Subnational Patterns of Participation: Compulsory Voting and the Conditional Impact of Institutional Design

Online Appendix

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Data and Replication: The data and replication materials are available on the Harvard Dataverse Network at: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/CAIUUG&version=1.0

Table of Contents

Appendix A: Data Information

Table A1. Descriptive Statistics

	2004				2008				2012			
	Min	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**
Turnout	0.26	0.96	0.56	0.09	0.29	0.97	0.57	0.09	0.27	0.90	0.54	0.12
Blank Votes	0	0.20	0.02	0.02	0	0.11	0.02	0.01	0	0.09	0.01	0.01
Null Votes	0	0.20	0.04	0.02	0	0.11	0.04	0.02	0	0.08	0.02	0.01
District Size	486	334943	38807	56224	486	334943	38911	56273	486	334943	38807	56224
Electoral Competition	0	1	0.82	01.5	0	1	0.83	0.15	0	1	0.82	0.15
Candidate Fragmentation	0	0.81	0.57	0.10	0	0.85	0.58	0.10	0	0.80	0.56	0.10
Campaign Spending	0.12	2.24	0.56	0.28	0.54	7.38	1.59	0.78	0.08	10.19	1.83	1.05
Percent Urban	0	1	0.59	0.33	0	1	0.59	0.33	0	1	0.59	0.33
Open Seat	0	1	0.13	0.33	0	1	0.21	0.41	0	1	0.17	0.37
District Magnitude	6	10	6.45	1.05	6	10	6.45	1.05	6	10	6.45	1.05
Alianza Incumbent	0	1	0.42	0.49	0	1	0.23	0.42	0	1	0.31	0.46
Concertación Incumbent	0	1	0.42	0.49	0	1	0.37	0.48	0	1	0.30	0.46
Previous Turnout	0.28	0.91	0.56	0.08	0.26	0.96	0.56	0.09	0.29	0.97	0.57	0.09

Discussion of Sample Selection

In October 2007, two new regions came into force: The I Tarapacá Region was divided laterally to create XV Arica and Parinacota Region to the north, and similarly, the X Los Lagos Region was split to create XIV Los Ríos Region to its north. This directly impacted the size of a number of comunas. For this reason we do not have accurate measures of the voting age population in these regions.

Prior to 2004 there were 342 municipalities. Four new comunas were created/combined in 2004, bringing the total number to 345. Because previous turnout data was not available for such comunas, they are excluded from the turnout analyses. Additionally, due to reporting errors in municipal voting age population and election results, a few municipalities were excluded from the turnout analysis and blank/null analyses. These include:

Comuna	**Year**	**Region**	**Reason**
Sierra Gorda	2008	Antofagasta	Election results nullified due to irregularities
Coltauco	2004, 2008, 2012	Libertador General Bernardo O'Higgins	Reported turnout higher than 100%
Hualpen	2004	Bio Bio	Comuna created in 2004
Chol Chol	2004	Araucania	Comuna created in 2004
Alto Bio Bio	2004	Bio Bio	Comuna created in 2004
Alto Hospicio	2004	Tarapaca	Comuna created in 2004

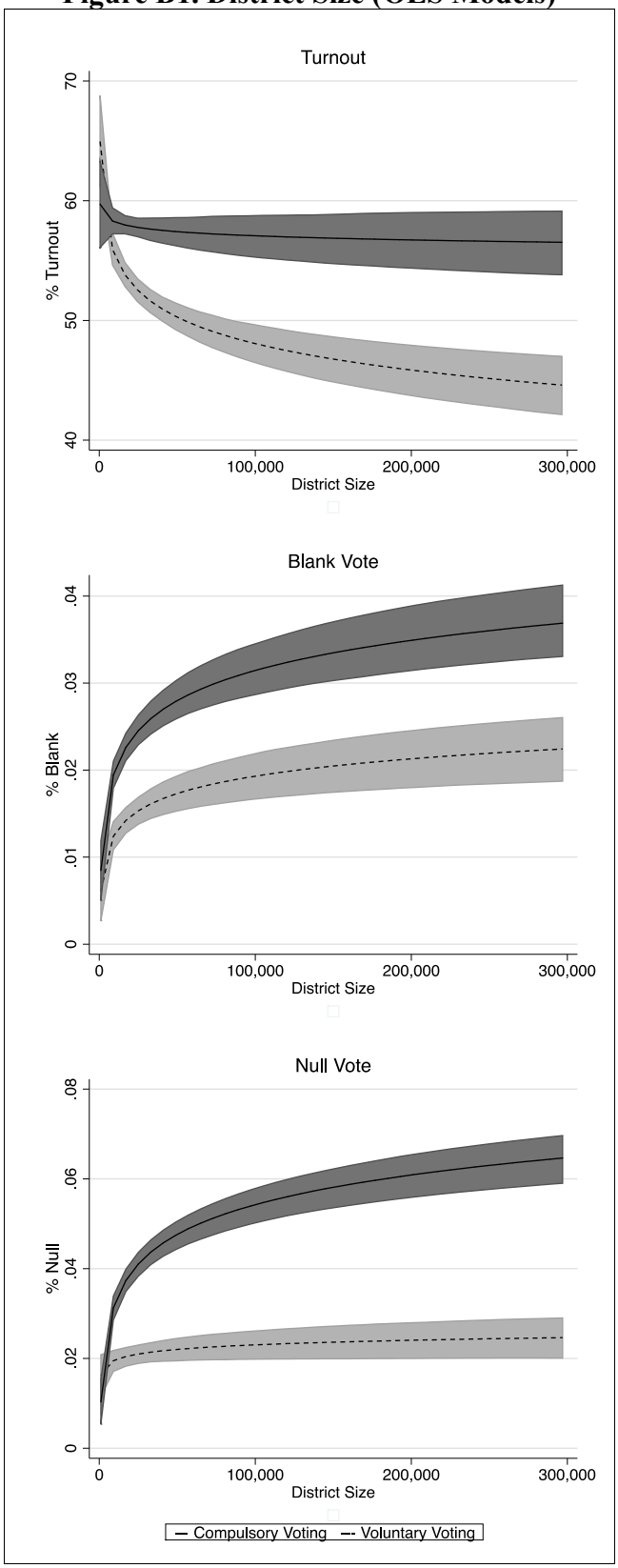
Appendix B: Robustness Tests

Table B1. OLS Models, Voter Turnout and Invalid Votes

	(1) Turnout	(2) Blank	(3) Null	(4) Turnout	(5) Blank	(6) Null
	2008-2012			2004-2012		
Voluntary Voting	-11.399	-0.045	-0.056*	-10.099	-0.089*	-0.084*
	(6.355)	(0.025)	(0.026)	(7.003)	(0.031)	(0.032)
District Size	-0.495	0.005*	0.010*	-1.356*	0.005*	0.009*
	(0.498)	(0.001)	(0.001)	(0.356)	(0.001)	(0.001)
*District Size**	-2.705*	-0.002*	-0.008*	-2.186*	-0.002*	-0.008*
Voluntary Voting	(0.435)	(0.000)	(0.001)	(0.397)	(0.000)	(0.001)
Electoral Competition	-1.366	-0.004	-0.010	-1.112	0.002	-0.005
	(1.869)	(0.004)	(0.007)	(1.686)	(0.004)	(0.006)
*Electoral Competition**	14.673*	-0.003	-0.011	14.487*	-0.009	-0.015
Voluntary Voting	(4.160)	(0.005)	(0.008)	(4.232)	(0.006)	(0.008)
Candidate Fragmentation	6.995	-0.251*	-0.179*	7.798	-0.421*	-0.304*
	(10.012)	(0.058)	(0.069)	(13.257)	(0.088)	(0.098)
*Candidate Fragmentation**	-17.030	0.102	0.098	-17.763	0.273*	0.223
Voluntary Voting	(27.447)	(0.095)	(0.099)	(28.589)	(0.116)	(0.123)
Candidate Fragmentation^2	-4.759	0.203*	0.152*	-5.032	0.349*	0.267*
	(7.966)	(0.048)	(0.058)	(11.019)	(0.073)	(0.081)
Candidate Fragmentation^2*	-0.140	-0.069	-0.068	0.290	-0.214*	-0.183
Voluntary Voting	(22.850)	(0.080)	(0.084)	(23.610)	(0.098)	(0.103)
Campaign Spending	0.002*	-0.000*	-0.000	0.001*	-0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Percent Urban	-0.408	-0.006*	0.008*	-0.940	-0.006*	0.008*
	(0.846)	(0.002)	(0.002)	(0.848)	(0.002)	(0.002)
Open Seat	0.318	0.001	-0.000	0.818	0.000	0.000
	(0.558)	(0.001)	(0.001)	(0.637)	(0.001)	(0.001)
District Magnitude	-0.721*	-0.001*	0.004*	-0.293	-0.001*	0.004*
	(0.299)	(0.000)	(0.001)	(0.206)	(0.001)	(0.001)
Alianza Incumbent	0.216	0.001	-0.001	0.463	0.001	-0.001
	(0.503)	(0.001)	(0.001)	(0.477)	(0.001)	(0.001)
Concertación Incumbent	-0.140	0.001	-0.000	0.099	0.001	-0.000
	(0.483)	(0.001)	(0.001)	(0.452)	(0.001)	(0.001)
Previous Turnout	76.348*			76.445*		
	(3.277)			(3.518)		
Constant	14.693*	0.121*	0.087*	10.751*	0.167*	0.112*
	(4.500)	(0.018)	(0.019)	(4.392)	(0.024)	(0.027)
Observations	687	689	689	1027	1034	1034
R^2	0.840	0.481	0.698	0.797	0.548	0.654

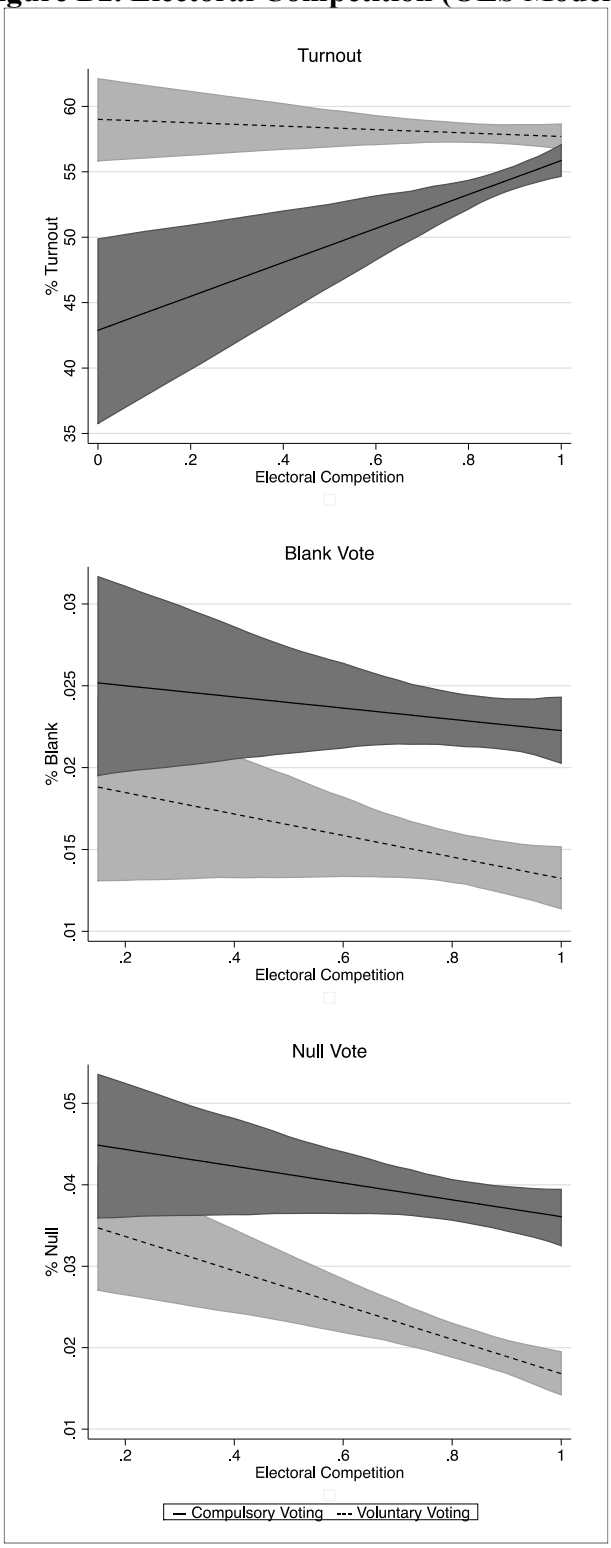
Notes: Ordinary Least Squares Models. Coefficients are statistically significant at *p<.05. Standard error in parentheses. Despite that the dependent variable is theoretically bounded between 0 and 1, a great deal of statistical work has shown that OLS as a baseline model is highly robust—particularly when the values of the DVs are normally distributed within the range of the data. Table B1 and Figures B1-B3 demonstrate that our results are also robust to this modeling strategy.

Figure B1. District Size (OLS Models)



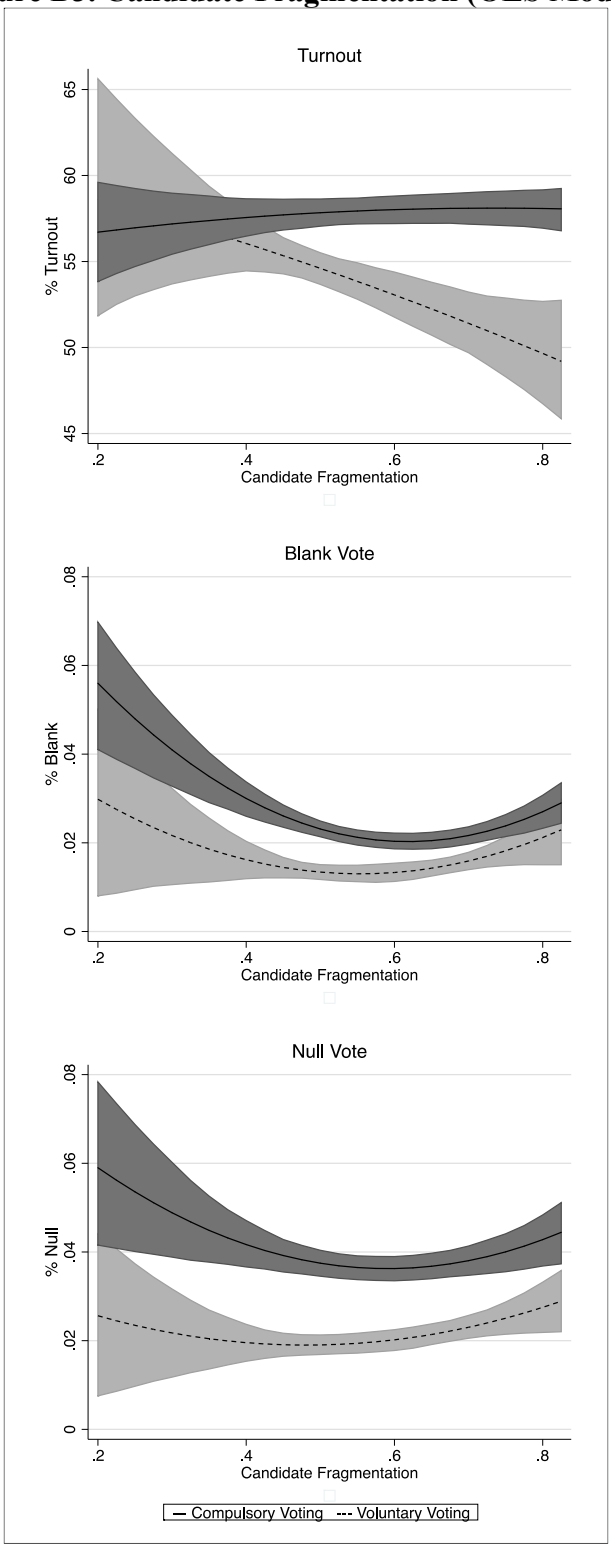
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as district size increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B1.

Figure B2. Electoral Competition (OLS Models)



Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as competition increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B1.

Figure B3. Candidate Fragmentation (OLS Models)



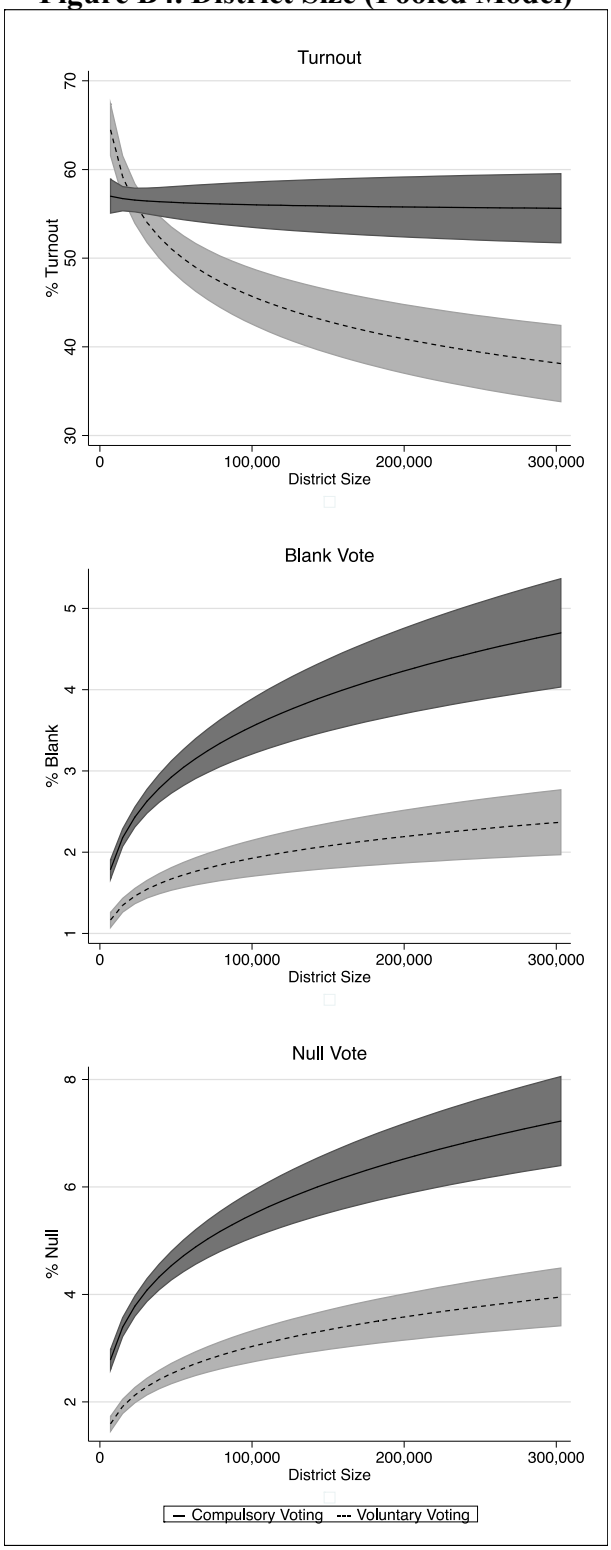
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as candidate fragmentation increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B1.

Table B2. Pooled Models 1996-2012, Voter Turnout and Invalid Votes

	(1) Turnout	(2) Blank	(3) Null
		1996-2012	
Voluntary Voting	-0.474*	-1.339*	-1.083*
	(0.241)	(0.391)	(0.490)
District Size	-0.015	0.265*	0.265*
	(0.028)	(0.025)	(0.022)
*District Size*Voluntary Voting*	-0.257*	-0.073*	-0.018
	(0.017)	(0.016)	(0.018)
Electoral Competition	0.258*	0.001	-0.315*
	(0.081)	(0.081)	(0.110)
*Electoral Competition*Voluntary Voting*	0.346	-0.573*	-0.836*
	(0.195)	(0.214)	(0.229)
Candidate Fragmentation	-1.017*	-7.410*	-5.189*
	(0.381)	(0.641)	(0.867)
*Candidate Fragmentation*Voluntary Voting*	-0.826	2.644	2.745
	(1.081)	(1.574)	(1.850)
Candidate Fragmentation^2	0.532	5.286*	4.349*
	(0.274)	(0.447)	(0.596)
*Candidate Fragmentation^2*Voluntary Voting*	0.440	-0.822	-1.325
	(0.947)	(1.321)	(1.520)
Percent Urban	-0.101	-0.297*	0.056
	(0.084)	(0.071)	(0.059)
Open Seat	0.042	-0.048	0.063*
	(0.028)	(0.025)	(0.026)
District Magnitude	-0.014	-0.074*	0.011
	(0.021)	(0.019)	(0.018)
Alianza Incumbent	0.013	-0.053*	-0.011
	(0.024)	(0.024)	(0.024)
Concertación Incumbent	0.054*	-0.042*	0.036
	(0.016)	(0.018)	(0.021)
Constant	0.537*	-0.156	-1.254*
	(0.224)	(0.291)	(0.348)
Observations	2042	2050	2050
Log Pseudo likelihood	-926.89	-172.01	-249.63

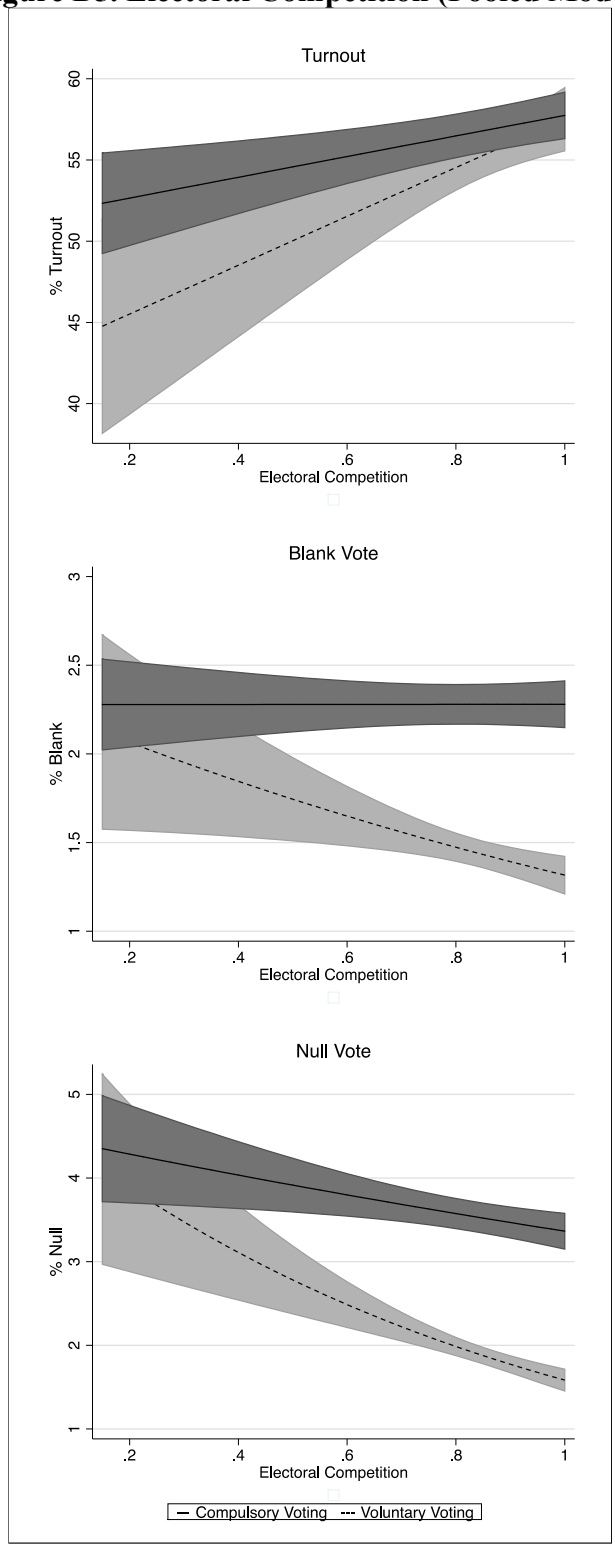
Notes: Generalized linear models. Coefficients are statistically significant at *p<.05. Standard error in parentheses.

Figure B4. District Size (Pooled Model)



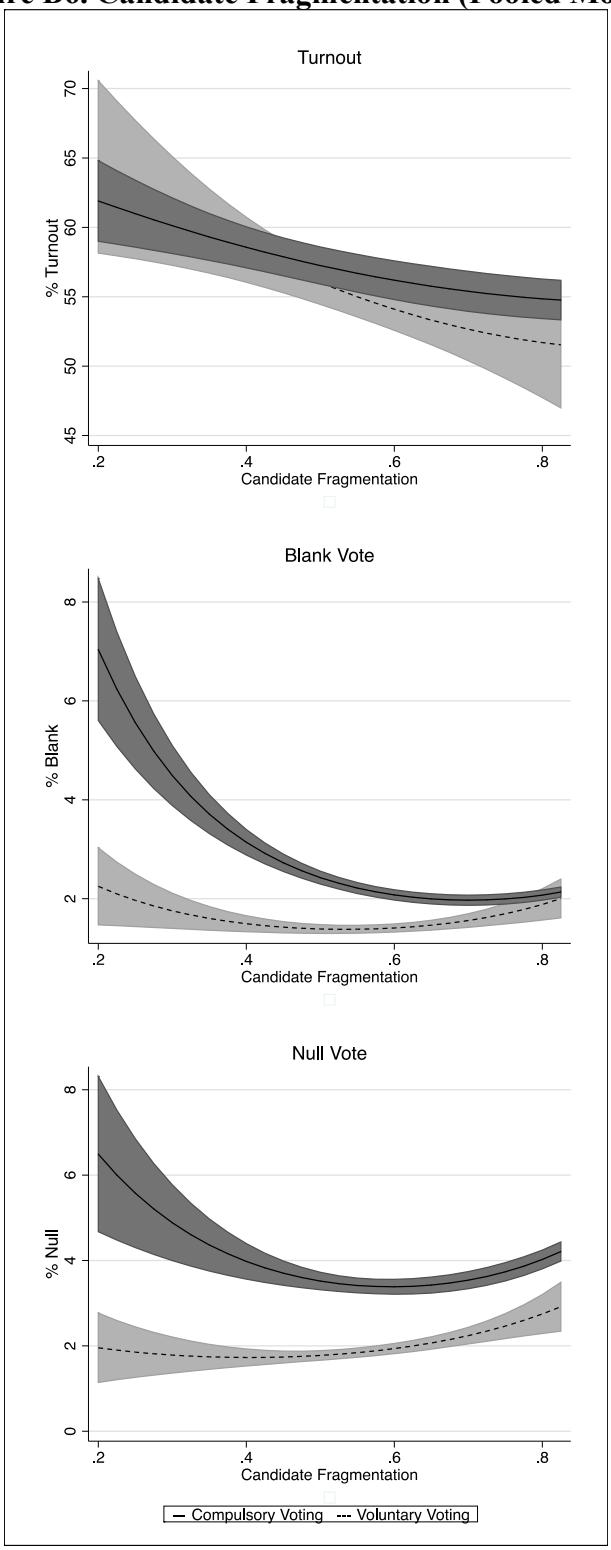
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as district size increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B2.

Figure B5. Electoral Competition (Pooled Model)



Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as competition increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B2.

Figure B6. Candidate Fragmentation (Pooled Model)



Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as candidate fragmentation increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B2.

Compositional Models Discussion

Our dependent variables (DV) are compositional, thus for two primary reasons ordinary least-squares (OLS) regression is technically inappropriate to test our hypotheses. One, OLS assumes the DV is theoretically unbounded and could fall anywhere on the real number line. Yet, our DVs are portions of some whole, and hence theoretically bounded between 0 and 1. Turnout is a portion of the whole voting-eligible population, where abstentions plus turnout equal one. Blank and null votes are a portion of the votes cast, with blank, null, and valid votes summing to one. Two, OLS treats each DV as independent. But, because the sum of the parts must equal one, the portions are not independent of one another. That is, for the share of blank votes to increase the share of null or valid votes must decrees.

To account for the bounded nature of our dependent variables and the correlation in the errors between the level of null and blank votes, we take the following steps. First, we convert our dependent variables to an unbounded scale using a multivariate t-transformation (King and Katz 1999; Jackson 2002; Tomz, Tucker, and Wittenberg 2002). This approach is consistent with a long line of research. Indeed, Papke and Wooldridge (1996) explain that the most common approach to analyzing a dependent variable that is bound between 0 and 1 is to model the log-odds ratio as a linear function. For our turnout measure we calculate the natural log of the share of turnout relative to abstentions (i.e., the baseline or comparison groups) for each district *i,* such that:

$$Y_i = [\ln (\text{Turnout}_i/\text{Abstentions}_i)]$$

For the second set of dependent variables—blank and null votes—we calculate the natural log of the vote share for both possible outcomes relative to valid votes, the baseline category (recall, we are interested in understanding when voters are more likely to cast an invalid vote given that they turn out to the polls) for each district *i,* such that:

$$Y_i = [\ln (\text{BlankVotes}_i/\text{ValidVotes}_i), \ln (\text{NullVotes}_i/\text{ValidVotes}_i)]$$

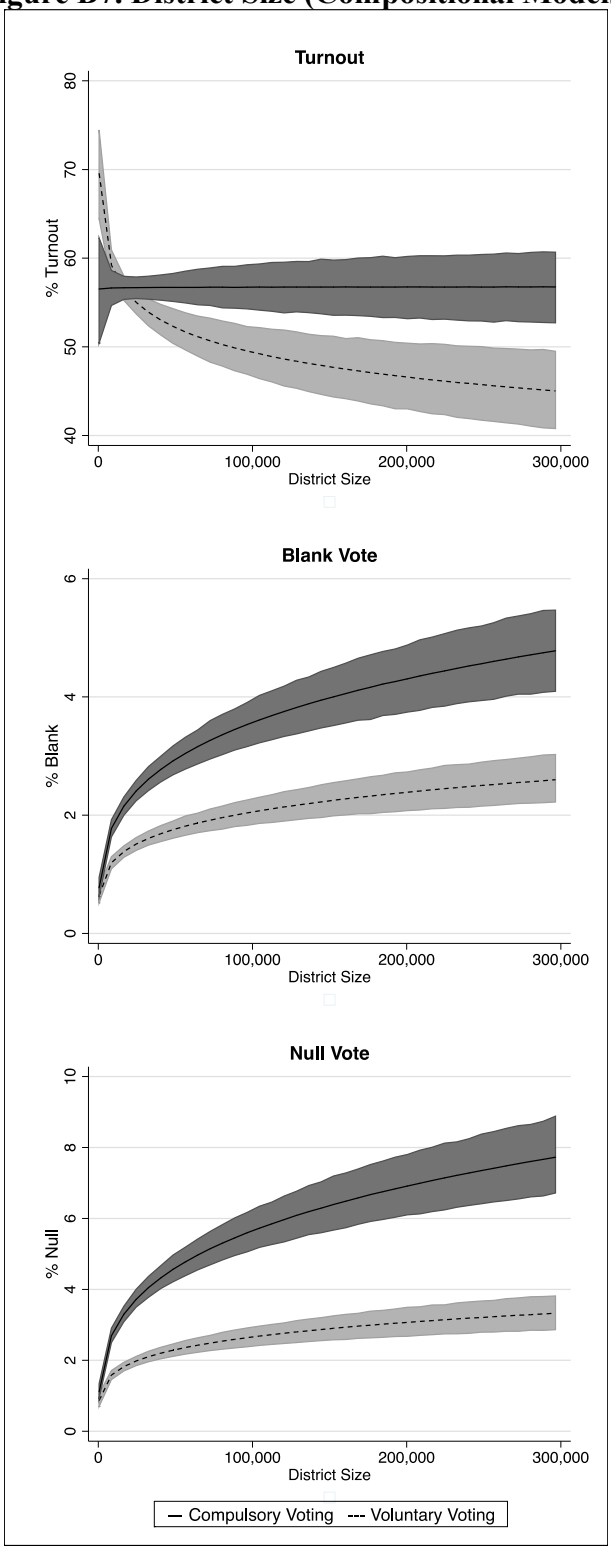
After transforming the dependent variables, we then model the log ratios for our dependent variables as a linear function of our independent variables. For the turnout model, we use an OLS regression with clustered standard errors for the municipality given that there are only two categories: i.e., turnout is evaluated relative to the baseline (abstention) (Papke and Wooldridge 1996). For invalid votes, we use a seemingly unrelated regression (SUR) to account for the correlation in errors across the two categories (blank and null votes) relative to the baseline (valid votes) (Tomz, Tucker, and Wittenberg 2002).

Table B3. Compositional Models, Voter Turnout and Invalid Votes

	(1) Turnout	(2) Blank	(3) Null	(4) Turnout	(5) Blank	(6) Null
	2008-2012			2004-2012		
Voluntary Voting	-0.464	-1.370*	-1.951*	-0.372	-1.727*	-2.189*
	(0.310)	(0.415)	(0.461)	(0.328)	(0.350)	(0.407)
District Size	-0.029	0.303*	0.378*	-0.071*	0.325*	0.399*
	(0.024)	(0.027)	(0.030)	(0.018)	(0.021)	(0.024)
*District Size**	-0.115*	-0.074*	-0.141*	-0.090*	-0.086*	-0.141*
Voluntary Voting	(0.021)	(0.023)	(0.026)	(0.020)	(0.020)	(0.024)
Electoral Competition	-0.094	-0.326	-0.603*	-0.094	-0.242	-0.507*
	(0.085)	(0.185)	(0.206)	(0.101)	(0.135)	(0.157)
*Electoral Competition**	0.659*	-0.353	-0.606*	0.661*	-0.441	-0.695*
Voluntary Voting	(0.182)	(0.263)	(0.292)	(0.197)	(0.232)	(0.270)
Candidate Fragmentation	0.302	-6.013*	-5.392*	0.486	-7.626*	-6.990*
	(0.532)	(1.195)	(1.328)	(0.628)	(0.785)	(0.913)
*Candidate Fragmentation**	-0.740	2.759	4.772*	-0.952	4.369*	6.261*
Voluntary Voting	(1.320)	(1.698)	(1.887)	(1.313)	(1.449)	(1.686)
Candidate Fragmentation^2	-0.095	4.874*	4.833*	-0.250	6.403*	6.454*
	(0.489)	(1.003)	(1.115)	(0.521)	(0.663)	(0.772)
Candidate Fragmentation^2*	-0.110	-1.521	-3.345*	0.082	-3.037*	-4.884*
Voluntary Voting	(1.136)	(1.456)	(1.618)	(1.100)	(1.255)	(1.460)
Campaign Spending	0.079*	-0.036	-0.032	0.055*	-0.027	-0.016
	(0.020)	(0.019)	(0.021)	(0.013)	(0.016)	(0.018)
Percent Urban	-0.021	-0.393*	0.194*	-0.053	-0.374*	0.186*
	(0.037)	(0.068)	(0.076)	(0.040)	(0.056)	(0.066)
Open Seat	0.008	0.020	-0.015	0.032	0.011	-0.017
	(0.027)	(0.046)	(0.051)	(0.032)	(0.043)	(0.050)
District Magnitude	-0.016	-0.081*	-0.011	0.003	-0.099*	-0.029
	(0.015)	(0.021)	(0.023)	(0.011)	(0.017)	(0.020)
Alianza Incumbent	-0.002	0.068	0.002	0.012	0.071	-0.009
	(0.024)	(0.042)	(0.047)	(0.023)	(0.038)	(0.045)
Concertación Incumbent	-0.018	0.073	-0.032	-0.004	0.074*	-0.012
	(0.023)	(0.040)	(0.045)	(0.020)	(0.037)	(0.044)
Previous Turnout	3.391*			3.328*		
	(0.198)			(0.185)		
Constant	-1.705*	-0.423	-0.781*	-1.865*	0.039	-0.391
	(0.232)	(0.354)	(0.393)	(0.224)	(0.253)	(0.294)
Observations	687	689	689	1027	1034	1034
R^2	0.822	0.478	0.478	0.753	0.488	0.488

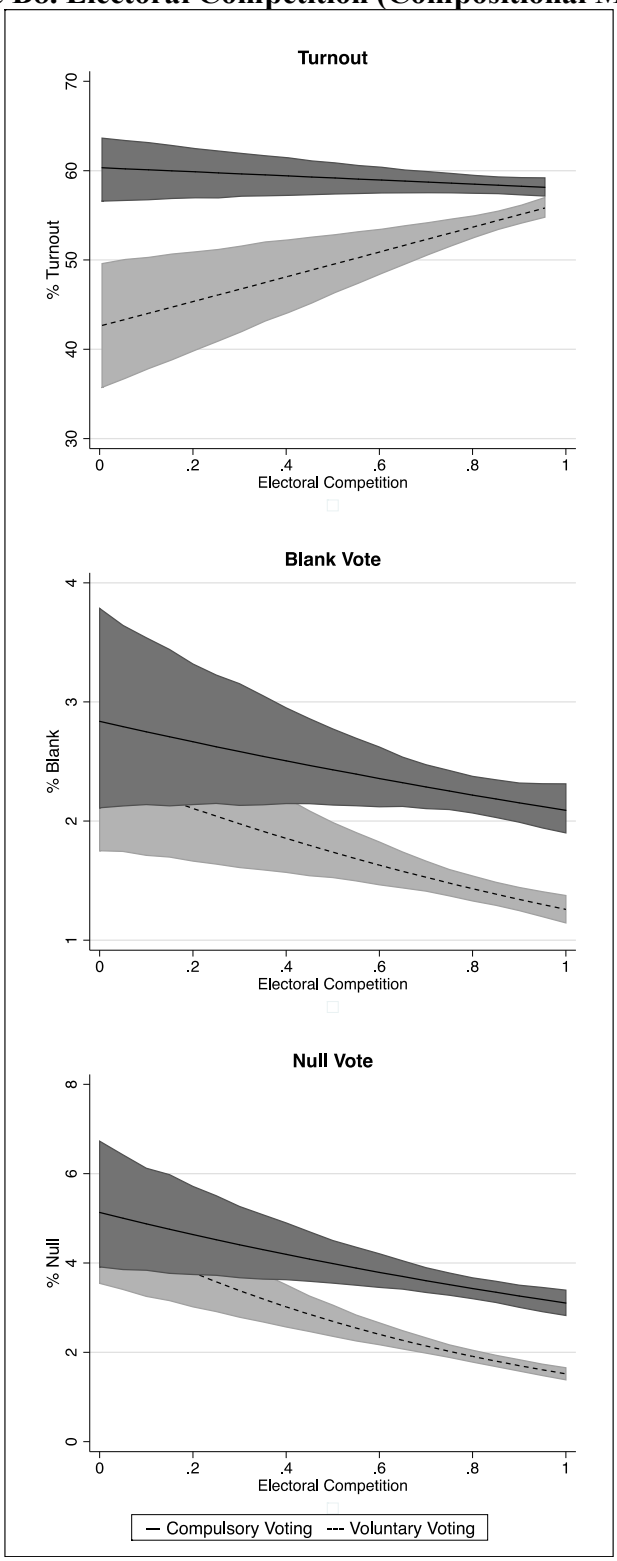
Notes: Recall the log transformation of the dependent variables are 1) log(turnout/abstentions), 2) log(blank votes/abstentions) and 3) log(null votes/abstentions). Coefficients are statistically significant at *p<.05. Standard error in parentheses.

Figure B7. District Size (Compositional Models)



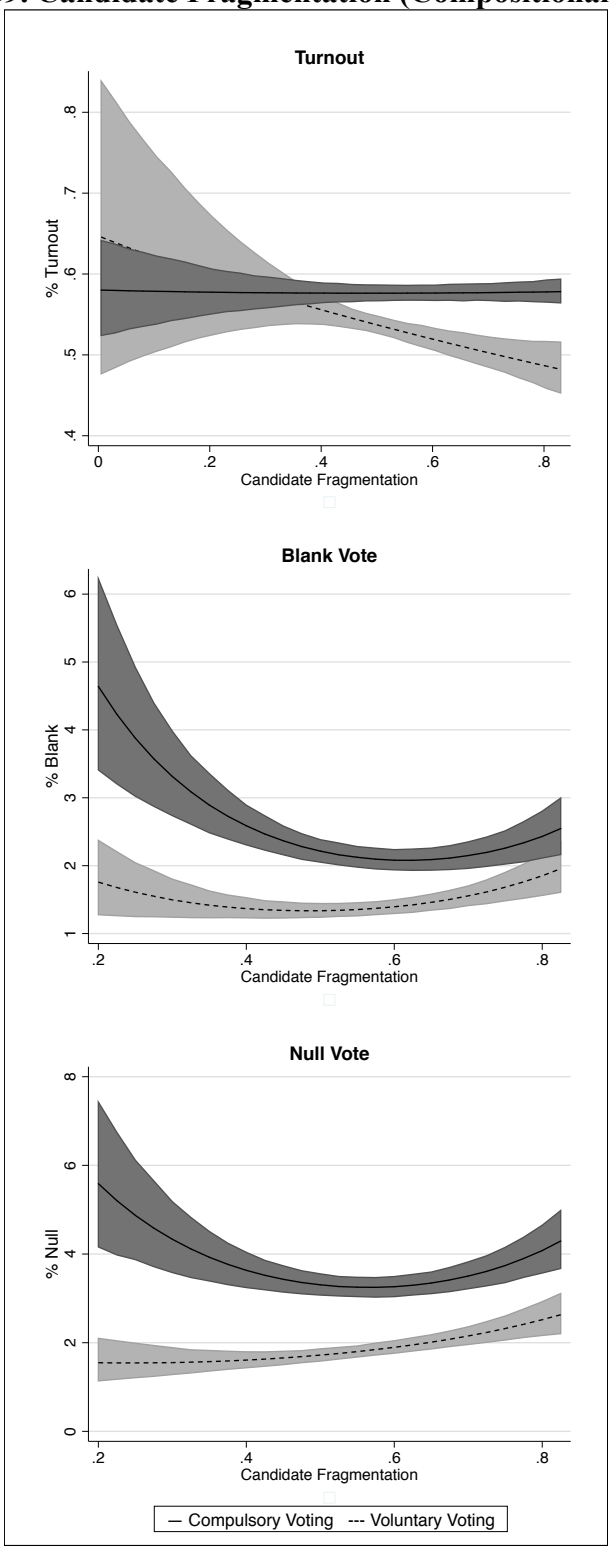
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as district size increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B3.

Figure B8. Electoral Competition (Compositional Models)



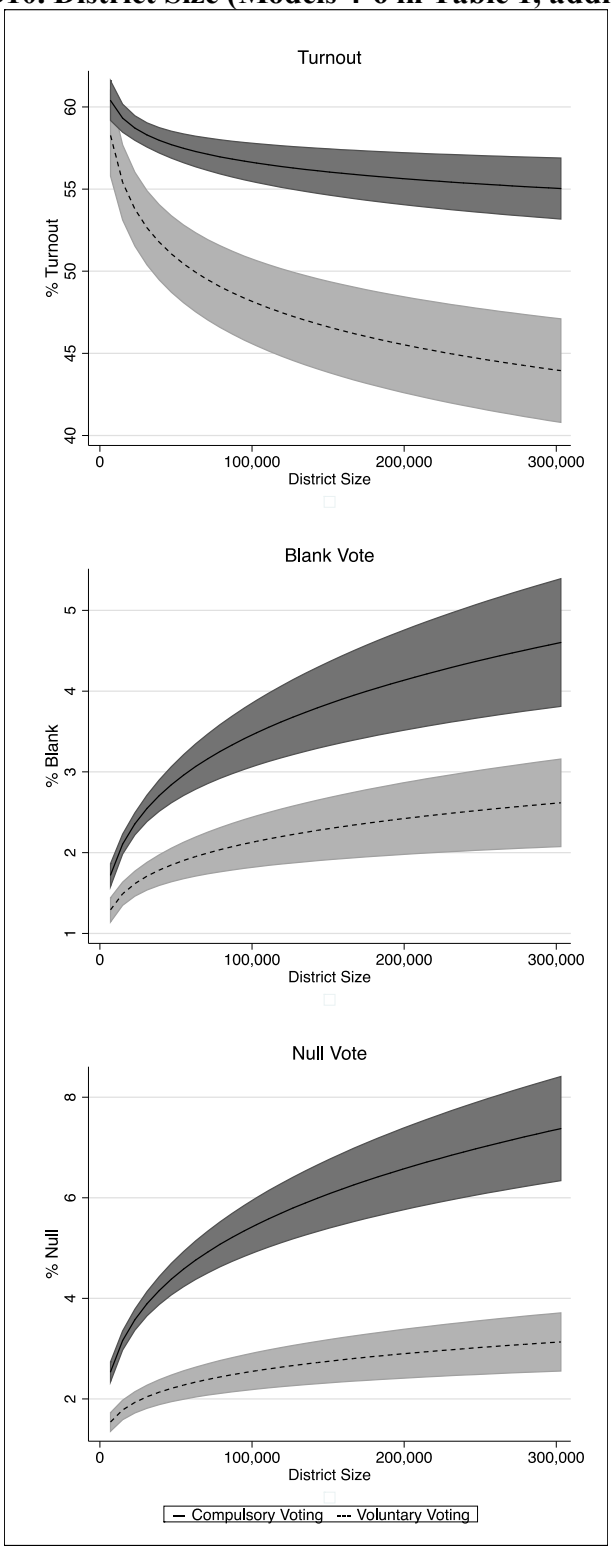
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as competition increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B3.

Figure B9. Candidate Fragmentation (Compositional Models)



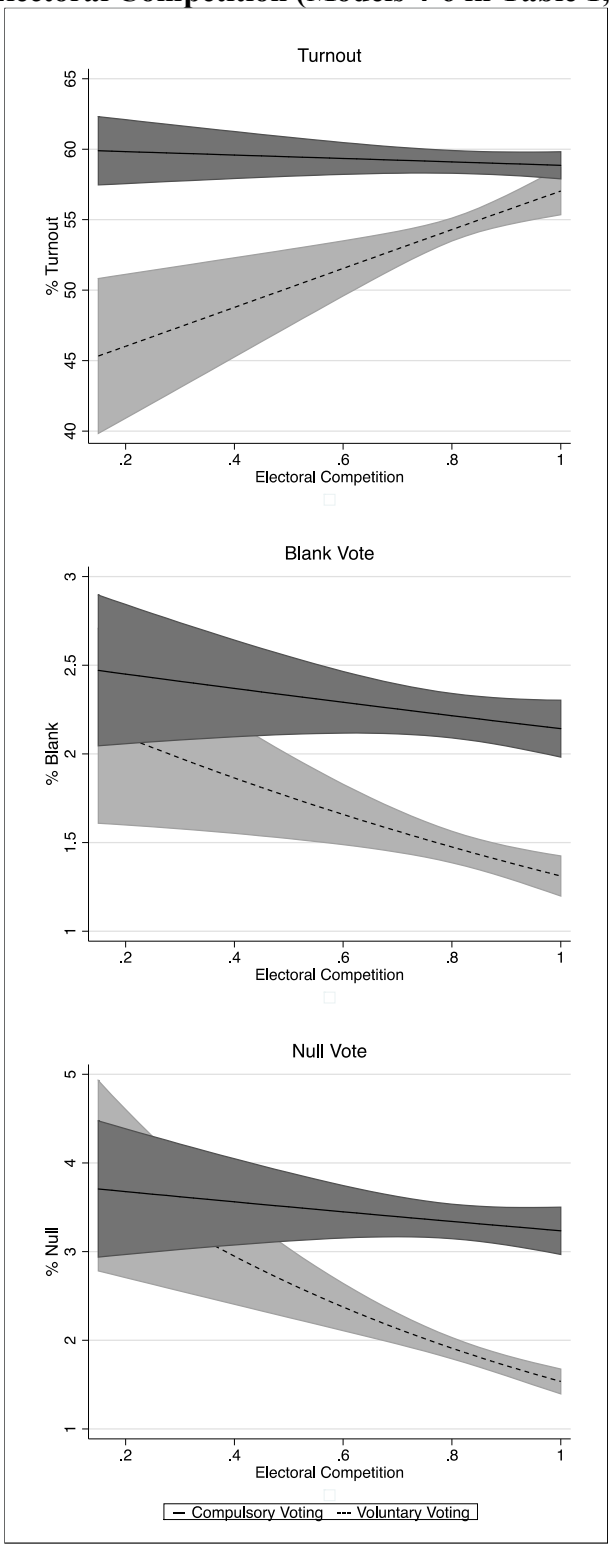
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as candidate fragmentation increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B3.

Figure B10. District Size (Models 4-6 in Table 1, adding 2004)



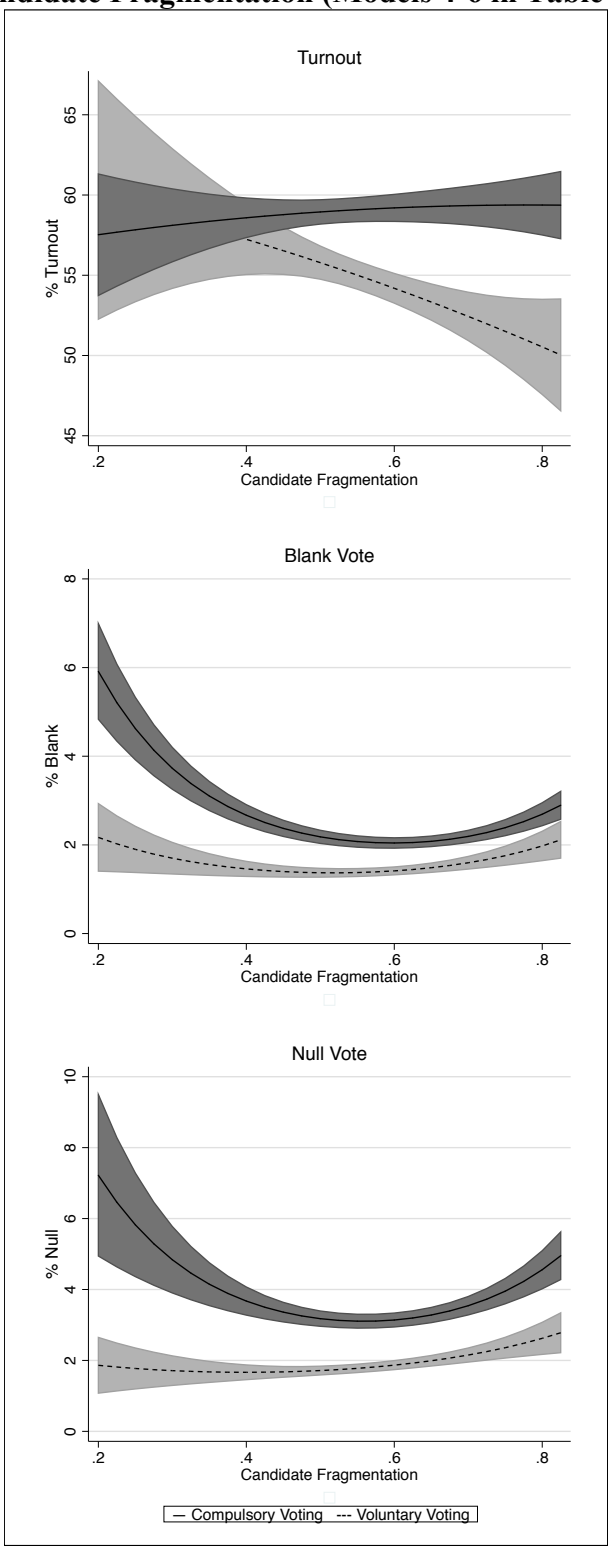
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as district size increases when all other variables are held at their mean or mode. Expected values were calculated using Models 4-6 in Table 1.

Figure B11. Electoral Competition (Models 4-6 in Table 1, adding 2004)



Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as competition increases when all other variables are held at their mean or mode. Expected values were calculated using Models 4-6 in Table 1.

Figure B12. Candidate Fragmentation (Models 4-6 in Table 1, adding 2004)



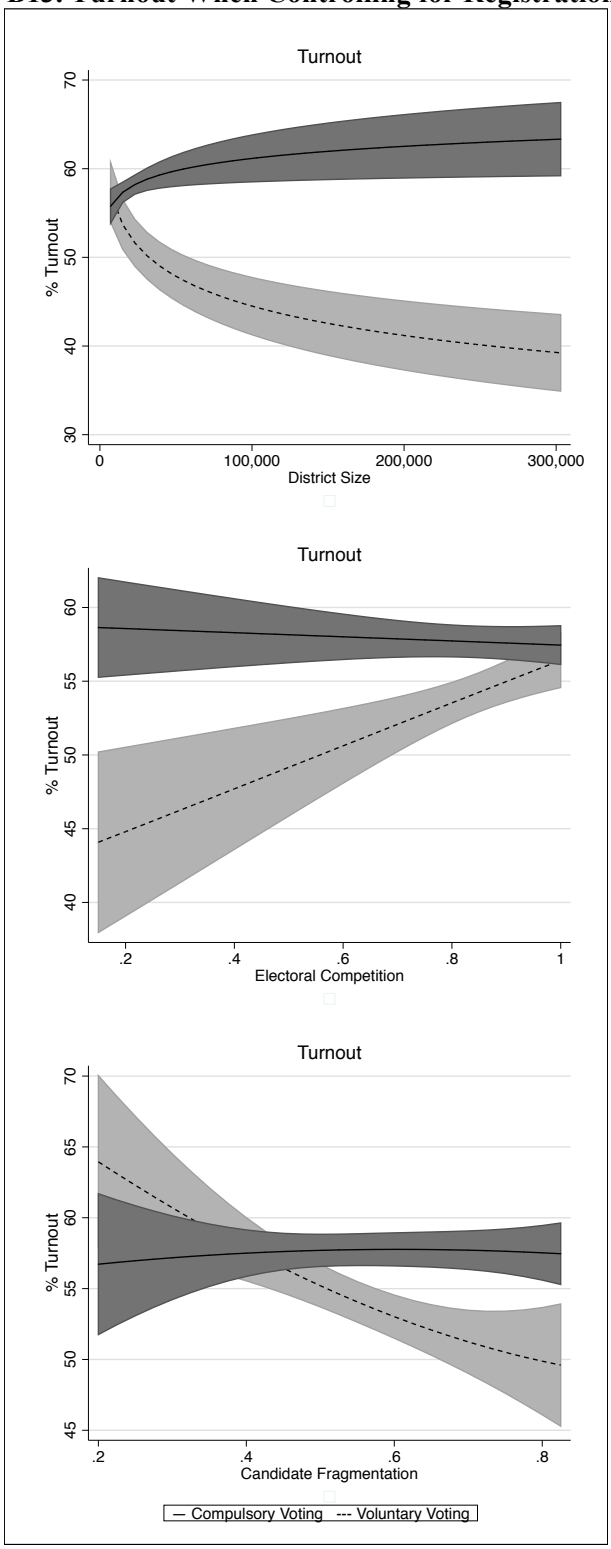
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as candidate fragmentation increases when all other variables are held at their mean or mode. Expected values were calculated using Models 4-6 in Table 1.

Table B4. Turnout Models Controlling for Registration Rates

	(1) Turnout 2008-2012	(2) Turnout 2004-2012
Voluntary Voting	-1.078*	-1.119*
	(0.311)	(0.259)
District Size	0.083*	0.077*
	(0.032)	(0.028)
District Size Voluntary Voting*	-0.282*	-0.293*
	(0.020)	(0.017)
Electoral Competition	-0.057	-0.017
	(0.098)	(0.068)
Electoral Competition Voluntary Voting*	0.641*	0.593*
	(0.182)	(0.182)
Candidate Fragmentation	0.315	0.686
	(0.746)	(0.485)
Candidate Fragmentation Voluntary Voting*	-2.113	-2.448*
	(1.175)	(1.084)
Candidate Fragmentation^2	-0.260	-0.580
	(0.611)	(0.396)
Candidate Fragmentation^2 Voluntary Voting*	1.096	1.442
	(1.005)	(0.948)
Campaign Spending	0.125*	0.074*
	(0.026)	(0.016)
Percent Urban	-0.088	-0.101
	(0.077)	(0.072)
Open Seat	-0.034	-0.009
	(0.029)	(0.027)
District Magnitude	-0.061*	-0.059*
	(0.017)	(0.016)
Alianza Incumbent	-0.031	-0.005
	(0.032)	(0.031)
Concertación Incumbent	-0.020	-0.003
	(0.025)	(0.024)
Registration Rates	2.323*	2.660*
	(0.376)	(0.273)
Constant	-0.903*	-1.186*
	(0.370)	(0.281)
Observations	687	1031
Log Pseudo likelihood	-304.26	-457.13

Notes: Generalized linear models. Coefficients are statistically significant at *p<.05. Standard error in parentheses. In this table we control for registration rates rather than previous turnout. We do not control for registration rates and previous turnout in the same model because these two variables are highly correlated under compulsory voting (recall all registered voters are required by law to turnout to vote under compulsory voting). These models demonstrate that turnout is not driven by fluctuations in registration rates. All three panels in Figure B13 show that under compulsory voting in Chile, turnout is better explained by compulsory voting than by variation in district size, electoral competition, or the effective number of candidates.

Figure B13. Turnout When Controlling for Registration Rates



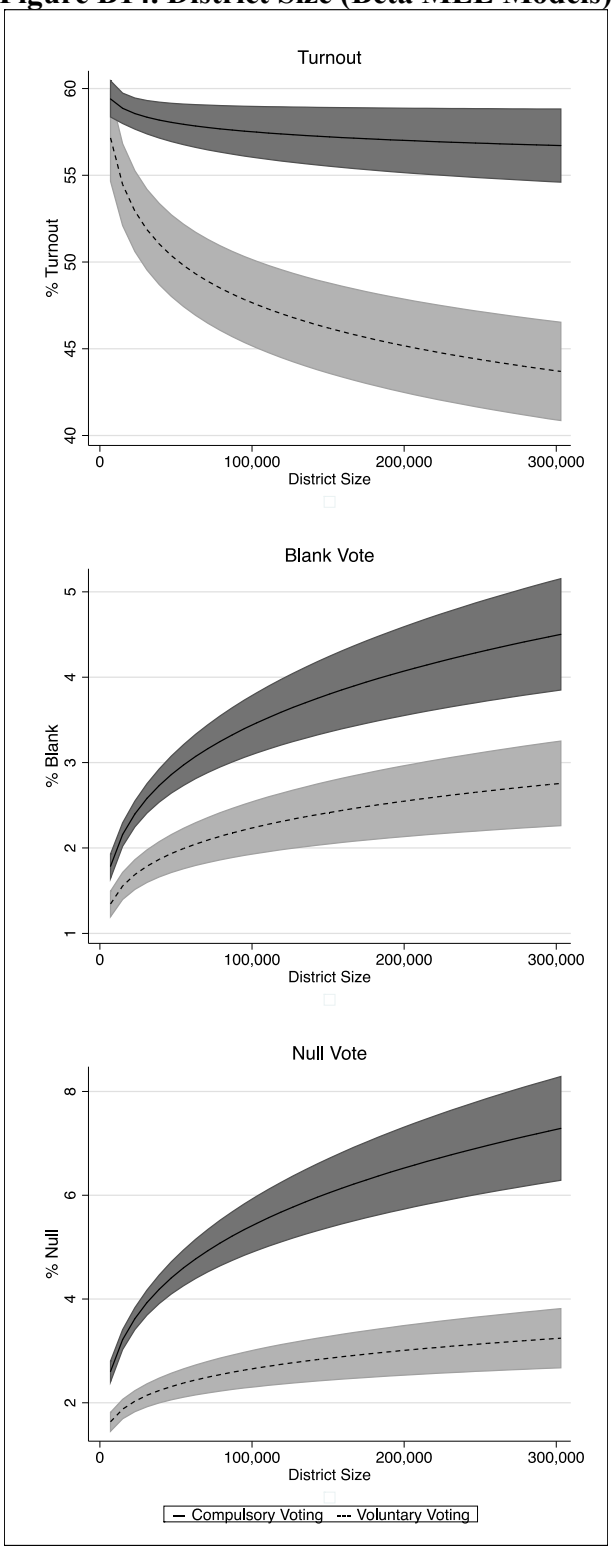
Note: This figure plots the expected level of turnout (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as district size, competition, and candidate fragmentation increases when all other variables are held at their mean or mode. Expected values were calculated using Model 1 in Table B4.

Table B5. BETA MLE Models, Voter Turnout and Invalid Votes

	(1) Turnout	(2) Blank	(3) Null
		2008-2012	
Voluntary Voting	-0.464*	-1.156*	-1.281*
	(0.214)	(0.273)	(0.364)
District Size	-0.029*	0.253*	0.286*
	(0.014)	(0.025)	(0.025)
*District Size**	-0.116*	-0.059*	-0.100*
Voluntary Voting	(0.012)	(0.022)	(0.022)
Electoral Competition	-0.085	-0.191	-0.203
	(0.093)	(0.156)	(0.151)
Electoral Competition Voluntary*	0.604*	-0.285	-0.721*
Voting	(0.134)	(0.246)	(0.245)
Candidate Fragmentation	0.430	-6.513*	-4.888*
	(0.599)	(0.751)	(1.029)
Candidate Fragmentation Voluntary*	-0.679	2.183	3.068*
Voting	(0.876)	(1.238)	(1.545)
Candidate Fragmentation^2	-0.268	5.300*	4.251*
	(0.503)	(0.635)	(0.859)
Candidate Fragmentation^2 Voluntary*	-0.077	-1.114	-1.850
Voting	(0.750)	(1.075)	(1.325)
Campaign Spending	0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)
Percent Urban	-0.021	-0.343*	0.311*
	(0.035)	(0.066)	(0.068)
Open Seat	0.011	0.048	0.010
	(0.023)	(0.043)	(0.041)
District Magnitude	-0.016	-0.074*	0.011
	(0.010)	(0.018)	(0.017)
Alianza Incumbent	0.003	0.065	-0.029
	(0.021)	(0.040)	(0.039)
Concertación Incumbent	-0.011	0.077*	0.008
	(0.020)	(0.038)	(0.037)
Previous Turnout	3.320*		
	(0.102)		
Constant	-1.693*	-0.527*	-1.515*
	(0.186)	(0.250)	(0.302)
Observations	687	689	689
Log Likelihood	1641.901	3703.958	3359.193

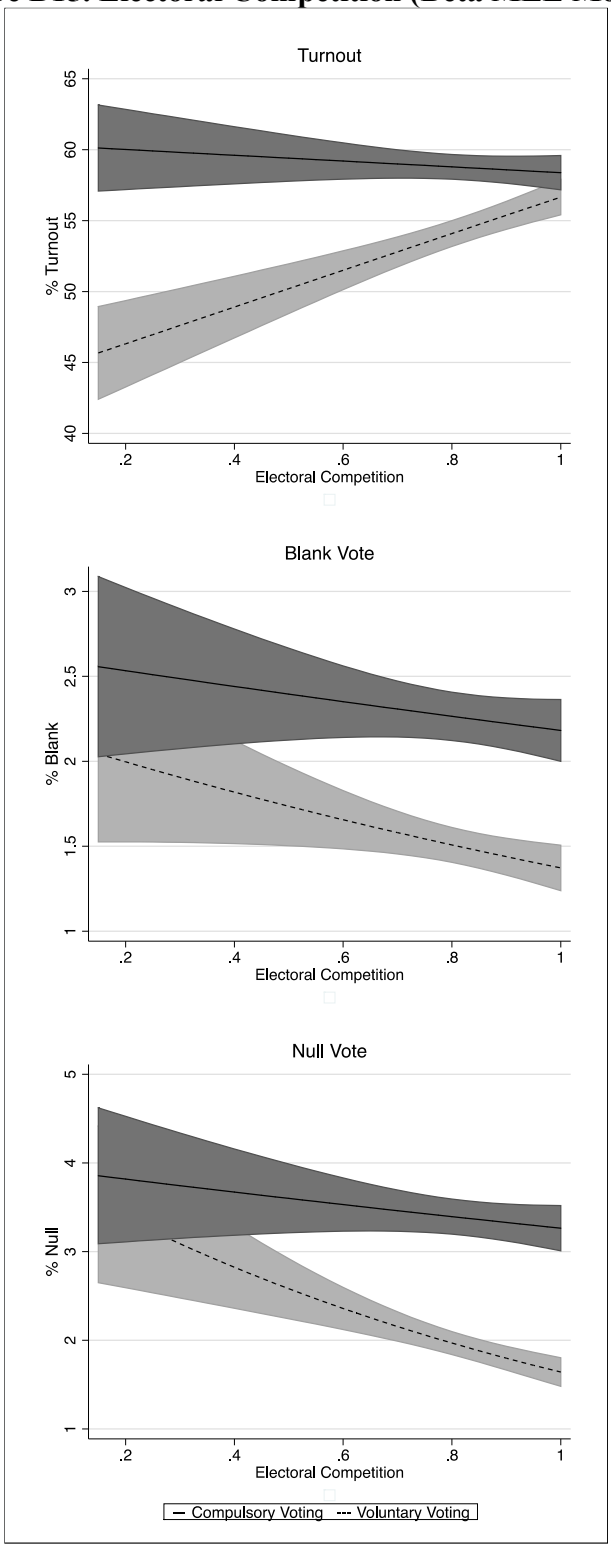
Notes: Coefficients are statistically significant at *p<.05. Standard error in parentheses.

Figure B14. District Size (Beta MLE Models)



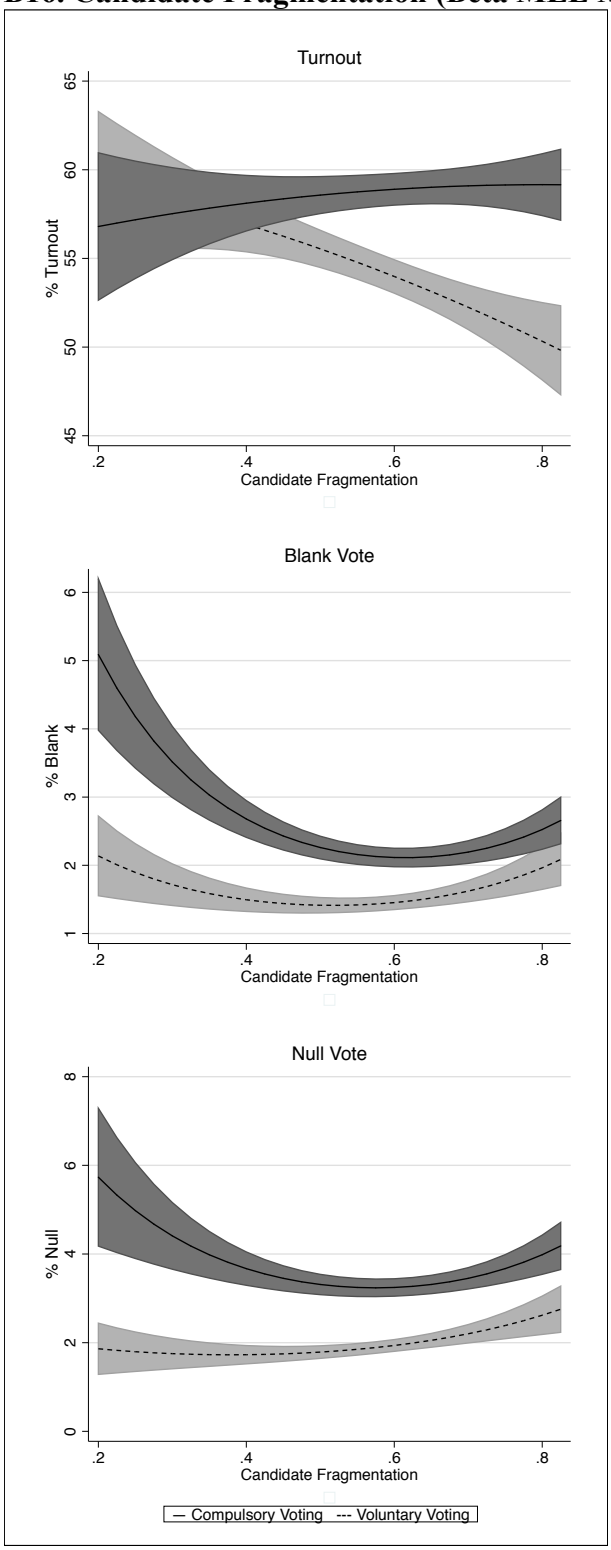
Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as district size increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B5.

Figure B15. Electoral Competition (Beta MLE Models)



Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as competition increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B5.

Figure B16. Candidate Fragmentation (Beta MLE Models)



Note: This figure plots the expected level of turnout, blank, and null votes (surrounded by 95 percent confidence intervals) for compulsory and voluntary systems as candidate fragmentation increases when all other variables are held at their mean or mode. Expected values were calculated using Models 1-3 in Table B5.

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