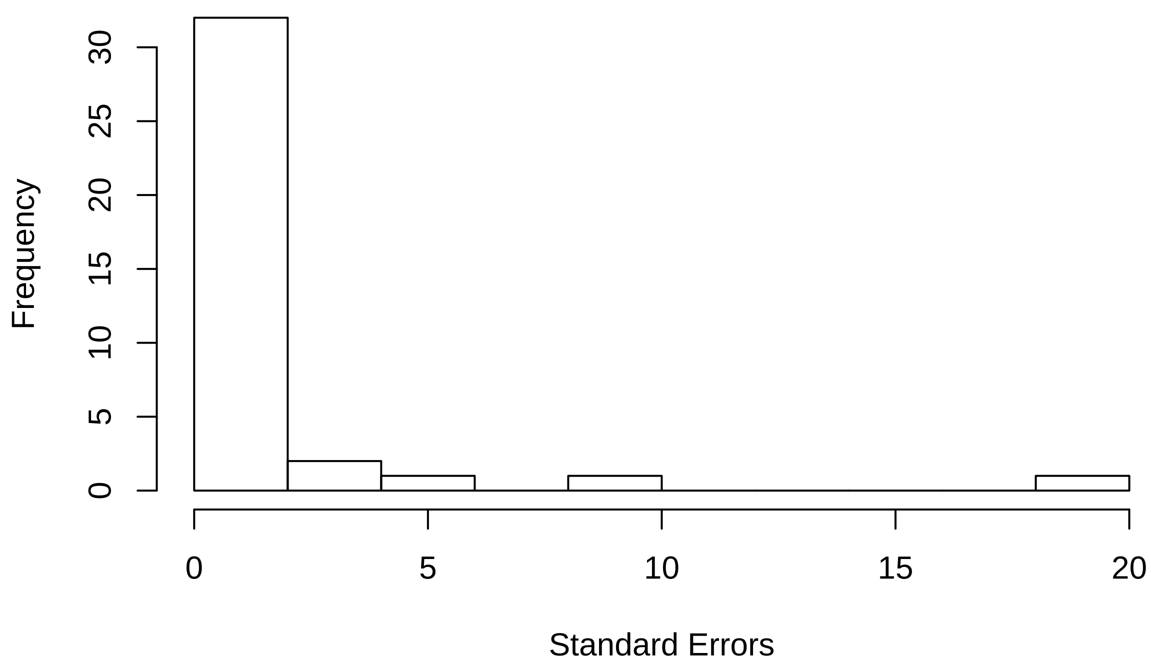
Dependent variables

Independent variables

Histogram Coefficients



Histogram Standard Errors



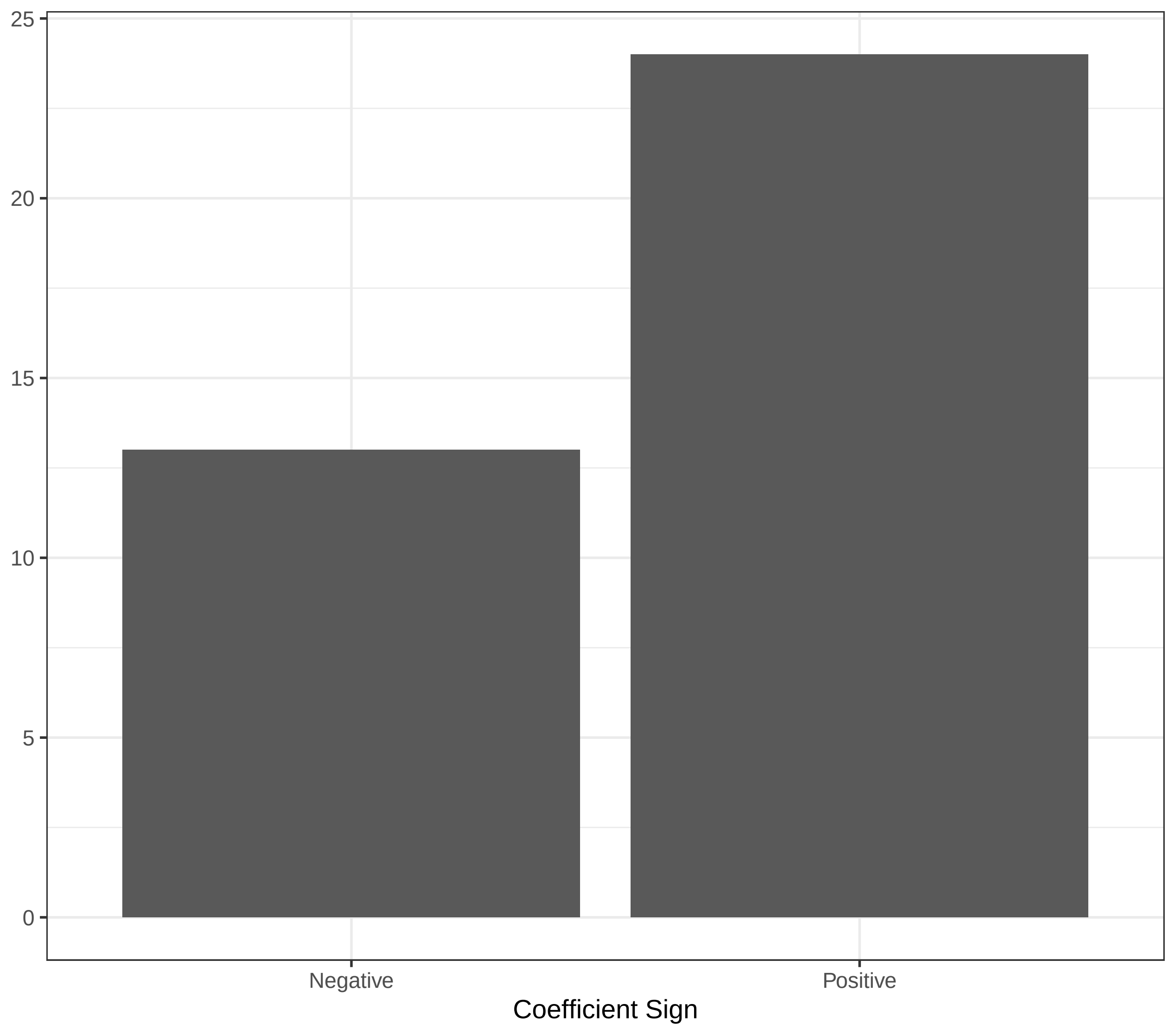


Figure 5: Coefficient Sign?

Sign Coefficients

A general test of the theory would be to study whether the coefficients are positive or negative. Note that the law of 1/n would pose that we should have a positive influence of legislature size on expenditure. To test this theory, we run a Binomial One-Proportion Z-test. For the number of legislators in the lower house (N), the results follow below.

```
##
##  Exact binomial test
##
## data:  table(aux$scoef)[1] and sum(table(aux$scoef))
## number of successes = 11, number of trials = 21, p-value = 1
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.2978068 0.7428694
## sample estimates:
## probability of success
##              0.5238095
```

Therefore, the most elementary test we could run, a sign direction test, tells us that the law of 1/n does not hold for our sample. For the number of legislators in the upper house (K), the results follow below.

```
##
##  Exact binomial test
##
## data:  table(aux$scoef)[1] and sum(table(aux$scoef))
## number of successes = 1, number of trials = 9, p-value = 0.03906
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.002809137 0.482496515
## sample estimates:
## probability of success
##              0.1111111
```

Here, the law of 1/n holds. However, the effect goes in a direction different from the predicted in the law of k/n paper.

Electoral system

Electoral system x Sign Coefficient

```
##
##             Majoritarian Non-Majoritarian
##   Negative            5                8
##   Positive           13               11
```

```
##
##  Pearson's Chi-squared test with simulated p-value (based on 2000
##  replicates)
##
## data:  table(dat$scoef, dat$elecsys2)
## X-squared = 0.83256, df = NA, p-value = 0.4783
```

Independent Variable x Sign Coefficient

```
##
##              K  N logN
##   Negative   1 11    1
```

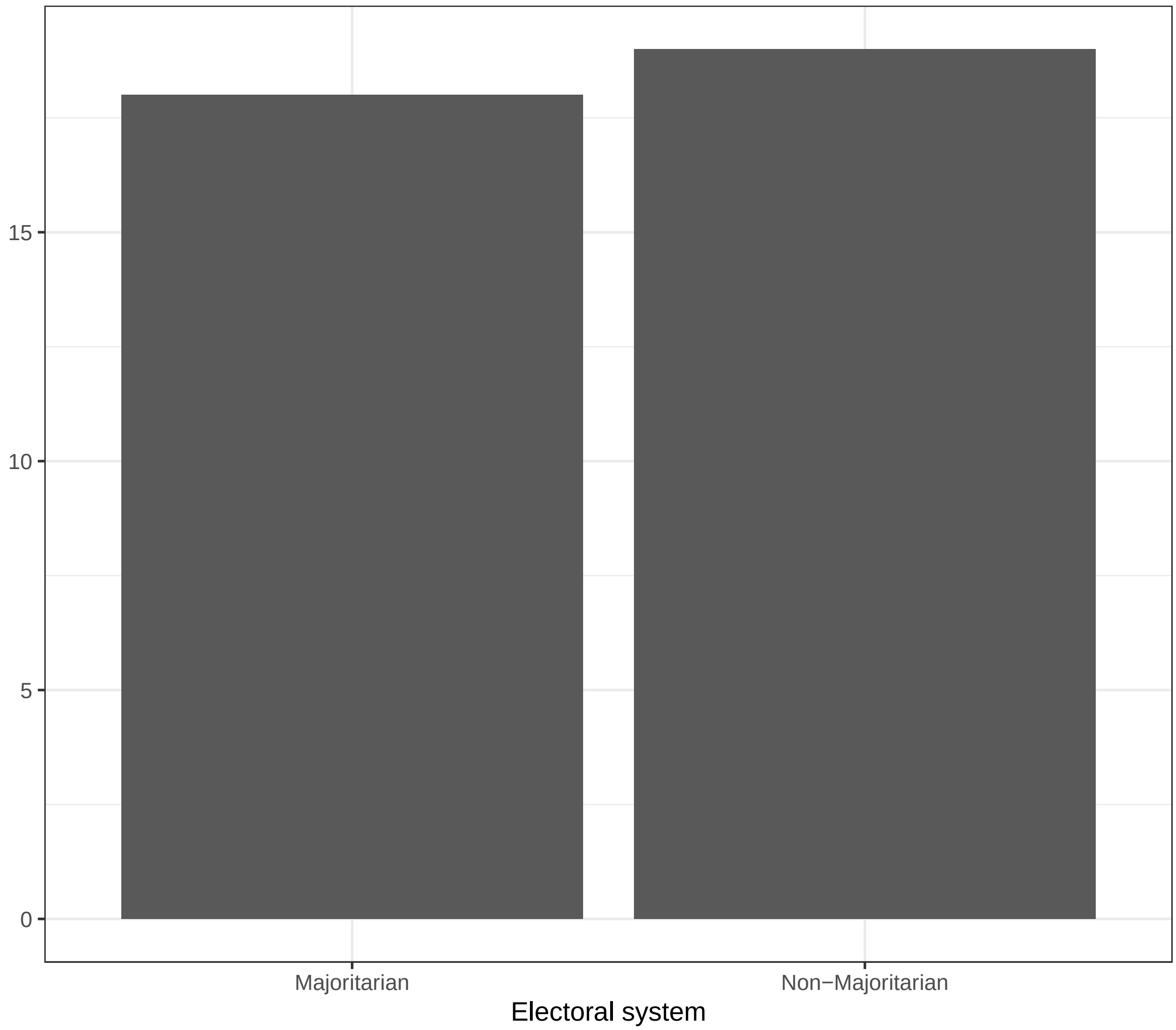


Figure 6: Electoral system

```
##   Positive  8 10    6
##
##  Pearson's Chi-squared test with simulated p-value (based on 2000
##  replicates)
##
## data:  table(dat$scoef, dat$indepvar2)
## X-squared = 6.3549, df = NA, p-value = 0.05197
```

Dependent variables x Independent variables

```
##
##            ExpPC PCTGDP logExpPC
##   Negative     6      4        3
##   Positive    12      8        4
##
##  Pearson's Chi-squared test with simulated p-value (based on 2000
##  replicates)
##
## data:  table(dat$scoef, dat$depvar2)
## X-squared = 0.22589, df = NA, p-value = 1
```

Meta-analysis

We combined the three independent (N, logN, and K) with the levels of the three dependent variables (ExpPC, logExpPC, PCTGDP). This formed a 3x3 possibility for our analysis.

ExpPC x N

```
##                                  SMD             95%-CI %W(random)
## Crowley (2019)               -0.3510 [-1.8112;  1.1092]        5.4
## Lee and Park (2018)          -0.8510 [-3.5851;  1.8831]        2.2
## Lee (2016)                    0.0164 [-2.5570;  2.5898]        2.5
## Kessler (2014)                0.1740 [ 0.0074;  0.3406]       12.4
## Bjedov et al. (2014)         -0.0030 [-0.0226;  0.0166]       12.6
## Baskaran (2013)               0.9740 [-0.1212;  2.0692]        7.2
## Erler (2007)                  3.9300 [ 1.6172;  6.2428]        2.9
## Chen and Malhotra (2007)     -1.4000 [-2.6544; -0.1456]        6.4
## Fiorino and Ricciuti (2007)  0.2260 [ 0.1221;  0.3299]       12.5
## Primo (2006)                 -0.8200 [-1.1924; -0.4476]       11.6
## Matsusaka (2005)             -0.9600 [-1.3128; -0.6072]       11.7
## Schaltegger and Feld (2009)  0.0010 [-0.0010;  0.0030]       12.6
##
## Number of studies combined: k = 12
##
##                           SMD            95%-CI     t p-value
## Random effects model -0.0996 [-0.7126; 0.5134] -0.36  0.7274
## Prediction interval          [-1.6716; 1.4724]
##
## Quantifying heterogeneity:
##  tau^2 = 0.4202 [0.1998; 4.3628]; tau = 0.6482 [0.4470; 2.0887];
##  I^2 = 87.6% [80.3%; 92.3%]; H = 2.84 [2.25; 3.59]
##
## Test of heterogeneity:
##      Q d.f.  p-value
```

```
##  89.01   11 < 0.0001
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

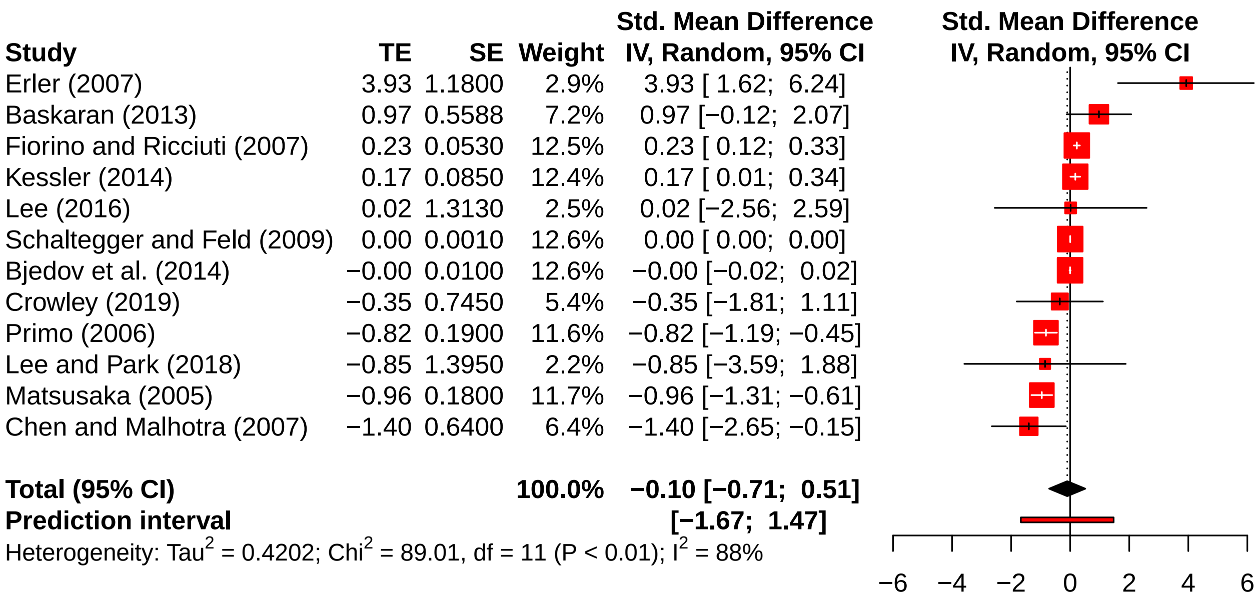


Figure 7: Effect of lower houses size (N) on Per Capita Expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 87.64.
2. The Random effects modem SMD estimated is $g = $ -0.1 ($SE = 0.278$).
3. The prediction interval ranges from -1.67 to 1.47. Therefore, it emcompasses zero.

Electoral system subgroup analysis

The law of 1/n was created for 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 binary electoral system.

Therefore, we can see that the hypothesis that majoritarian systems produce systematic positive effects was disproved. 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 non-significant, but they reassure us that the absense of effect is not caused by pooling multiple types of electoral systems.

PCTGDP x N

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 main treatment variable.

```
# Pooling effects analysis -- PCTGDP x N
aux <- filter(dat,
              indepvar2=='N'&depvar2=='PCTGDP')
```

Study or Subgroup	TE	SE	Weight	Std. Mean Difference IV, Random, 95% CI
Majoritarian				
Erler (2007)	3.93	1.180	2.9%	3.93 [1.62; 6.24]
Kessler (2014)	0.17	0.085	12.4%	0.17 [0.01; 0.34]
Lee (2016)	0.02	1.313	2.5%	0.02 [−2.56; 2.59]
Crowley (2019)	−0.35	0.745	5.4%	−0.35 [−1.81; 1.11]
Primo (2006)	−0.82	0.190	11.6%	−0.82 [−1.19; −0.45]
Lee and Park (2018)	−0.85	1.395	2.2%	−0.85 [−3.59; 1.88]
Matsusaka (2005)	−0.96	0.180	11.7%	−0.96 [−1.31; −0.61]
Chen and Malhotra (2007)	−1.40	0.640	6.4%	−1.40 [−2.65; −0.15]
Total (95% CI)			**55.1%**	**−0.25 [−1.44; 0.93]**
Heterogeneity: $Tau^2 = 1.0528$; $Chi^2 = 63.32$, df = 7 ($P < 0.01$); $I^2 = 89\%$				
Non−Majoritarian				
Baskaran (2013)	0.97	0.559	7.2%	0.97 [−0.12; 2.07]
Fiorino and Ricciuti (2007)	0.23	0.053	12.5%	0.23 [0.12; 0.33]
Schaltegger and Feld (2009)	0.00	0.001	12.6%	0.00 [0.00; 0.00]
Bjedov et al. (2014)	−0.00	0.010	12.6%	−0.00 [−0.02; 0.02]
Total (95% CI)			**44.9%**	**0.08 [−0.20; 0.37]**
Heterogeneity: $Tau^2 = 0.0155$; $Chi^2 = 21.21$, df = 3 ($P < 0.01$); $I^2 = 86\%$				
Total (95% CI)			**100.0%**	**−0.10 [−0.71; 0.51]**
Prediction interval				**[−1.67; 1.47]**

Heterogeneity: $Tau^2 = 0.4202$; $Chi^2 = 89.01$, df = 11 ($P < 0.01$); $I^2 = 88\%$
Residual heterogeneity: $Tau^2 = NA$; $Chi^2 = 84.54$, df = 10 ($P < 0.01$); $I^2 = 88\%$
Test for subgroup differences: $Chi^2 = 0.43$, df = 1 ($P = 0.51$)

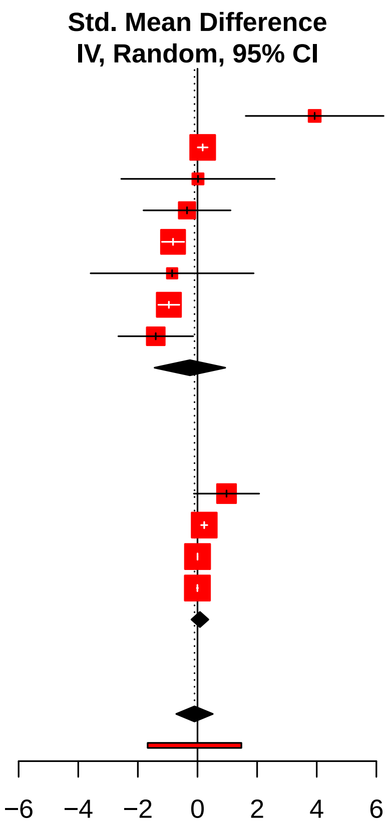


Figure 8: Subgroup Analysis of (N) x (ExpPC), controlling by electoral system

```r
mod <-
  metagen(coef, SE, data=aux,
          studlab=paste(authoryear),
          comb.fixed = FALSE,
          comb.random = TRUE,
          method.tau = "REML",
          hakn = TRUE,
          prediction=TRUE,
          sm="SMD")
mod
```

```
##                                SMD             95%-CI %W(random)
## Bjedov et al. (2014)       -0.0040 [-0.0432;  0.0352]       15.1
## Maldonado (2012)           -0.0609 [-0.0838; -0.0380]       19.5
## Mukherjee (2003)            0.0030 [ 0.0010;  0.0050]       23.0
## Bradbury and Crain (2001)   0.0036 [ 0.0008;  0.0065]       23.0
## Ricciuti (2004)             0.0140 [-0.0095;  0.0375]       19.4
##
## Number of studies combined: k = 5
##
##                           SMD             95%-CI     t p-value
## Random effects model -0.0083 [-0.0450; 0.0285] -0.62  0.5667
## Prediction interval          [-0.1054; 0.0889]
##
## Quantifying heterogeneity:
##  tau^2 = 0.0008 [0.0002; 0.0072]; tau = 0.0275 [0.0129; 0.0849];
##  I^2 = 87.1% [72.2%; 94.0%]; H = 2.78 [1.90; 4.08]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  30.97    4 < 0.0001
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

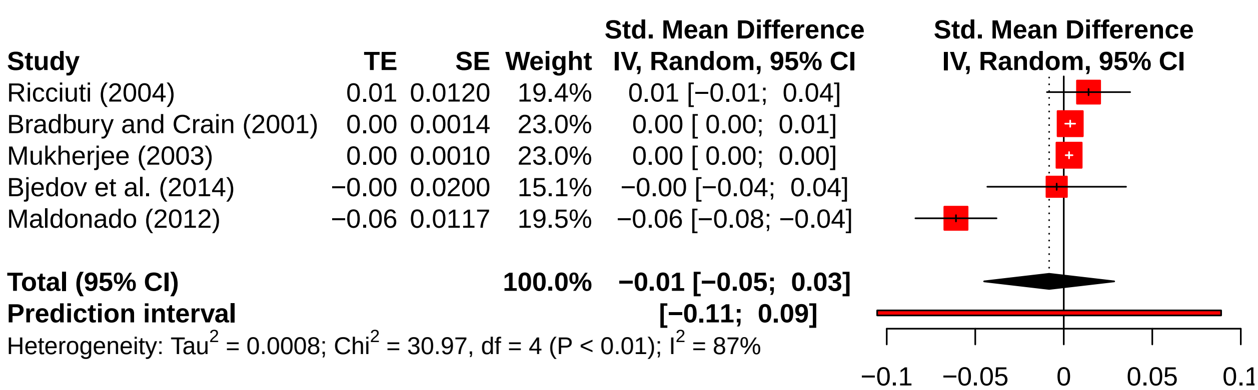


Figure 9: Effect of lower houses size (N) on percentage of public expenditure GDP (PCTGDP)

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 87.08.
2. The Random effects modem SMD estimated is $g = $ -0.01 (SE = 0.013).
3. The prediction interval ranges from -0.11 to 0.09. Therefore, it emcompasses zero.

logExpPC x N

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

```
# Pooling effects analysis -- logExpPC x N
aux <- filter(dat,
              indepvar2=='N'&depvar2=='logExpPC')
mod <-
  metagen(coef, SE, data=aux,
          studlab=paste(authoryear),
          comb.fixed = FALSE,
          comb.random = TRUE,
          method.tau = "REML",
          hakn = TRUE,
          prediction=TRUE,
          sm="SMD")
mod
```

```
##                               SMD             95%-CI %W(random)
## Lewis (2019)              -0.1740 [-0.2450; -0.1030]       24.3
## Höhmann (2017)            -0.0300 [-0.0496; -0.0104]       26.6
## Drew and Dollery (2017)    0.0770 [ 0.0221;  0.1319]       25.3
## Pettersson-Lidbom (2012) -0.1590 [-0.2394; -0.0786]       23.7
##
## Number of studies combined: k = 4
##
##                           SMD            95%-CI     t p-value
## Random effects model -0.0686 [-0.2560; 0.1188] -1.17  0.3282
## Prediction interval          [-0.6179; 0.4807]
##
## Quantifying heterogeneity:
##  tau^2 = 0.0128 [0.0034; 0.1933]; tau = 0.1133 [0.0584; 0.4396];
##  I^2 = 92.5% [84.1%; 96.5%]; H = 3.66 [2.51; 5.34]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  40.11    3 < 0.0001
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 92.52.
2. The Random effects modem SMD estimated is $g = $ -0.07 (SE = 0.059).

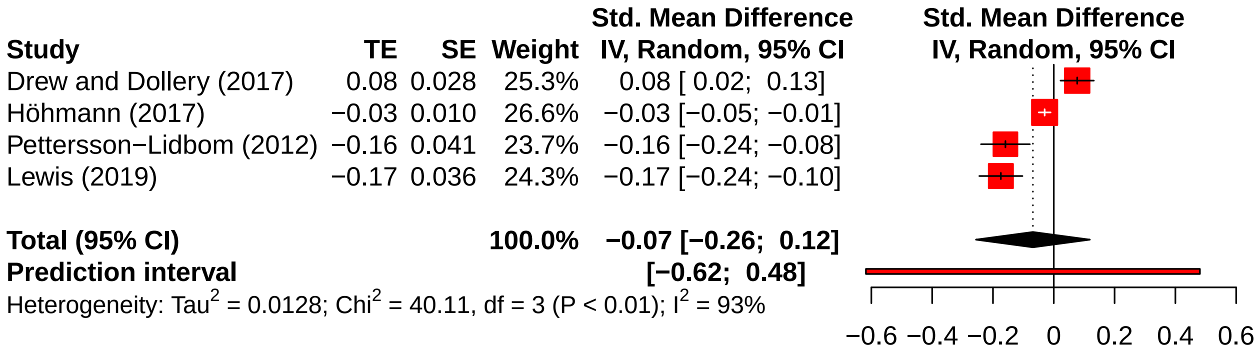


Figure 10: Effect of lower houses size (N) on log of per capita expenditure (logExpPC)

3. The prediction interval ranges from -0.62 to 0.48. Therefore, it emcompasses zero.

ExpPC x logN

There were no studies that had per capita expenditure in the dependent variable and log of lower house size in the treatment variable.

PCTGDP x logN

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

```r
# Pooling effects analysis -- PCTGDP x logN
aux <- filter(dat,
              indepvar2=='logN'&depvar2=='PCTGDP')
mod <-
  metagen(coef, SE, data=aux,
          studlab=paste(authoryear),
          comb.fixed = FALSE,
          comb.random = TRUE,
          method.tau = "REML",
          hakn = TRUE,
          prediction=TRUE,
          sm="SMD")
mod
```

```
##                                   SMD            95%-CI %W(random)
## Baqir (1999)                   2.0660 [ 1.4887; 2.6433]       34.0
## Lledo (2003)                  -4.6900 [-9.9427; 0.5627]        7.0
## Stein et al. (1998)            0.0109 [-0.0171; 0.0389]       35.6
## Milesi-Ferretti et al. (2001)  1.0500 [-0.8209; 2.9209]       23.4
##
## Number of studies combined: k = 4
##
##                          SMD            95%-CI    t p-value
## Random effects model 0.6242 [-2.4792; 3.7276] 0.64  0.5676
## Prediction interval         [-6.4447; 7.6931]
##
## Quantifying heterogeneity:
##  tau^2 = 1.7483 [0.3608; >100.0000]; tau = 1.3222 [0.6007; >10.0000];
##  I^2 = 94.3% [88.6%; 97.2%]; H = 4.20 [2.96; 5.95]
```

```
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  52.82    3 < 0.0001
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

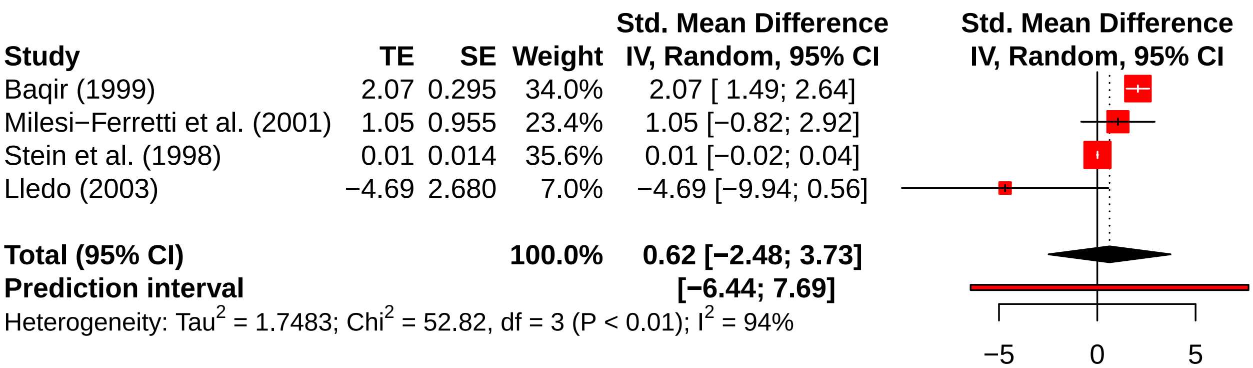


Figure 11: Effect of log lower houses size (logN) on the GDP share of public expenditure (PCTGDP)

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 94.32.
2. The Random effects modem SMD estimated is $g = $ 0.62 $(SE = 0.975)$.
3. The prediction interval ranges from -6.44 to 7.69. Therefore, it emcompasses zero.

logExpPC x logN

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

```
# Pooling effects analysis -- logExpPC x logN
aux <- filter(dat,
              indepvar2=='logN'&depvar2=='logExpPC')
mod <-
  metagen(coef, SE, data=aux,
          studlab=paste(authoryear),
          comb.fixed = FALSE,
          comb.random = TRUE,
          method.tau = "REML",
          hakn = TRUE,
          prediction=TRUE,
          sm="SMD")
mod
```

```
##                       SMD           95%-CI %W(random)
## MacDonald (2008) 0.1360 [0.0447; 0.2273]       31.9
## Baqir (2002)     0.1127 [0.0396; 0.1858]       34.2
## Baqir (1999)     0.3020 [0.2269; 0.3771]       33.9
```

```
##
## Number of studies combined: k = 3
##
##                          SMD            95%-CI    t p-value
## Random effects model 0.1844 [-0.0738; 0.4425] 3.07  0.0916
## Prediction interval         [-1.2580; 1.6267]
##
## Quantifying heterogeneity:
##  tau^2 = 0.0093 [0.0014; 0.4193]; tau = 0.0964 [0.0372; 0.6476];
##  I^2 = 85.9% [59.0%; 95.2%]; H = 2.66 [1.56; 4.54]
##
## Test of heterogeneity:
##      Q d.f. p-value
##  14.18    2  0.0008
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

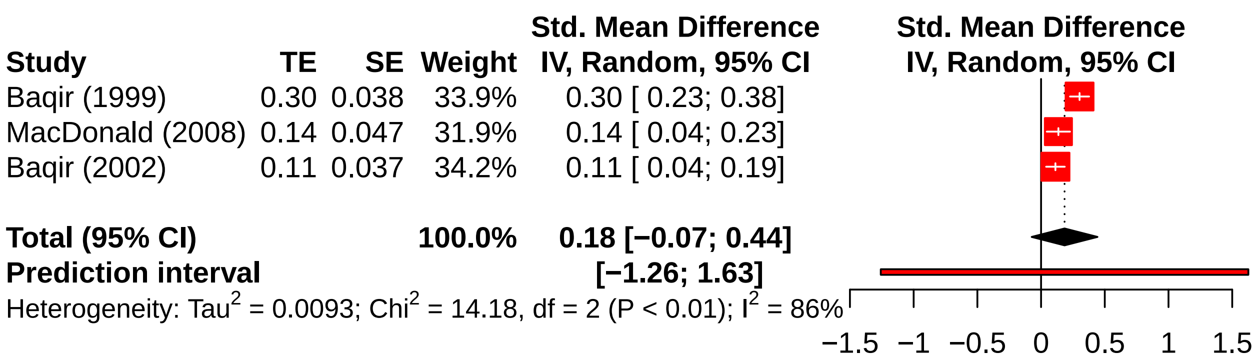


Figure 12: Effect of log lower houses size (logN) on the log of per capita government expenditure (logExpPC)

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 85.9.
2. The Random effects modem SMD estimated is $g = $ 0.18 ($SE = 0.06$). **This model is significant at the 10% confidence level.**
3. The prediction interval ranges from -1.26 to 1.63. Therefore, it emcompasses zero.

ExpPC x K

Now we are investigating the upper house size (K). In this model, we investigate the effect of upper house size on expenditure per capita (ExpPC).

```
# Pooling effects analysis -- ExpPC x K
aux <- filter(dat,
              indepvar2=='K'&depvar2=='ExpPC')
mod <-
  metagen(coef, SE, data=aux,
          studlab=paste(authoryear),
          comb.fixed = FALSE,
```

```
          comb.random = TRUE,
          method.tau = "REML",
          hakn = TRUE,
          prediction=TRUE,
          sm="SMD")
mod
```

```
##                                       SMD             95%-CI %W(random)
## Crowley (2019)                     8.2100 [ 0.2702; 16.1498]       16.0
## Lee and Park (2018)               19.7400 [ 3.2645; 36.2155]        6.8
## Lee (2016)                        38.4400 [ 0.7499; 76.1301]        1.6
## Bradbury and Stephenson (2009)    0.6240 [ 0.2295;  1.0185]       27.0
## Chen and Malhotra (2007)           8.3000 [ 3.6941; 12.9059]       22.0
## Primo (2006)                       0.9700 [-0.4804;  2.4204]       26.5
##
## Number of studies combined: k = 6
##
##                           SMD              95%-CI    t p-value
## Random effects model 5.5440 [ -2.2851; 13.3731] 1.82  0.1284
## Prediction interval         [-10.4258; 21.5138]
##
## Quantifying heterogeneity:
##  tau^2 = 23.8083 [4.9130; >238.0830]; tau = 4.8794 [2.2165; >15.4299];
##  I^2 = 78.4% [52.4%; 90.2%]; H = 2.15 [1.45; 3.19]
##
## Test of heterogeneity:
##      Q d.f. p-value
##  23.13    5  0.0003
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

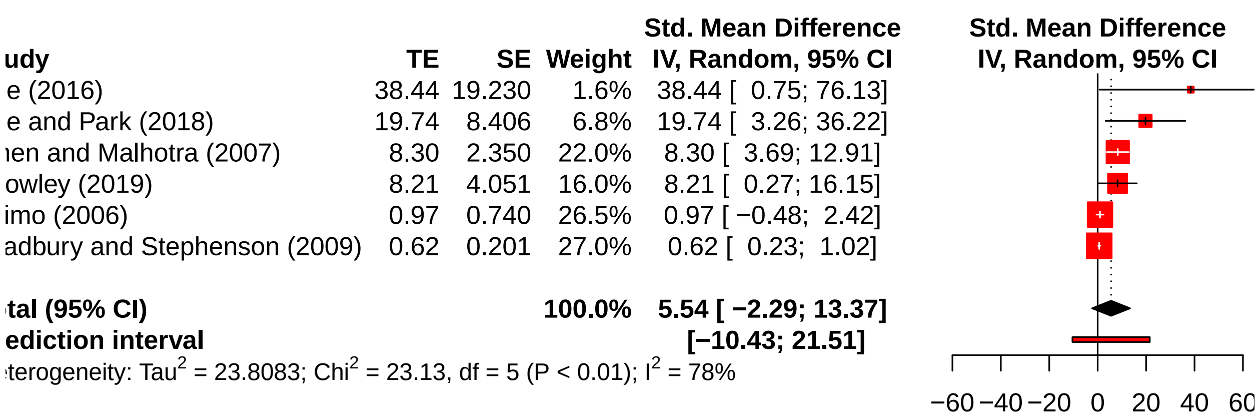


Figure 13: Effect of upper house size (K) on the per capita government expenditure (ExpPC)

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 78.38.

2. The Random effects modem SMD estimated is $g = $ 5.54 ($SE = 3.046$).
3. The prediction interval ranges from -10.43 to 21.51. Therefore, it emcompasses zero.

PCTGDP x K

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

```
# Pooling effects analysis -- PCTGDP x K
aux <- filter(dat,
              indepvar2=='K'&depvar2=='PCTGDP')
mod <-
  metagen(coef, SE, data=aux,
          studlab=paste(authoryear),
          comb.fixed = FALSE,
          comb.random = TRUE,
          method.tau = "REML",
          hakn = TRUE,
          prediction=TRUE,
          sm="SMD")
mod
```

```
##                                SMD            95%-CI %W(random)
## Maldonado (2012)           -0.0400 [-0.0659; -0.0141]       31.3
## Bradbury and Crain (2001)   0.0126 [ 0.0010;  0.0243]       36.4
## Ricciuti (2004)             0.0160 [-0.0075;  0.0395]       32.3
##
## Number of studies combined: k = 3
##
##                           SMD            95%-CI     t p-value
## Random effects model -0.0027 [-0.0793; 0.0738] -0.15  0.8915
## Prediction interval          [-0.4284; 0.4229]
##
## Quantifying heterogeneity:
##  tau^2 = 0.0008 [0.0001; 0.0388]; tau = 0.0284 [0.0101; 0.1970];
##  I^2 = 85.8% [58.6%; 95.1%]; H = 2.65 [1.55; 4.53]
##
## Test of heterogeneity:
##      Q d.f. p-value
##  14.07    2  0.0009
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-profile method for confidence interval of tau^2 and tau
## - Hartung-Knapp adjustment for random effects model
```

And the forest plot:

Highlights:

1. The results are highly heterogeneous: $I^2 = $ 85.79.
2. The Random effects modem SMD estimated is $g = $ 0 ($SE = 0.018$).
3. The prediction interval ranges from -0.43 to 0.42. Therefore, it emcompasses zero.

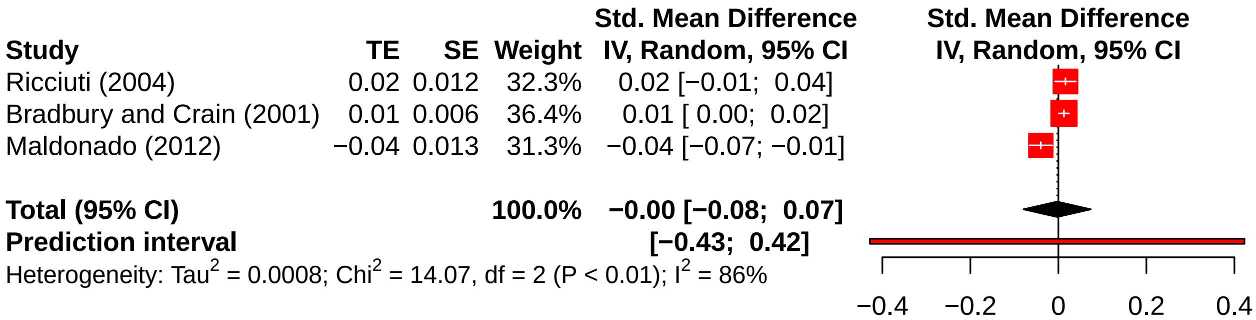


Figure 14: Effect of upper house size (K) on the public expenditure share of the GDP (PCTGDP)

logExpPC x K

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

Meta-regressions

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

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 stydy (N, K, log of N);
3. The electoral system (Majoritarian, Proportional Representation, and Mixed).

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

```
## Warning in rma(yi = coef, sei = SE, data = dat, method = "REML", mods = ~depvar2
## + : Ratio of largest to smallest sampling variance extremely large. May not be
## able to obtain stable results.
```

```
##
## Mixed-Effects Model (k = 37; tau^2 estimator: REML)
##
## tau^2 (estimated amount of residual heterogeneity):     0.2057 (SE = 0.0713)
## tau (square root of estimated tau^2 value):             0.4535
## I^2 (residual heterogeneity / unaccounted variability): 99.98%
## H^2 (unaccounted variability / sampling variability):   4915.03
## R^2 (amount of heterogeneity accounted for):            0.00%
##
## Test for Residual Heterogeneity:
## QE(df = 30) = 280.5545, p-val < .0001
##
## Test of Moderators (coefficients 2:7):
## F(df1 = 6, df2 = 30) = 0.6628, p-val = 0.6800
##
## Model Results:
##
##                  estimate      se     tval    pval    ci.lb   ci.ub
## intrcpt            0.3993  0.4080   0.9788  0.3355  -0.4338  1.2325
## depvar2PCTGDP      0.1119  0.4772   0.2345  0.8162  -0.8627  1.0865
## depvar2logExpPC   -0.3174  0.4226  -0.7512  0.4584  -1.1804  0.5456
## indepvar2N        -0.4421  0.3957  -1.1173  0.2728  -1.2503  0.3661
## indepvar2logN      0.2329  0.5163   0.4510  0.6553  -0.8216  1.2873
## elecsysMixed      -0.2478  0.5017  -0.4940  0.6249  -1.2723  0.7767
```

```
## elecsysPR          0.1909  0.4376   0.4363  0.6657  -0.7027  1.0846
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

As we have considerable heterogeneity in our sample, we run a permutation test to ensure the validity of our estimates. The results follow below.

```
## Running 1000 iterations for approximate permutation test.
##
  |
  |                                                                      |   0%
  |
  |                                                                      |   1%
  |
  |=                                                                     |   1%
  |
  |=                                                                     |   2%
  |
  |==                                                                    |   2%
  |
  |==                                                                    |   3%
  |
  |==                                                                    |   4%
  |
  |===                                                                   |   4%
  |
  |===                                                                   |   5%
  |
  |====                                                                  |   5%
  |
  |====                                                                  |   6%
  |
  |=====                                                                 |   6%
  |
  |=====                                                                 |   7%
  |
  |=====                                                                 |   8%
  |
  |======                                                                |   8%
  |
  |======                                                                |   9%
  |
  |=======                                                               |   9%
  |
  |=======                                                               |  10%
  |
  |=======                                                               |  11%
  |
  |========                                                              |  11%
  |
  |========                                                              |  12%
  |
  |=========                                                             |  12%
  |
```

```
|=========                                                             |  13%
|
|=========                                                             |  14%
|
|==========                                                            |  14%
|
|==========                                                            |  15%
|
|===========                                                           |  15%
|
|===========                                                           |  16%
|
|============                                                          |  16%
|
|============                                                          |  17%
|
|============                                                          |  18%
|
|=============                                                         |  18%
|
|=============                                                         |  19%
|
|==============                                                        |  19%
|
|==============                                                        |  20%
|
|==============                                                        |  21%
|
|===============                                                       |  21%
|
|===============                                                       |  22%
|
|================                                                      |  22%
|
|================                                                      |  23%
|
|================                                                      |  24%
|
|=================                                                     |  24%
|
|=================                                                     |  25%
|
|==================                                                    |  25%
|
|==================                                                    |  26%
|
|===================                                                   |  26%
|
|===================                                                   |  27%
|
|===================                                                   |  28%
|
|====================                                                  |  28%
|
```

```
|====================                                                  |  29%
|
|=====================                                                 |  29%
|
|=====================                                                 |  30%
|
|=====================                                                 |  31%
|
|======================                                                |  31%
|
|======================                                                |  32%
|
|=======================                                               |  32%
|
|=======================                                               |  33%
|
|=======================                                               |  34%
|
|========================                                              |  34%
|
|========================                                              |  35%
|
|=========================                                             |  35%
|
|=========================                                             |  36%
|
|==========================                                            |  36%
|
|==========================                                            |  37%
|
|==========================                                            |  38%
|
|===========================                                           |  38%
|
|===========================                                           |  39%
|
|============================                                          |  39%
|
|============================                                          |  40%
|
|============================                                          |  41%
|
|=============================                                         |  41%
|
|=============================                                         |  42%
|
|==============================                                        |  42%
|
|==============================                                        |  43%
|
|==============================                                        |  44%
|
|===============================                                       |  44%
|
```

```
|===============================                                       |  45%
|
|================================                                      |  45%
|
|================================                                      |  46%
|
|=================================                                     |  46%
|
|=================================                                     |  47%
|
|=================================                                     |  48%
|
|==================================                                    |  48%
|
|==================================                                    |  49%
|
|===================================                                   |  49%
|
|===================================                                   |  50%
|
|===================================                                   |  51%
|
|====================================                                  |  51%
|
|====================================                                  |  52%
|
|=====================================                                 |  52%
|
|=====================================                                 |  53%
|
|=====================================                                 |  54%
|
|======================================                                |  54%
|
|======================================                                |  55%
|
|=======================================                               |  55%
|
|=======================================                               |  56%
|
|========================================                              |  56%
|
|========================================                              |  57%
|
|========================================                              |  58%
|
|=========================================                             |  58%
|
|=========================================                             |  59%
|
|==========================================                            |  59%
|
|==========================================                            |  60%
|
```

```
|==========================================                            |  61%
|
|===========================================                           |  61%
|
|===========================================                           |  62%
|
|============================================                          |  62%
|
|============================================                          |  63%
|
|============================================                          |  64%
|
|=============================================                         |  64%
|
|=============================================                         |  65%
|
|==============================================                        |  65%
|
|==============================================                        |  66%
|
|===============================================                       |  66%
|
|===============================================                       |  67%
|
|===============================================                       |  68%
|
|================================================                      |  68%
|
|================================================                      |  69%
|
|=================================================                     |  69%
|
|=================================================                     |  70%
|
|=================================================                     |  71%
|
|==================================================                    |  71%
|
|==================================================                    |  72%
|
|===================================================                   |  72%
|
|===================================================                   |  73%
|
|===================================================                   |  74%
|
|====================================================                  |  74%
|
|====================================================                  |  75%
|
|=====================================================                 |  75%
|
|=====================================================                 |  76%
|
```

```
|======================================================                |  76%
|
|======================================================                |  77%
|
|======================================================                |  78%
|
|=======================================================               |  78%
|
|=======================================================               |  79%
|
|========================================================              |  79%
|
|========================================================              |  80%
|
|========================================================              |  81%
|
|=========================================================             |  81%
|
|=========================================================             |  82%
|
|==========================================================            |  82%
|
|==========================================================            |  83%
|
|==========================================================            |  84%
|
|===========================================================           |  84%
|
|===========================================================           |  85%
|
|============================================================          |  85%
|
|============================================================          |  86%
|
|=============================================================         |  86%
|
|=============================================================         |  87%
|
|=============================================================         |  88%
|
|==============================================================        |  88%
|
|==============================================================        |  89%
|
|===============================================================       |  89%
|
|===============================================================       |  90%
|
|===============================================================       |  91%
|
|================================================================      |  91%
|
|================================================================      |  92%
|
```

```
  |=================================================================     |  92%
  |
  |=================================================================     |  93%
  |
  |=================================================================     |  94%
  |
  |==================================================================    |  94%
  |
  |==================================================================    |  95%
  |
  |===================================================================   |  95%
  |
  |===================================================================   |  96%
  |
  |====================================================================  |  96%
  |
  |====================================================================  |  97%
  |
  |====================================================================  |  98%
  |
  |===================================================================== |  98%
  |
  |===================================================================== |  99%
  |
  |======================================================================|  99%
  |
  |======================================================================| 100%
##
## Test of Moderators (coefficients 2:7):
## F(df1 = 6, df2 = 30) = 0.6628, p-val* = 0.2360
##
## Model Results:
##
##                  estimate      se     tval   pval*    ci.lb   ci.ub
## intrcpt            0.3993  0.4080   0.9788  0.1360  -0.4338  1.2325
## depvar2PCTGDP      0.1119  0.4772   0.2345  0.7370  -0.8627  1.0865
## depvar2logExpPC   -0.3174  0.4226  -0.7512  0.3030  -1.1804  0.5456
## indepvar2N        -0.4421  0.3957  -1.1173  0.1030  -1.2503  0.3661
## indepvar2logN      0.2329  0.5163   0.4510  0.5220  -0.8216  1.2873
## elecsysMixed      -0.2478  0.5017  -0.4940  0.4800  -1.2723  0.7767
## elecsysPR          0.1909  0.4376   0.4363  0.5540  -0.7027  1.0846
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Therefore, no effects.

Theory of Meta Analysis

There are two main estimators for conducting meta analysis: fixed effects and random effects models. The fixed effects model assumes that there is one true effect in reality, and that all estimates are an attempt to uncover this true effect. The random effects model, on the other hand, assumes that there are a distribution of true effects, that vary based on sample and tests characteristics.

In this paper, we use the 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. **Subjects**: Counties, Municipalities, States, Provinces, Countries.
2. **Electoral systems**: Majoritarian, PR, Mixed.
3. **Modeling strategies**: Panel data, Standard OLS, IV, RDD.

These sources of heterogeneity have two implications. First, it makes our estimates very disperse. The heterogeneity tests are all but one significant. When the sample sizes are large enough, we removed more heterogeneous studies, but we still had considerable dispersion in our estimates. Second, the amount of heterogeneity makes fixed effects estimates unrealistic and bised. Thus, we opt for random effects model.

Let each study having an effect of T_i. In a random effects model, we can decompose this effect in two components, the true effect that the study with the same specifications as i come 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.

In all empirical estimates, we use the package `meta`, and the package `dmetar`, described in (Doing Meta-Analysis with R)[https://bookdown.org/MathiasHarrer/Doing_Meta_Analysis_in_R/random.html]. To empirically implement the random effects model, we need to choose a method to estimate the true effect size variance, τ^2, which in our formulation, represents the variance of ξ_i. We selected the **Restricted Maximum Likelihood Estimator**, as the literature regards it as more precise when we have continuous measures, such as we have on our data (link)[https://www.ncbi.nlm.nih.gov/pubmed/26332144].