Are Voters Rational?

Teemu Lyytikäinen and **Janne Tukiainen**

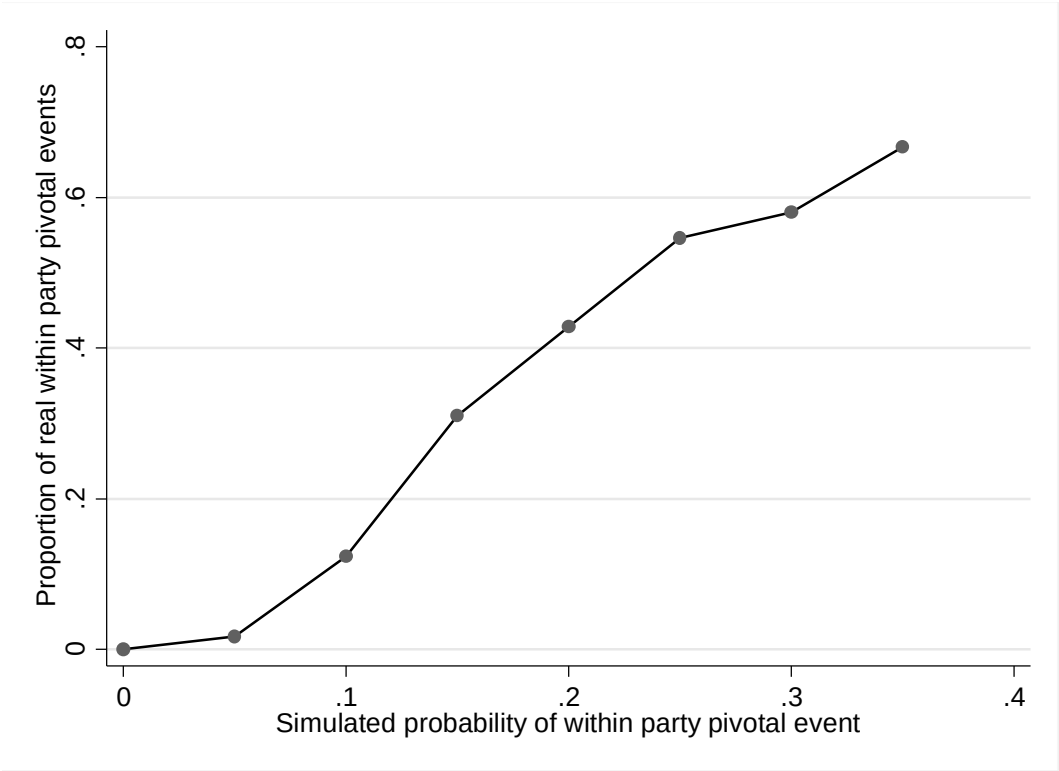
16 January 2019

Supporting information (Online publication only)

ONLINE APPENDIX A: The validity of pivotal probability measures and how they change at the thresholds

As a simple validity check, we use the individual candidate level data for both the simulated within party pivotal probability and a dummy variable for whether the candidate in reality was in a respective pivotal situation, that is, either drew for the last seat or won or lost a seat with one vote margin. We divide the data into 5% percent bins in the simulated variable (horizontal axis), and plot them in Graph A1 against the frequency (mean of the dummy variable) of real pivotal events in these bins (vertical axis). We see that the simulated pivotal probability predicts the reality very well and seems to provide a monotonic transformation of the real occurrence. There is some difference in levels as the simulation underestimated the real pivotal events. This is likely caused by the sampling variance introduced by the bootstrap being larger than the sampling variance in reality across elections. However, this does not bias our estimation given that we use a monotonic transformation of the real pivotal probabilities. It may also make our findings more plausible that real pivotal occurrence frequencies are quite high.

Graph A1. Comparing simulated within party pivotal probabilities to realizations of within party pivotal events.



We also conduct two counterfactual experiments in the pivotal probability simulation to assess the effect of crossing the population threshold on the pivotal probabilities. In the first counterfactual, we assume that in each municipality, fewer seats than in the real elections were actually given while maintaining everything else the same. The number of seats is assumed to be what they would be below the next population threshold downwards. However, we keep the total number of votes given unchanged. Only the allocated amount of seats is different. We call this counterfactual "CF down" in Table 2. "CF up" is otherwise the same but the number of seats is as above the next threshold upwards.

In Table A1, we report a summary of our simulation results both for the simulated real council size elections and the simulated counterfactual elections. In the first three rows, we

show the average between parties results for all the election-party observations and in the last three rows we show the average within party results for all the election-candidate observations. The counterfactual results work as expected, as pivotal probability is lower when fewer seats are allocated and higher with more seats.

Table A1. Descriptive statistics of the pivotal probability simulations.

Simulation	N	Mean	Std. Dev.	Min	Max
CF down between	10171	0.017	0.019	0	0.111
Real between	10171	0.020	0.020	0	0.123
CF up between	10171	0.024	0.021	0	0.231
CF down within	146234	0.024	0.047	0	0.408
Real within	146234	0.028	0.051	0	0.389
CF up within	146234	0.032	0.057	0	0.494

Notes: The unit of observation is election-party (first three rows) or election-candidate (last three rows). Only municipalities with a population below 45,000 are included. "between" and "within" refer to pivotalities between and within parties. "CF down" refers to counterfactual simulation where the council size is what it would be in the next population group below the real one and "CF up" refers to counterfactual simulation where the council size is what it would be in the next population group above the real one.

In Table A2, we report the simulated causal effect of crossing the nearest population threshold on the pivotal probability for each threshold separately. This effect is not yet the actual first stage regression of the IV estimation, but rather based on the counterfactual simulations. This effect is calculated as the difference between the "Real" and "CF down" results for those municipalities just above (10% bandwidth) the threshold and as the difference between "CF up" and "Real" for those municipalities just below the threshold. We find systematically larger effects for smaller thresholds as expected.

Table A2. The effect of crossing the threshold on the pivotal probabilities both between and within parties. Simulation results within 10% population bands around each threshold.

Threshold	Band	Mean	Std. Dev.	N	Relative council size change
2k between	10 %	0.0052	0.029	518	0.24
4k between	10 %	0.0045	0.024	717	0.29
8k between	10 %	0.0039	0.018	947	0.3
15k between	10 %	0.0019	0.015	430	0.23
30k between	10 %	0.0008	0.011	322	0.19
2k within	10 %	0.0070	0.056	4799	0.24
4k within	10 %	0.0066	0.052	8554	0.29
8k within	10 %	0.0055	0.043	14081	0.3
15k within	10 %	0.0030	0.031	8324	0.23
30k within	10 %	0.0024	0.023	7376	0.19

Notes: The unit of observation is election-party (first three rows) or election-candidate (last three rows). Only municipalities with a population below 45,000 are included. “Relative council size change” is the relative council size change at the given threshold. N is the number of observations (at party or candidate level) in the group around the threshold defined as being within the 10% population band of the population at the threshold. “Mean” is the average change in the pivotal probability of crossing the threshold defined as the average of the differences between both real and counterfactual down and counterfactual up and real.

ONLINE APPENDIX B: Robustness and validity

The drawback of our main specification (equation (3)) is that it uses data far from the cut-offs to estimate the function *f* at the cut-offs. One concern is that omitted election-level variables may confound the results if *f* does not adequately control for them. To address this issue, we conduct a large battery of additional analyses. First, we look at the robustness of the results to adding control variables. In Table B1, we repeat the analysis in Table 6 but add a set of municipality controls. The results do not change.

Table B1. Council size and voter turnout (municipality attributes controlled for).

Dep var: Turnout in municipal elections							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.0250***	-0.0164**	-0.0077	0.0028	0.0103	0.0153	0.0173
	[0.0071]	[0.0075]	[0.0081]	[0.0093]	[0.0101]	[0.0110]	[0.0113]
pop>4k	-0.0061	0.0072	0.0176**	0.0249***	0.0263***	0.0237***	0.0203**
	[0.0056]	[0.0071]	[0.0080]	[0.0086]	[0.0086]	[0.0083]	[0.0087]
pop>8k	-0.0006	0.0160*	0.0218**	0.0155	0.008	0.0035	0.0036
	[0.0075]	[0.0091]	[0.0095]	[0.0095]	[0.0100]	[0.0107]	[0.0106]
pop>15k	0.0234*	0.0329**	0.0179	0.0008	0.0046	0.0163	0.0167
	[0.0121]	[0.0132]	[0.0138]	[0.0158]	[0.0153]	[0.0169]	[0.0172]
pop>30k	0.0487***	0.0054	0.0046	0.0331*	0.0094	0.0014	0.0177
	[0.0140]	[0.0152]	[0.0148]	[0.0189]	[0.0159]	[0.0179]	[0.0196]
Average effect	-0.001	0.008	0.012**	0.014**	0.014**	0.014**	0.015**
	[0.005]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
N	1736	1736	1736	1736	1736	1736	1736

Notes: Sample size is 1,736. Controls: tax revenue/capita, municipality employees/capita, unemployment rate, central government grants/capita, share of over 65 year olds, municipal expenditure/capita. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Our second approach adds flexibility to f by allowing for different polynomials between different cut-offs. This model is written as

$$(5) \qquad Turnout_{it} = \beta_1 + \beta_2 Group2_{it} + \ ... + \beta_6 Group6_{it} + f_1(Pop_{it})$$

$$+ Group2_{it} * f_2(Pop_{it} - 2000) + \cdots + Group6_{it} * f_6(Pop_{it} - 30000) + u_{it}.$$

Here the function f is a 1st to 3rd order polynomial of population and is allowed to vary between the cut-off groups. Note that already a linear specification maps turnout quite flexibly to the population. Normalizing population to zero at the cutoff when estimating functions $f_2,\ldots, f_6$ implies that, like in equation (3), the coefficients $\beta_2,\ldots, \beta_6$ on the dummies for groups above the cut-offs give direct treatment effect estimates of interest.

Table B2 shows the results of the model in equation (5), where we allow for different polynomials between different cut-offs. The improvement in flexibility comes at the price of reduced efficiency and higher than 2nd order polynomials give estimates that are too imprecise to be informative, but the point estimate is robust. We report the estimated effect at each threshold and the average treatment effect estimates for specifications using 1st - 3rd order polynomials of population interacted with the group dummies.

The average treatment effect estimate is 1.4 percentage points and significant at the 5% level in the first column of Table B2 with the piecewise linear specification. Including the 2nd order term (column 2) reduces the estimate to 1.1 percentage points and it is now only weakly (10% level) significant. In the third column, the average effect increases but becomes insignificant. In Table B3, we control for municipality attributes. The weighted estimated average effects are almost the same as without additional controls.

Table B2. Council size and voter turnout in municipal elections (equation (5) results).

Dep var: Turnout in municipal elections			
	Order of polynomial of pop		
Threshold	1st	2nd	3rd
pop>2k	0.013	-0.002	0.013
	[0.011]	[0.012]	[0.014]
pop>4k	0.015*	0.019*	0.025**
	[0.009]	[0.010]	[0.012]
pop>8k	0.012	0.012	0.019
	[0.012]	[0.014]	[0.016]
pop>15k	0.018	0.014	-0.01
	[0.016]	[0.022]	[0.026]
pop>30k	0.014	0.017	-0.017
	[0.012]	[0.018]	[0.020]
Average effect	0.014**	0.011*	0.013
	[0.006]	[0.006]	[0.008]
N	1747	1747	1747

Notes*:* Sample size is 1,747. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Table B3. Council size and voter turnout in municipal elections (equation (5) results with controls).

Dep var: Turnout in municipal elections			
	Order of polynomial of pop		
Threshold	1st	2nd	3rd
pop>2k	0.015	0	0.014
	[0.011]	[0.012]	[0.013]
pop>4k	0.013	0.018*	0.022*
	[0.008]	[0.010]	[0.012]
pop>8k	0.011	0.01	0.018
	[0.010]	[0.012]	[0.014]
pop>15k	0.011	0.009	-0.012
	[0.015]	[0.021]	[0.025]
pop>30k	0.019	0.013	-0.017
	[0.014]	[0.019]	[0.022]
Average effect	0.013**	0.010*	0.011
	[0.006]	[0.006]	[0.008]
N	1736	1736	1736

Notes*:* Sample size is 1,736. Controls: tax revenue/capita, municipality employees/capita, unemployment rate, central government grants/capita, share of over 65 year olds, municipal expenditure/capita. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Third, in Table B4, we report the results from a nonparametric local linear estimation at each cutoff separately. We use triangular kernel as is standard. We report the results using the optimal bandwidth by Imbens and Kalyanaraman (2012) and also study the sensitivity of the results to half and double the optimal ones. We also report the results from using the bias correction and robust inference method of Calonico et al. (2014) (CCT) using their improved MSE-optimal bandwidth. For that method, we report both the main bandwidth and the bandwidth used to estimate the bias. N is based on the main bandwidth. For the CCT approach, we report both the non-clustered and clustered inference and bandwidth selection.

In Table B5, we report the results from pooling all the cutoffs together, with forcing variable defined as distance to this normalized and pooled cutoff at zero. As we have strong trend in turnout and population, this pooling increases residual variance. To account for this, we also report results where we control either for cutoff fixed effects or a third order polynomial of the real population. Overall, the results both at the individual thresholds and the pooled are close to those obtained with the parametric specifications.

Table B4. Nonparametric local linear RDD, individual cutoffs.

Threshold	(1)	(2)	(3)	(4)	(5)
pop>2k	-0.014	0.003	0.008	-0.021	-0.021
	[0.012]	[0.011]	[0.011]	[0.016]	[0.016]
Bandwidth	425	850	1700	308/493	314/471
N	218	411	507	161	164
pop>4k	0.034***	0.027***	0.023***	0.045**	0.045**
	[0.012]	[0.009]	[0.009]	[0.025]	[0.022]
Bandwidth	514	1028	2056	349/579	352/556
N	178	382	527	122	123
pop>8k	0.005	0.011	0.012	0.003	0.005
	[0.011]	[0.012]	[0.012]	[0.019]	[0.019]
Bandwidth	857	1713	3426	707/1096	672/1005
N	160	286	402	134	130
pop>15k	0.008	0.004	0.008	-0.004	-0.006
	[0.019]	[0.021]	[0.021]	[0.027]	[0.027]
Bandwidth	1952	3903	7806	1225/2029	1442/2119
N	77	143	199	50	58
pop>30k	-0.01	-0.001	0.005	0.022	0.022
	[0.022]	[0.015]	[0.015]	[0.037]	[0.023]
Bandwidth	3446	6891	13782	1766/3239	1869/3107
N	40	79	101	25	25
Bandwidth	IK*0.5	IK	IK*2	MSE	MSE, clustered
Clustering	municipality	municipality	municipality	no	municipality
Method	local linear	local linear	local linear	CCT-correction	CCT-correction

Notes: Table shows nonparametric local linear estimation results for each threshold separately and the weighted average effect. Triangular kernel is used. IK refers to Imbens and Kalyanaraman (2012) optimal bandwidth. Standard errors are in brackets (clustered at the municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Table B5. Nonparametric local linear RDD, pooled cutoffs.

Threshold	(1)	(2)	(3)	(4)	(5)	(6)
All	0.011	0.010	0.014**	0.014	0.015**	0.015*
	[0.008]	[0.010]	[0.007]	[0.009]	[0.007]	[0.009]
Bandwidth	949/1719	895/1640	1052/1940	965/1815	1175/2691	1171/2669
N	1028	972	1112	1040	1166	1166
Controls	no	no	cutoff FE	cutoff FE	3rd order pop	3rd order pop
Bandwidth	MSE	MSE, clustered	MSE	MSE, clustered	MSE	MSE, clustered
Clustering	no	municipality	no	municipality	no	municipality
Method	CCT-correction	CCT-correction	CCT-correction	CCT-correction	CCT-correction	CCT-correction

We also test the validity of the RDD through two placebo tests. First, as already discussed in Graph 2, we use data on turnout in national parliamentary elections to see if the overall propensity to vote is correlated with the treatment variables. Sample size is somewhat smaller than in the municipal election data. Table B6 confirms the findings in Graph 2 that the average effect is close to zero and insignificant in all specifications (1st to 7th order polynomials). This suggests that the positive effect on turnout in local elections is indeed caused by the council size change and is not driven by other factors.

Table B6. Placebo tests with national elections data.

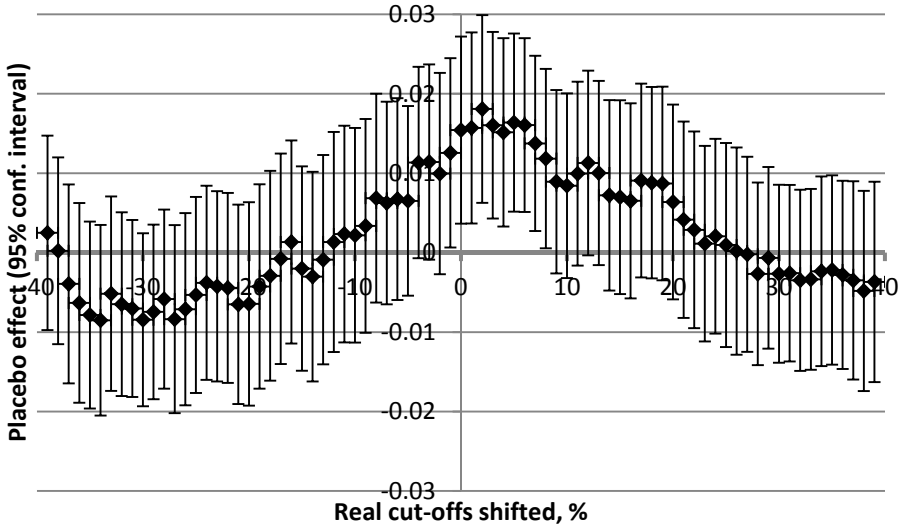
Dep var: Turnout in national elections							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.0051	-0.0048	-0.0038	-0.0037	-0.0041	-0.0066	-0.0086
	[0.0063]	[0.0065]	[0.0071]	[0.0081]	[0.0090]	[0.0099]	[0.0104]
pop>4k	0.0011	0.0015	0.0028	0.0028	0.0028	0.0042	0.0079
	[0.0058]	[0.0074]	[0.0090]	[0.0100]	[0.0101]	[0.0101]	[0.0104]
pop>8k	0.0112	0.0117	0.0125	0.0125	0.0129	0.0151	0.0149
	[0.0071]	[0.0090]	[0.0096]	[0.0099]	[0.0106]	[0.0111]	[0.0111]
pop>15k	0.0013	0.0017	-0.0002	-0.0002	-0.0005	-0.0063	-0.006
	[0.0103]	[0.0115]	[0.0114]	[0.0137]	[0.0132]	[0.0153]	[0.0153]
pop>30k	0.0324**	0.0310***	0.0295**	0.0297*	0.0311**	0.0360**	0.0166
	[0.0138]	[0.0118]	[0.0134]	[0.0165]	[0.0134]	[0.0167]	[0.0168]
Average effect	0.004	0.005	0.005	0.005	0.005	0.005	0.004
	[0.004]	[0.005]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
N	1076	1076	1076	1076	1076	1076	1076

Notes: Sample size is 1,076. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

In our second placebo test, we estimate equation (3) style models with artificial cut-offs created by shifting the real cut-offs between -40% and 40%. We use the 6th order polynomial of population. Graph B1 shows the results. The pattern is as it should be. Analysis with placebo thresholds results consistently in zero effect, unless the artificial location is very close the real one. When the location is shifted only between -1 % and +8 % the result is

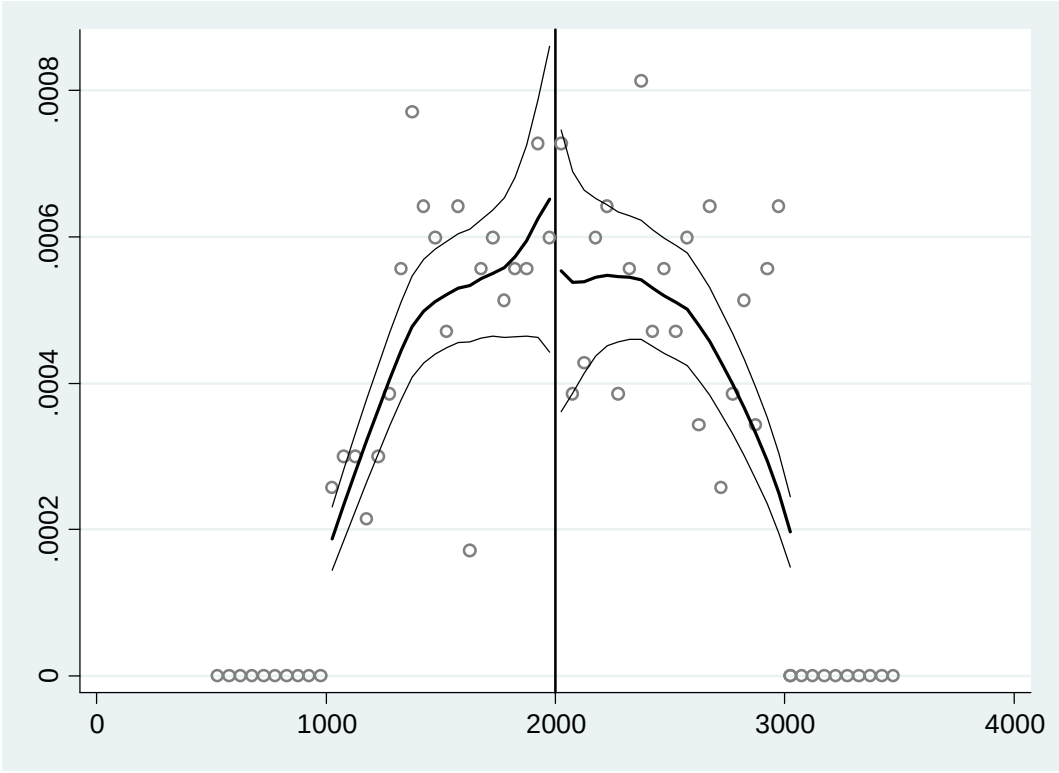
positive and statistically significant. These results reflect the somewhat inflexible specification rather than any threat to validity.

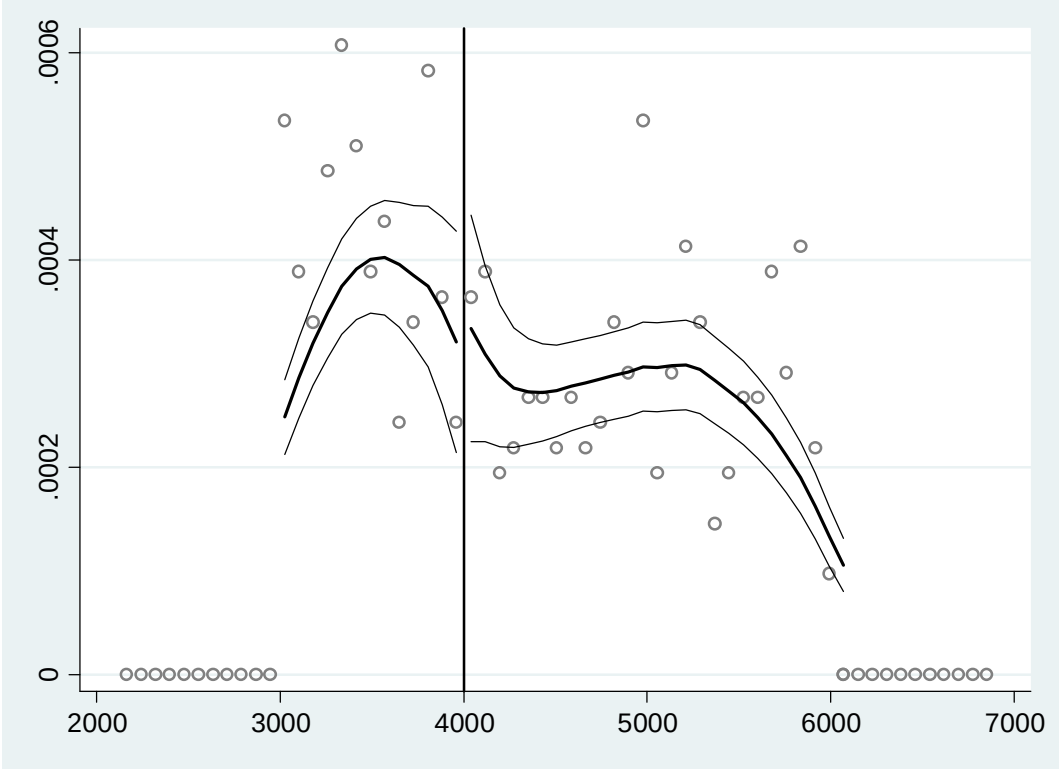
Graph B1. Placebo tests with artificial cut-offs (eq. (3), 6th order polynomial of pop).

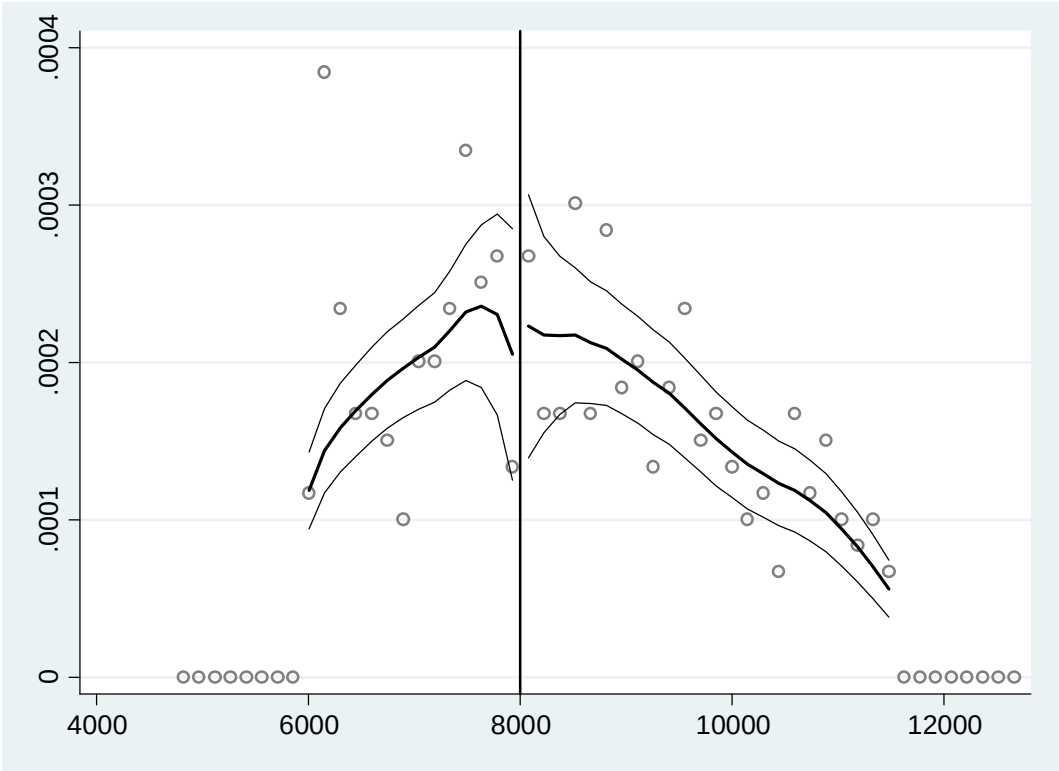


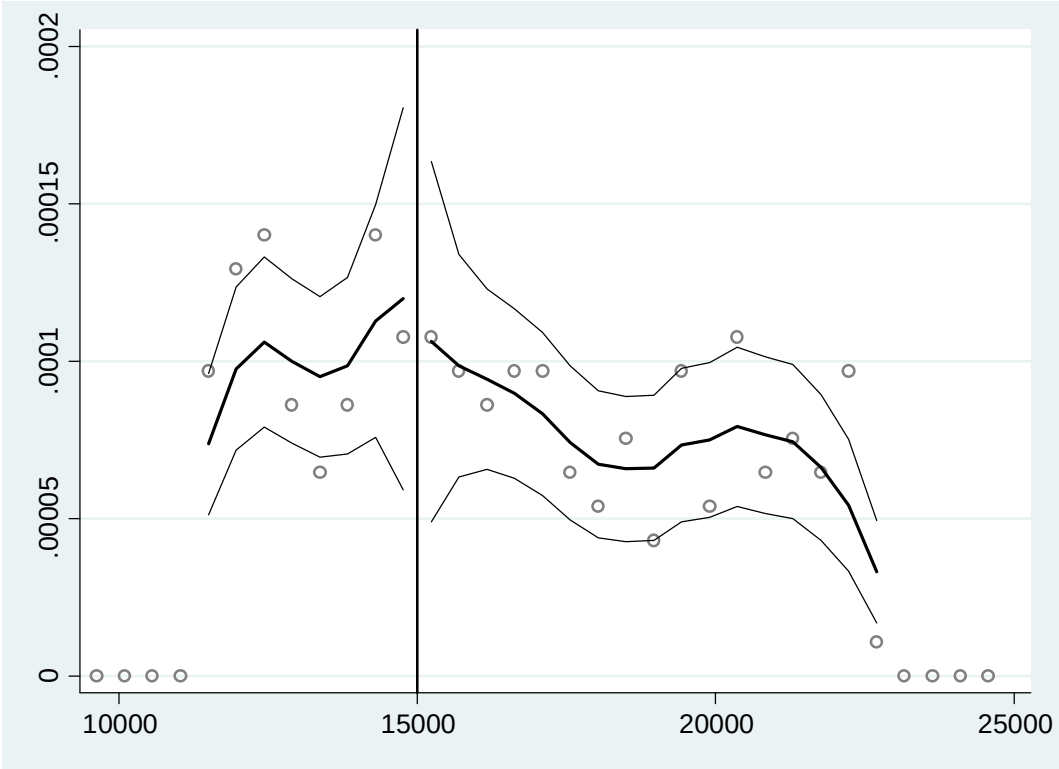
Manipulation and precise control over population measures would invalidate the research design. In our setup, the manipulation of population statistics would be very costly to municipalities, because this information is gathered independently by central government from the official population register. Furthermore, as is standard in the literature, we conduct a McCrary (2008) density test of manipulation separately for each threshold. The idea is to show that there are no discontinuities in the amount of observations at the thresholds, as there should be in the case of local randomization. We present these tests in Graph B2. We do not find evidence of manipulation at any of the five analyzed thresholds. Furthermore, the statistically insignificant jumps may go up or down depending on the threshold, implying that even a joint test would not (and does not) provide statistically significant evidence of a jump in any direction.

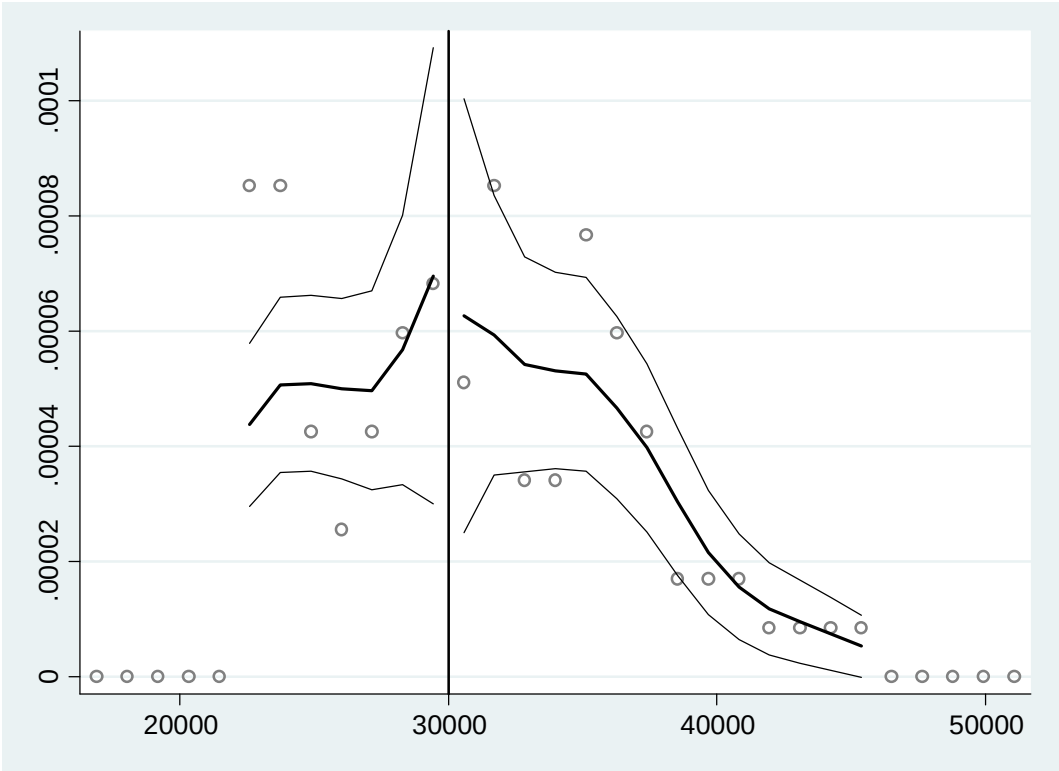
Graph B2. McCrary (2008) tests of manipulation of the forcing variable for each threshold.






0
.0001
.0002
.0003
.0004
4000
6000
8000
10000
12000


0
.00005
.0001
.00015
.0002
10000
15000
20000
25000



Finally, we (indirectly) test for main RDD identifying assumption that potential outcomes develop smoothly over the cutoff by using background characteristics of municipalities as the dependent variable in equation (3) type specifications. Table B7 reports these covariate balance tests for six municipality characteristics that are likely to correlate with turnout: number of municipal employees per capita, unemployment rate, tax revenue per capita, share of over 65 year olds, central government grants per capita and municipal expenditure per capita. Three out of 30 estimates for individual threshold treatment effects are significant at the 5% level, but the average effect is insignificant for all of these covariates, supporting the validity of the RDD. Moreover, Table B7 reports two measures of political competition: the number of parties and the minimum within party margin of victory in the municipality. Neither of these measures jumps at the thresholds. This implies that we do not need to

address political competition, i.e. closeness of elections, as an endogenous variable in the next section.

Table B7. Balancing tests for municipality characteristics and political competition (eq. (3), 6th order polynomial of pop).

Threshold	Munic. Employees	Tax revenue	Share of over 65yo	Grants	Expenditures	Unemp. share	Number of parties	Political competition
pop>2k	111	-0.061	0.010	0.194	0.266	0.164	-0.0001	-0.0937
	[167]	[0.077]	[0.009]	[0.162]	[0.268]	[0.909]	[0.0001]	[0.2224]
pop>4k	111	0.074	-0.006	-0.053	0.091	0.051	0.0000	-0.1454
	[126]	[0.068]	[0.009]	[0.138]	[0.183]	[0.944]	[0.0001]	[0.1941]
pop>8k	35	-0.021	-0.010	0.045	-0.007	-0.403	-0.0002***	0.3644
	[134]	[0.141]	[0.009]	[0.149]	[0.218]	[1.060]	[0.0001]	[0.2298]
pop>15k	59	0.323**	0.013	-0.059	0.006	-2.029	0.0000	0.288
	[168]	[0.156]	[0.012]	[0.192]	[0.276]	[1.336]	[0.0001]	[0.3089]
pop>30k	-59	-0.331	-0.036**	-0.206	-0.660**	-0.53	-0.0002	-0.4268
	[180]	[0.286]	[0.018]	[0.183]	[0.326]	[2.355]	[0.0001]	[0.5287]
Avg. effect	72.6	0.0282	-0.00221	0.0179	0.0436	-0.386	-0.000065	0.0393
	79.2	0.0594	0.00495	0.0852	0.125	0.571	0.000040	0.1262
N	1736	1736	1736	1736	1736	1736	1733	1736

Notes*:* All models use the parametric RDD with 6th order polynomial. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

In Table B8, we report balancing tests for characteristics of candidates, other than share of incumbents, which we use as a measure of candidate quality in IV regression. The table show that candidates' mean wage, mean age, share of female candidates and share of candidates who are employed by the municipality are balanced at the cut-offs.

Table B8. Balancing tests for candidate characteristics (eq. (3), 6th order polynomial of pop).

Dep var:	Mean wage of candidates	Mean age of candidates	Share of female candidates	Share of candidates municipal employees
Threshold				
pop>2k	-0.342	0.116	-0.005	0.000
	[0.926]	[0.501]	[0.016]	[0.013]
pop>4k	0.333	-0.274	0.000	0.009
	[0.599]	[0.396]	[0.010]	[0.011]
pop>8k	0.802	-0.366	0.015	0.01
	[0.847]	[0.437]	[0.010]	[0.013]
pop>15k	0.208	-0.171	0.014	-0.019
	[0.927]	[0.533]	[0.014]	[0.018]
pop>30k	-1.264	0.065	-0.007	0.028
	[1.057]	[0.539]	[0.020]	[0.026]
Average effect	0.164	-0.167	0.004	0.004
	[0.42]	[0.242]	[0.006]	[0.007]
N	1736	1736	1736	1736

Notes*:* Sample size is 1,736. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

ONLINE APPENDIX C: First stages of IV regression, municipality and municipality-party level.

Table C1. IV estimation, first stage for simulated pivotal probability, municipality level (eq. (3)).

Dep var: Simulated pivotal probability							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.0223***	-0.0159***	-0.0086***	-0.0018	-0.0002	0.0007	0.0035
	[0.0033]	[0.0032]	[0.0030]	[0.0034]	[0.0041]	[0.0049]	[0.0056]
pop>4k	-0.0163***	-0.0052***	0.003	0.0079**	0.0077**	0.0068**	0.0067***
	[0.0017]	[0.0020]	[0.0023]	[0.0031]	[0.0034]	[0.0027]	[0.0022]
pop>8k	-0.0006	0.0128***	0.0179***	0.0142***	0.0107***	0.0095***	0.0089***
	[0.0018]	[0.0024]	[0.0026]	[0.0020]	[0.0018]	[0.0024]	[0.0025]
pop>15k	0.0124***	0.0202***	0.0084***	-0.001	0.0002	0.0039	0.0048
	[0.0028]	[0.0030]	[0.0022]	[0.0031]	[0.0027]	[0.0027]	[0.0030]
pop>30k	0.0321***	-0.0015	-0.0062**	0.0126***	0.0002	-0.0008	-0.0013
	[0.0050]	[0.0055]	[0.0029]	[0.0042]	[0.0027]	[0.0038]	[0.0030]
Avg. effect	-0.0061***	0.0008	0.0042***	0.0062***	0.0050***	0.0051***	0.0056***
	[0.0015]	[0.0014]	[0.0015]	[0.0017]	[0.0017]	[0.0017]	[0.0019]
1st stage F	106.0	39.8	21.5	15.0	8.7	7.4	6.3

Notes: Sample size is 1,746. 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C1. Population and pivotality, municipality level (eq. (3), 6th order polynomial of population).

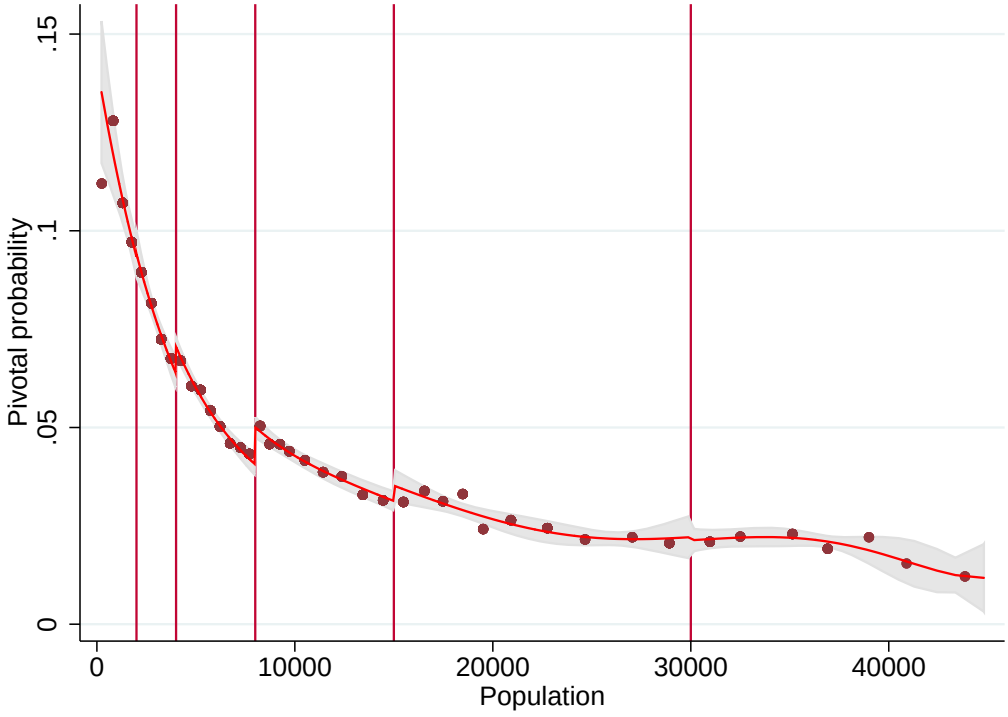


Table C2. IV estimation, first stage for the number of candidates, municipality level (eq. (3)).

Dep var: Candidates							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	11.08***	6.77***	5.68***	2.47	3.8	1.31	-0.31
	[1.48]	[1.77]	[1.99]	[2.12]	[2.34]	[2.06]	[1.85]
pop>4k	15.13***	8.37***	7.03***	4.72**	5.01**	6.30**	8.87***
	[1.98]	[2.54]	[2.60]	[2.39]	[2.31]	[2.46]	[2.68]
pop>8k	13.08***	4.63	3.83	5.68	4.37	6.61*	6.54*
	[3.23]	[3.57]	[3.34]	[3.72]	[4.14]	[3.90]	[3.86]
pop>15k	11.47*	6.22	8.03	13.38*	13.92*	8.07	7.58
	[6.62]	[6.03]	[7.00]	[7.75]	[7.87]	[8.21]	[8.16]
pop>30k	9.69	30.74***	31.49***	22.11**	18.17	22.70**	10.14
	[8.40]	[10.35]	[10.07]	[9.93]	[11.43]	[10.77]	[11.64]
Avg. effect	12.74***	8.32***	7.80***	6.96***	6.83***	6.63***	6.04***
	[2.27]	[2.20]	[2.15]	[2.02]	[2.05]	[2.04]	[2.05]
1st stage F	29.7	9.1	3.9	2.8	2.8	2.8	3.2

Notes: Sample size is 1,746. 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C2. Population and the number of candidates, municipality level (eq. (3), 6th order polynomial of population).

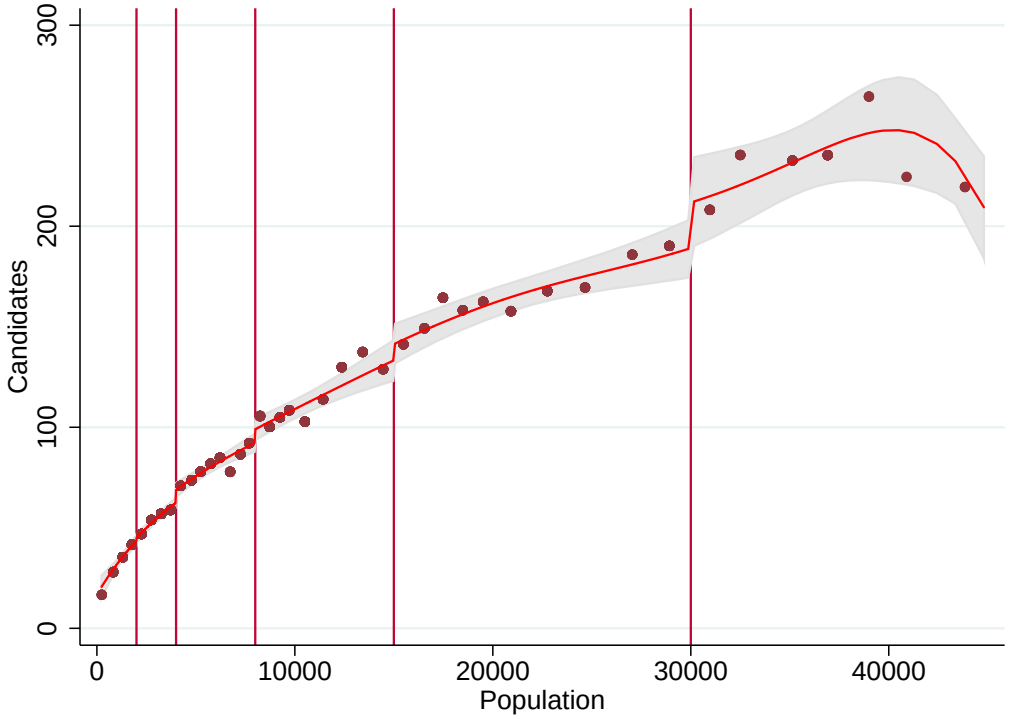


Table C3. IV estimation, first stage for the share of incumbents, municipality level (eq. (3)).

Dep var: Share of incumbents							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.039***	-0.025***	-0.013	0.005	0.016	0.033**	0.040***
	[0.009]	[0.009]	[0.009]	[0.011]	[0.013]	[0.014]	[0.014]
pop>4k	-0.017***	0.004	0.019**	0.032***	0.034***	0.026**	0.014
	[0.006]	[0.007]	[0.010]	[0.012]	[0.012]	[0.010]	[0.010]
pop>8k	0.019***	0.045***	0.055***	0.044***	0.033***	0.019*	0.019*
	[0.007]	[0.009]	[0.011]	[0.010]	[0.010]	[0.010]	[0.010]
pop>15k	0.020*	0.036***	0.015	-0.015	-0.01	0.028**	0.031**
	[0.011]	[0.011]	[0.010]	[0.014]	[0.013]	[0.014]	[0.014]
pop>30k	0.055***	-0.009	-0.018	0.034**	0.001	-0.029**	0.031***
	[0.012]	[0.010]	[0.011]	[0.014]	[0.010]	[0.013]	[0.011]
Avg. effect	-0.0024	0.0111**	0.0173***	0.0219***	0.0208***	0.0222***	0.025***
	[0.0043]	[0.0053]	[0.0061]	[0.0067]	[0.0064]	[0.0062]	[0.0061]
1st stage F	16.4	10.3	7.9	6.6	3.9	3.3	4.3

Notes: Sample size is 1,746. 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C3. Population and share of incumbents, municipality level (eq. (3), 6th order polynomial of population).

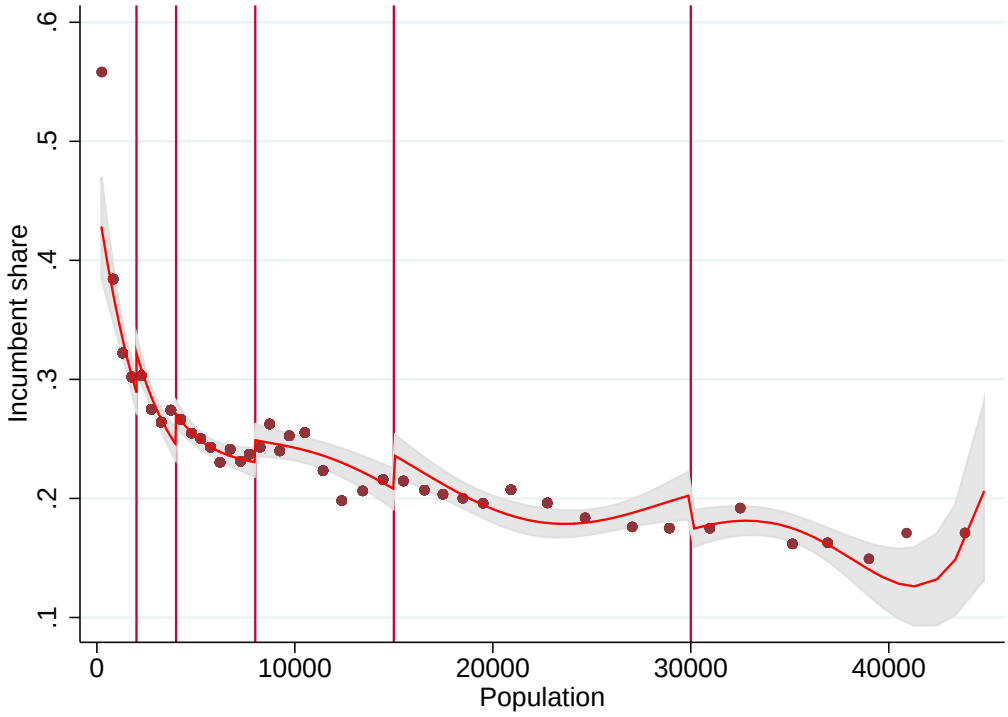


Table C4. IV estimation, first stage for proportionality, municipality level (eq. (3)).

Dep var: Proportionality							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.00693***	-0.00628***	-0.00546***	-0.00400***	-0.00299***	-0.00187*	-0.00147
	[0.00059]	[0.00053]	[0.00048]	[0.00059]	[0.00079]	[0.00101]	[0.00108]
pop>4k	-0.00425***	-0.00322***	-0.00222***	-0.00117	-0.00095	-0.00153**	-0.00217***
	[0.00027]	[0.00039]	[0.00059]	[0.00081]	[0.00083]	[0.00061]	[0.00045]
pop>8k	-0.00218***	-0.00091**	-0.0003	-0.00114***	-0.00214***	-0.00314***	-0.00312***
	[0.00025]	[0.00045]	[0.00057]	[0.00038]	[0.00034]	[0.00052]	[0.00050]
pop>15k	-0.00002	0.00077	-0.00059*	-0.00302***	-0.00261***	0.00001	0.00013
	[0.00040]	[0.00052]	[0.00035]	[0.00072]	[0.00060]	[0.00055]	[0.00055]
pop>30k	0.00191***	-0.00127*	-0.00184**	0.00242**	-0.00058	-0.00261***	0.00052
	[0.00064]	[0.00065]	[0.00071]	[0.00113]	[0.00079]	[0.00096]	[0.00081]
Avg. effect	-0.0033***	-0.0026***	-0.0022***	-0.0018***	-0.0019***	-0.0019***	-0.0017***
	0.0002	0.0002	0.0003	0.0004	0.0003	0.0003	0.0004
1st stage F	244.5	111.8	47.2	34.4	20.8	20.6	18.3

Notes: Sample size is 1,746. 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C4. Population and proportionality, municipality level (eq. (3), 6th order polynomial of population).

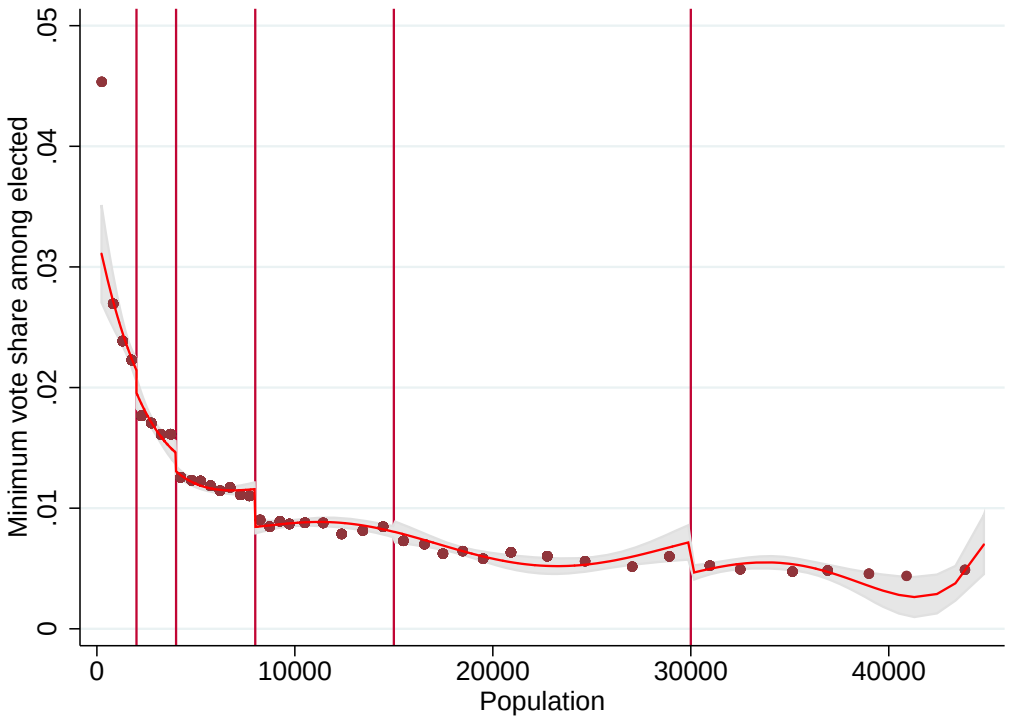


Table C5. IV estimation , first stage for between party pivotal probability, municipality-party level (eq. (3)).

Dep var: Simulated pivotal probability (between parties)							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.009***	-0.008***	-0.005***	-0.001	-0.001	0.000	0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]
pop>4k	-0.008***	-0.003***	0.000	0.003**	0.003*	0.003*	0.003*
	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.001]
pop>8k	0.001	0.004***	0.007***	0.007***	0.005***	0.004***	0.004**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
pop>15k	0.005***	0.007***	0.003***	-0.001	-0.001	0.001	0.002
	[0.002]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]
pop>30k	0.012***	0.001	-0.002*	0.004**	0	-0.001	-0.001
	[0.003]	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
Avg. effect	-0.0026***	-0.0006	0.0012	0.0024***	0.0020**	0.0021**	0.0026**
	[0.0009]	[0.0007]	[0.0008]	[0.0009]	[0.0009]	[0.0009]	[0.0011]
1st stage F	37.9	28.5	16.6	9.8	5.3	3.2	3.0

Notes: Unit of observation is party-election (N=10,171). 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C5. Population and between party pivotal probability, municipality-party level (eq. (3), 6th order polynomial of population).

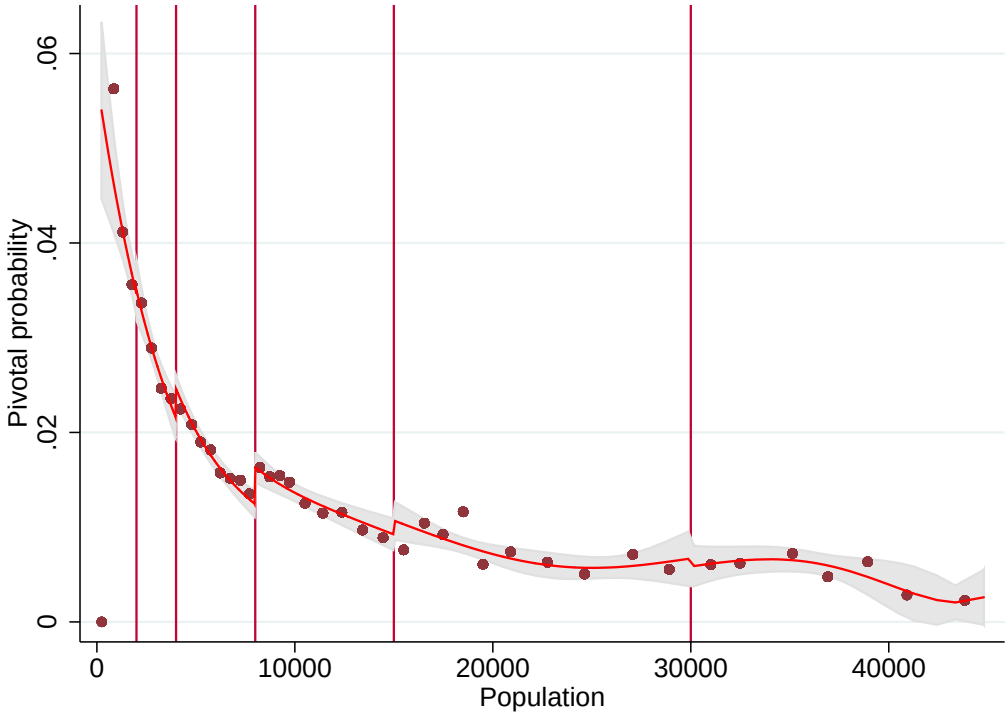


Table C6. IV estimation , first stage for within party pivotal probability, municipality-party level (eq. (3)).

Dep var: Simulated pivotal probability (within parties)							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.009***	-0.006***	-0.004***	-0.002***	0.000	0.003	0.004**
	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
pop>4k	-0.002***	-0.001	0.001*	0.003***	0.004***	0.004***	0.003***
	[0.001]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
pop>8k	0.001	0.002***	0.003***	0.002***	0.001**	-0.001*	-0.002**
	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]
pop>15k	0.004***	0.003***	0.001***	-0.002***	-0.003***	0.001*	0.002**
	[0.001]	[0.001]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]
pop>30k	0.007***	0.000	-0.002**	0.004***	0.000	-0.003**	0.002**
	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Avg. effect	-0.0015***	-0.0007**	0.0002	0.001**	0.0011**	0.0014**	0.0019***
	[0.0005]	[0.0003]	[0.0004]	[0.0005]	[0.0005]	[0.0006]	[0.0007]
1st stage F	21.1	34.7	16.5	11.9	8.2	4.7	4.5

Notes: Unit of observation is party-election (N=10,171). 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C6. Population and within party pivotal probability, municipality-party level (eq. (3), 6th order polynomial of population).

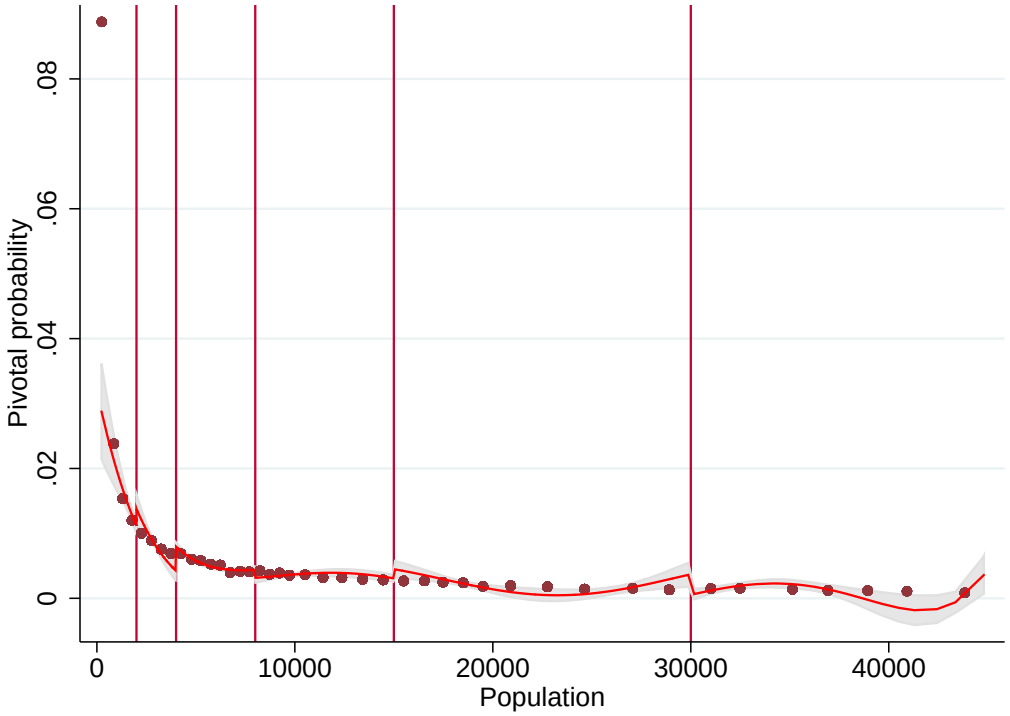


Table C7. IV estimation , first stage for the number of candidates, municipality-party level (eq. (3)).

Dep var: Candidates							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	1.04***	0.35	0.17	0.32	0.93*	0.92*	0.36
	[0.32]	[0.36]	[0.40]	[0.44]	[0.51]	[0.55]	[0.58]
pop>4k	2.46***	1.33***	1.10**	1.22**	1.48***	1.48***	1.89***
	[0.37]	[0.48]	[0.54]	[0.54]	[0.53]	[0.53]	[0.55]
pop>8k	2.15***	0.72	0.56	0.51	0.06	0.06	0.21
	[0.53]	[0.60]	[0.58]	[0.61]	[0.67]	[0.67]	[0.65]
pop>15k	1.64	0.46	0.67	0.44	0.42	0.41	0.08
	[1.06]	[1.00]	[1.12]	[1.26]	[1.25]	[1.33]	[1.34]
pop>30k	0.99	3.68***	3.85***	4.20***	3.13**	3.14**	1.26
	[1.10]	[1.23]	[1.23]	[1.32]	[1.31]	[1.33]	[1.47]
Avg. effect	1.82***	0.99**	0.88**	0.93**	0.96***	0.96***	0.80**
	[0.37]	[0.40]	[0.39]	[0.37]	[0.37]	[0.37]	[0.38]
1st stage F	19.1	5.0	3.0	3.3	2.8	2.8	2.6

Notes: Unit of observation is party-election (N=10,171). 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C7. Population and the number of candidates, municipality-party level (eq. (3), 6th order polynomial of population).

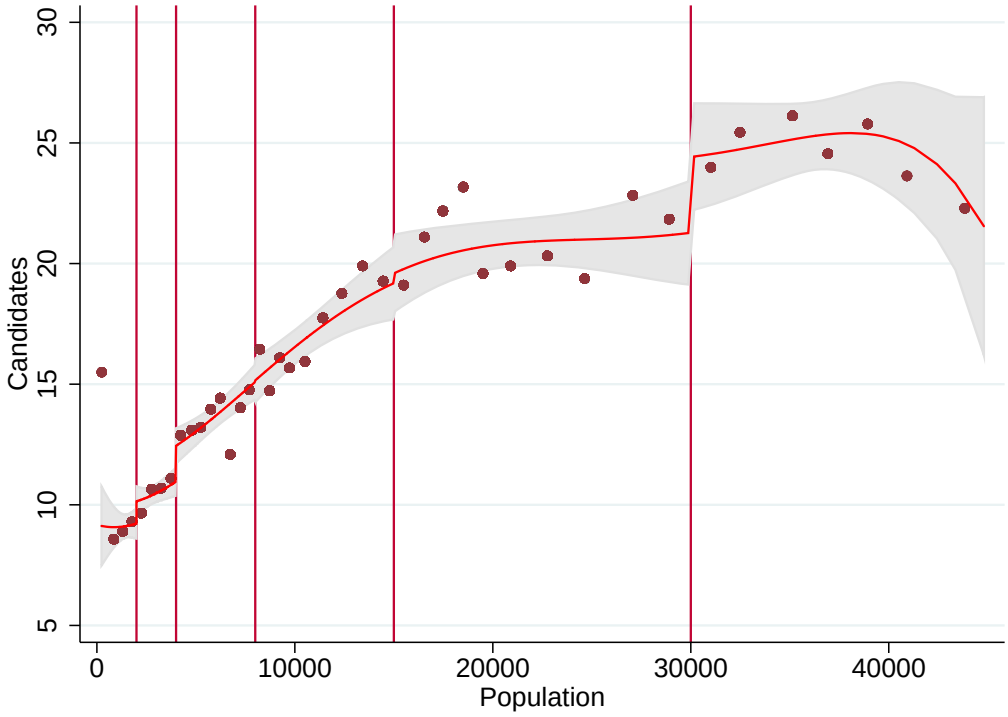


Table C8. IV estimation, first stage for the share of incumbents, municipality-party level (eq. (3)).

Dep var: Share of incumbents							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.025	-0.023***	-0.015	0.001	0.012	0.024*	0.034**
	[0.018]	[0.009]	[0.009]	[0.010]	[0.012]	[0.013]	[0.014]
pop>4k	-0.030**	-0.008	0.003	0.016	0.021**	0.019*	0.012
	[0.014]	[0.007]	[0.009]	[0.010]	[0.011]	[0.010]	[0.010]
pop>8k	0.023	0.040***	0.048***	0.043***	0.035***	0.026**	0.023**
	[0.016]	[0.009]	[0.010]	[0.010]	[0.010]	[0.011]	[0.011]
pop>15k	0.006	0.025**	0.015	-0.009	-0.01	0.01	0.015
	[0.024]	[0.011]	[0.011]	[0.013]	[0.013]	[0.014]	[0.016]
pop>30k	0.033	0.004	-0.004	0.033*	0.013	-0.005	0.027
	[0.033]	[0.012]	[0.014]	[0.017]	[0.015]	[0.016]	[0.018]
Avg. effect	-0.0059	0.0064	0.0116*	0.0168***	0.0173***	0.0189***	0.0216***
	[0.0101]	[0.0054]	[0.0061]	[0.0062]	[0.0061]	[0.0061]	[0.0064]
1st stage F	3.2	11.3	8.9	6.8	3.7	2.3	2.9

Notes: Unit of observation is party-election (N=10,171). 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C8. Population and the share of incumbents, municipality-party level (eq. (3), 6th order polynomial of population).

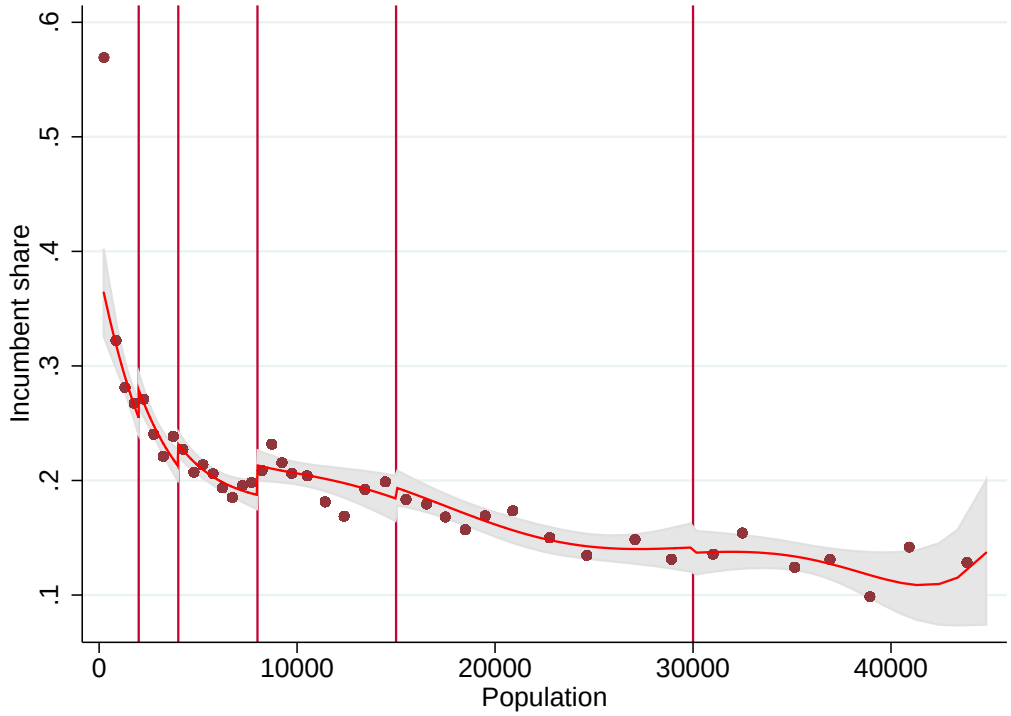


Table C9. IV estimation, first stage for proportionality, municipality-party level (eq. (3)).

Dep var: Proportionality							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.0086***	-0.0080***	-0.0073***	-0.0061***	-0.0054***	-0.0045***	-0.0042***
	[0.0007]	[0.0007]	[0.0007]	[0.0007]	[0.0008]	[0.0009]	[0.0009]
pop>4k	-0.0060***	-0.0050***	-0.0041***	-0.0031***	-0.0028***	-0.0030***	-0.0033***
	[0.0003]	[0.0004]	[0.0005]	[0.0006]	[0.0006]	[0.0006]	[0.0006]
pop>8k	-0.0036***	-0.0024***	-0.0017***	-0.0021***	-0.0027***	-0.0033***	-0.0034***
	[0.0003]	[0.0003]	[0.0004]	[0.0004]	[0.0004]	[0.0004]	[0.0004]
pop>15k	-0.0017***	-0.0008*	-0.0017***	-0.0035***	-0.0035***	-0.0022***	-0.0019***
	[0.0004]	[0.0005]	[0.0004]	[0.0005]	[0.0005]	[0.0004]	[0.0005]
pop>30k	0.0003	-0.0020***	-0.0027***	0.0002	-0.0013**	-0.0025***	-0.0010*
	[0.0005]	[0.0005]	[0.0005]	[0.0007]	[0.0005]	[0.0006]	[0.0006]
Avg. effect	-0.0049***	-0.0042***	-0.0038***	-0.0034***	-0.0034***	-0.0033***	-0.0031***
	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
1st stage F	284	123	55	38	34	32	27

Notes: Unit of observation is party-election (N=10,171). 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C9. Population and proportionality, municipality-party level (eq. (3), 6th order polynomial of population).

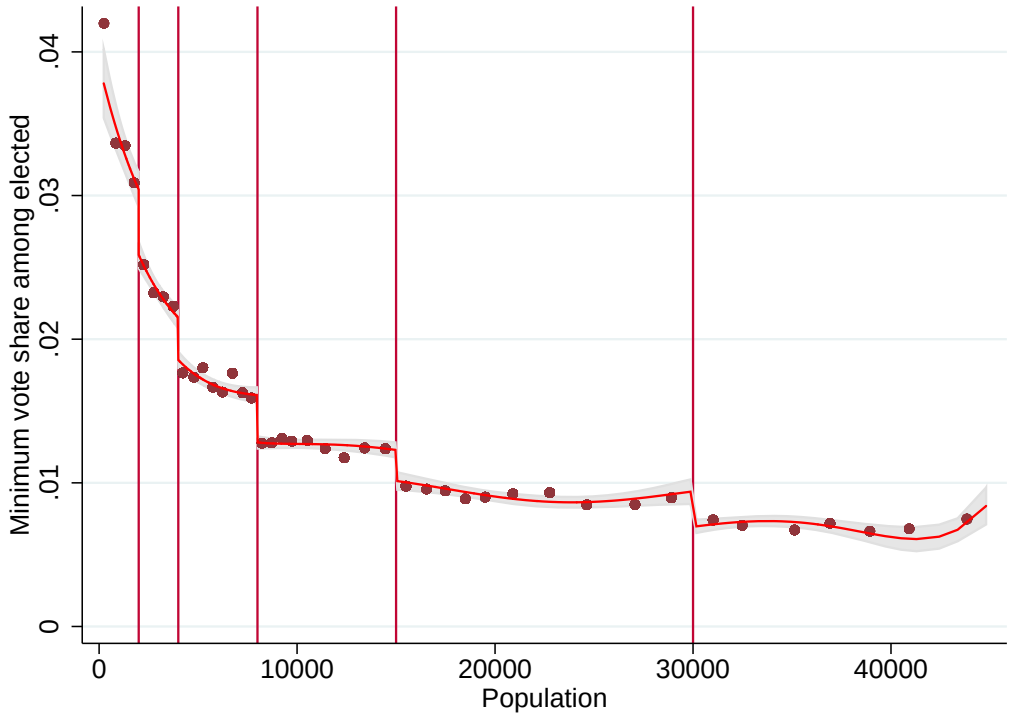


Table C10. IV estimation, first stage for political competition, municipality-party level (eq. (3)).

Dep var: Political competition							
	Order of polynomial of pop						
Threshold	1st	2nd	3rd	4th	5th	6th	7th
pop>2k	-0.00096***	-0.00092***	-0.00085***	-0.00081***	-0.00084***	-0.00086**	-0.00086**
	[0.00025]	[0.00025]	[0.00026]	[0.00028]	[0.00031]	[0.00034]	[0.00036]
pop>4k	-0.00090***	-0.00084***	-0.00074***	-0.00071***	-0.00072***	-0.00072***	-0.00072***
	[0.00014]	[0.00016]	[0.00019]	[0.00023]	[0.00024]	[0.00024]	[0.00024]
pop>8k	-0.00052***	-0.00045***	-0.00038**	-0.00039**	-0.00037**	-0.00036*	-0.00036*
	[0.00011]	[0.00015]	[0.00018]	[0.00017]	[0.00017]	[0.00020]	[0.00020]
pop>15k	-0.00055***	-0.00050***	-0.00059***	-0.00064***	-0.00064***	-0.00067***	-0.00067***
	[0.00015]	[0.00019]	[0.00017]	[0.00020]	[0.00020]	[0.00020]	[0.00021]
pop>30k	-0.0002	-0.00035**	-0.00041**	-0.00033	-0.00028	-0.00026	-0.00027
	[0.00018]	[0.00017]	[0.00019]	[0.00025]	[0.00021]	[0.00026]	[0.00025]
Avg. effect	-0.00072***	-0.00068***	-0.00063***	-0.00062***	-0.00062***	-0.00062***	-0.00062***
	0.00008	0.0001	0.00012	0.00013	0.00014	0.00014	0.00014
1st stage F	37.2	13.8	8.6	6.4	6.2	5.7	5.2

Notes: Unit of observation is party-election (N=10,171). 1st stage F is the F test of the excluded instruments. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

Graph C10. Population and political competition, municipality-party level (eq. (3), 6th order polynomial of population).

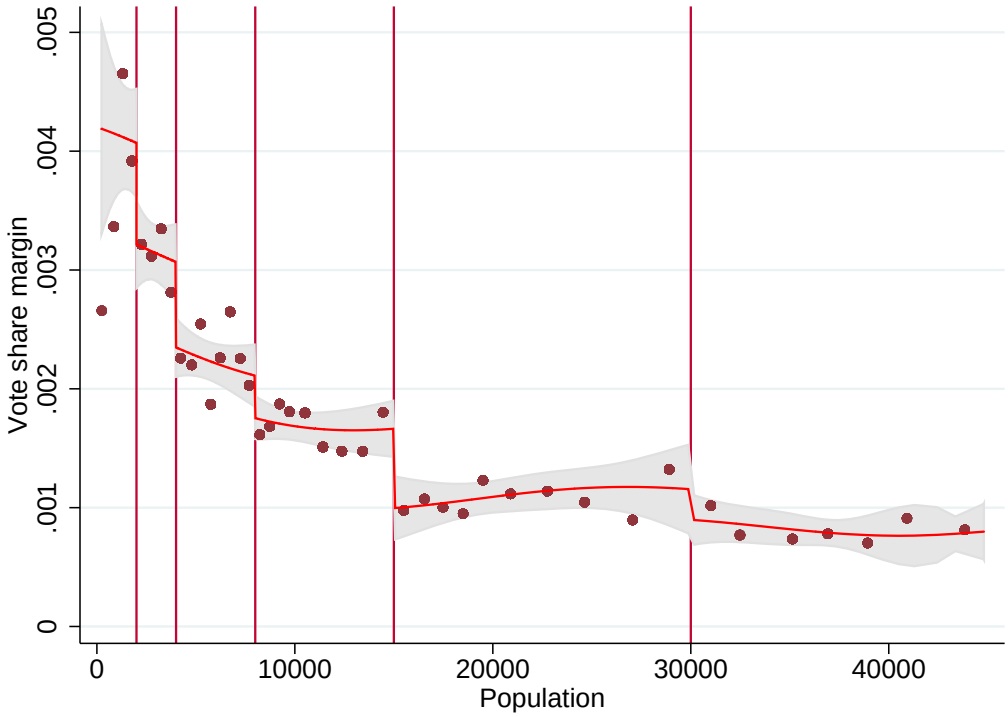


Table C11. IV estimation, second stage with nonlinear confounders, municipality-party level.

Dep var: Party turnout in municipal elections				
	Order of polynomial of pop			
	3rd	4th	5th	6th
Candidates	0.004	0.006	0.008	0.007
	[0.005]	[0.005]	[0.007]	[0.009]
Candidates^2	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Within party pivotality	6.606***	6.573***	6.118***	6.622***
	[0.861]	[1.036]	[1.314]	[2.380]
Share of incumbents	0.048	0.173	0.247	0.336
	[0.608]	[0.498]	[0.566]	[0.618]
(Share of incumbents)^2	-0.213	-0.414	-0.541	-0.651
	[0.963]	[0.783]	[0.857]	[0.875]
Within party pivotality	7.235***	7.645***	7.839***	8.259***
	[1.464]	[1.520]	[1.764]	[2.120]
Proportionality	-2.728	3.412	3.143	2.82
	[3.778]	[2.616]	[2.444]	[2.552]
Proportionality^2	57.903	-63.326	-51.231	-41.455
	[80.025]	[51.966]	[48.515]	[51.526]
Within party pivotality	3.79	7.935***	8.021***	8.173***
	[2.987]	[2.087]	[2.066]	[2.267]
Political competition	13.048	22.708	20.283	11.368
	[17.132]	[17.658]	[34.850]	[19.120]
(Political competition)^2	-825.825	-1698.355	-1535.205	-648.009
	[1323.135]	[1478.083]	[3090.007]	[1842.541]
Within party pivotality	5.702***	6.129***	6.183***	6.965***
	[1.284]	[1.274]	[1.417]	[1.638]

Notes*:* Unit of observation is party-election. Standard errors are in brackets (clustered at municipality level). Significance is denoted by asterisks: * p<0.1, ** p<0.05, *** p<0.01.

ONLINE APPENDIX D: Data sources and descriptive statistics

We have received the main data from Statistics Finland. The election data are publicly available from their website, but some control variables used in the Online Appendix require access to proprietary databases. We limit the sample used in the analysis to five election years and to municipalities with a population below 45,000. This leaves us with 1,747 municipality-election year (i.e., election) observations. Besides the endogenous variables of interest described in Table 2, the other key variables for our analysis are council size, population and turnout. Table D1 reports summary statistics for these variables and other municipal characteristics that we will use for validity tests and as controls.

Table D1. Summary statistics for outcome and control variables (population < 45,000).

Variable	N	Mean	Std. Dev.	Min	Max
Turnout	1747	0.646	0.060	0.420	0.895
Population	1747	7506	7592	234	44804
Council size	1747	27	9	13	51
Political competition	1743	0.00033	0.00058	0	0.00831
Number of parties	1747	5.8	1.7	1	13
Tax revenue €1000/capita	1747	2.3	0.5	1.4	6.2
Municipality personnel/1000 people	1746	59	16	4	134
Unemployment rate %	1736	13.2	5.2	2.2	33.9
Grants €1000/capita	1747	1.5	0.8	-0.1	5.1
Share of 65+ year old	1747	0.196	0.049	0.049	0.386
Expenditure €1000/capita	1747	5.5	1.1	3.1	12.0