Online Supplemental Materials for "Do Changes in District Magnitude Affect Electoral Fragmentation?"

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Appendix 1: The Cases in the Analysis

The criteria for selecting cases are described in the text along with a description of how we deal with cases where districts split or where other forms of redistricting occurred. Table A1 lists all the countries and elections that are in the sample along with a commentary on the cases where reforms occurred.

Table A1: Description of Cases

Country	**Years**	**N districts**	**Notes**
Argentina	1985, 1987, 1989, 1991, 1993, 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013	24	
Brazil	1986, 1990, 1994, 1998, 2002, 2006, 2010	25 27	 After 1986, Goiás was split and Tocantin formed. Those 2 districts are only included after 1990.
Cape Verde	1996, 2001, 2006	15 17	 Sao Miguel and Tarrafal were a single district in 1996 and then split into distinct districts in subsequent elections. The combined district is excluded from the analysis in 1996.
Colombia	1974, 1978, 1982, 1986 2002, 2006, 2010, 2014	26 33	Redistricting occurred in 1991. Eight new districts were added and two (Valle and Quindio) were deleted; election data is not available after that until 1998 We have electoral data for 1998 but not data on district magnitude
Costa Rica	1953, 1958, 1962, 1966, 1970, 1974, 1978, 1982, 1986, 1990, 1994, 1998, 2002, 2006, 2010, 2014	7	
Denmark	1945, 1947, 1950, 1953, 1953 (SECOND), 1957, 1960, 1964, 1966, 1968	23	1953 saw a reform that increased the number of seats available and the formula for obtaining them but which did not change the primary districts.

	1971, 1973, 1975, 1977, 1979, 1981, 1984, 1987, 1988, 1990, 1994, 1998, 2001, 2005, 2011, 2015	17 10	Subnational boundaries were reformed in 1970 and districts from 1971-2005 reflect the new boundaries. Following 2005 districts were again reformed, reducing them to 10
Finland	1983, 1987, 1995, 1999, 2003, 2007, 2011	15	
Honduras	1997, 2001, 2005, 2009	18	
Iceland	1959, 1963, 1967, 1971, 1974, 1978, 1979, 1983, 1987, 1991, 1999 2003, 2007, 2009, 2013	8 6	In 1987 the process of allocating seats across districts was changed but the districts themselves were not In 2000 the electoral system was reformed, changing the structures of the districts
Italy	1948, 1953 1958, 1963, 1968, 1972, 1976, 1979, 1983, 1987, 1992	31 32	 Trieste returns as part of the Republic in 1954 and is added as an electoral district in the 1958 elections
Latvia	1993, 1995, 1998, 2002, 2006, 2010, 2011	5	
Norway	1977, 1981, 1985, 1989, 1993, 1997, 2001, 2005, 2009	19	
Paraguay	2003, 2008, 2013	18	
Peru	2006, 2011	25	
Portugal	1976 1979, 1980, 1983, 1985, 1987, 1991, 1995, 1999, 2002, 2005, 2009, 2011	19 20	The three Azores districts are not included in the analysis because we do not have two elections for them 1979 is the first election where the Azores are combined into one district.
Romania	1992, 1996, 2000, 2004	42	
South Africa	1994, 1999, 2004, 2009	9	
Spain	1977, 1979, 1982, 1986, 1989, 1993, 1996, 2000, 2004, 2008	52	
Sweden	1944, 1948, 1952, 1956, 1958, 1960, 1964, 1968, 1970, 1973, 1976, 1979, 1982, 1985, 1988, 1991, 1994	28	1969 saw a reform that increased the number of seats in the parliament from 233 to 350 without changing the structure of district boundaries; in 1974 it was reduced to 349

	1998, 2002	29	In 1994 redistricts were redrawn
Switzerland	1947, 1951, 1955, 1959, 1963, 1967, 1971, 1975, 1979, 1983, 1987, 1991, 1995, 1999, 2003, 2007	26	Switzerland's smaller districts occasionally see candidates run unopposed-these districts are excluded from the analysis (as are the subsequent elections that would require a lagged vote total)

Appendix 2: Descriptive Variables

The table below lists all the variables in the analysis. While most of the variables are entered in the models in a first-differenced form, we present below the descriptive statistics for their un-differenced and first differenced values to help the reader understand the distribution of the underlying variables.

Table A2: Descriptive Statistics for Variables in the Analysis

Variable	Mean	Std. Dev.	Min	Max
Ln(Number of Parties Running)	2.259	0.600	0.000	3.970
ΔLn(Number of Parties Running)	0.061	0.380	-1.466	2.773
Ln(Effective Number of Parties Winning Votes)	1.253	0.359	0.000	2.536
ΔLn(Effective Number of Parties Winning Votes)	0.020	0.211	-1.043	1.509
Ln(Effective Number of Parties Winning Seats)	0.969	0.381	0.000	2.329
ΔLn(Effective Number of Parties Winning Seats)	0.018	0.222	-1.022	1.313
Ln(M)	1.951	0.828	0.000	5.011
Δ Ln(M)	0.003	0.118	-0.693	0.693
Ln(Effective Number of Parties Winning Votes Nationally)	1.466	0.343	0.678	2.421
ΔLn(Effective Number of Parties Winning Votes Nationally)	0.016	0.195	-0.548	1.012
Presidential Election Year	0.200	0.400	0.000	1.000
Log(Valid Votes Cast)	5.287	0.610	3.022	7.343
ΔLog(Valid Votes Cast)	0.021	0.110	-1.321	1.446
Has a Corrective Tier	0.292	0.455	0.000	1.000
First Four Elections	0.366	0.482	0.000	1.000
Ethnolinguistic Fragmentation	0.000	0.217	-0.273	0.606

Appendix 3: Results Excluding Cases that Substantially Changed their Electoral System

As noted in Appendix 1 and described in the text, there are some cases where countries substantially changed their electoral rules between elections, leaving the new district boundaries constant. In the analysis, we treat these new districts as new districts embedded within the original country to account for similarities in the national party system and electorates within those countries over time. In particular, districts were redrawn in Colombia before 2002, Denmark before 1971, Iceland before 2000, Italy before 1958, and Sweden before 1998. Yet this of courses raises the question of whether these results are comparable given the endogeneity concerns we have about large national-level reforms. Thus in Table A3 below we estimate the base model (Table 3, model 11) for ENPV while in Table A4 we estimate the base model for the number of parties running (Table 2, model 7) with and without those cases to examine the effect of that modeling decision. Including the cases where major districting occurred slightly decreases the estimated effect of changes in district magnitude, although the substantive conclusions do not change. We include all the possible available cases in the text for robustness' sake, but highlight that the choice to include these elections do not affect the substantive conclusions.

Table A3: The Effect of ΔLn(M) on ΔLn(ENPV) with and without Cases After Major Electoral Reforms

	Without Any Elections After Reforms	With All Cases
ΔLn(M)	0.105***	0.095***
	(0.028)	(0.027)
Presidential Election Year	0.119***	0.101***
	(0.030)	(0.029)
ΔLog(Valid Votes Cast)	-0.036	-0.025
	(0.023)	(0.021)
First Four Elections	-0.006	-0.020
	(0.014)	(0.012)
Ethnolinguistic Fragmentation	-0.003	0.070
	(0.097)	(0.075)
Constant	0.027	0.021
	(0.030)	(0.024)
Random-effects Parameters		
Country	0.011	0.006
	(0.004)	(0.002)
Year	0.010	0.008
	(0.002)	(0.002)
District	0.000	0.000
	(0.000)	(0.000)
District-Year	0.033	0.034

	(0.001)	(0.001)
N District-Years	3,037	3711
N Districts	445	541
N Countries	20	20
Wald χ^2	33.55***	29.61***
Cross-Nested Multi-Level Model with Standard Errors in Parentheses ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001		

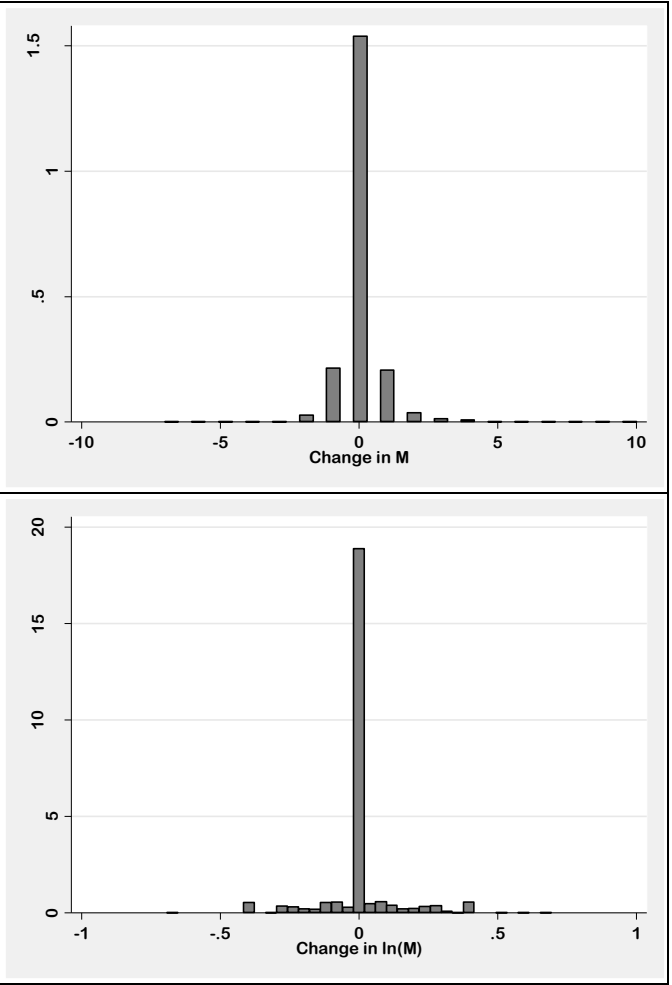
Table A3: The Effect of ΔLn(M) on ΔLn(Number of Parties Running) with and without Cases After Major Electoral Reforms

	Without Any Elections After Reforms	With All Cases
ΔLn(M)	0.120*	0.098*
	(0.049)	(0.046)
Presidential Election Year	0.166***	0.166***
	(0.043)	(0.042)
ΔLog(Valid Votes Cast)	-0.129*	-0.116*
	(0.059)	(0.058)
First Four Elections	-0.028	-0.055*
	(0.025)	(0.023)
Ethnolinguistic Fragmentation	-0.144	-0.199
	(0.254)	(0.256)
Constant	0.024	0.059
	(0.074)	(0.073)
Random-effects Parameters		
Country	0.070	0.077
	(0.025)	(0.027)
Year	0.037	0.040
	(0.008)	(0.008)
District	0.000	0.000
	(0.000)	(0.000)
District-Year	0.090	0.087
	(0.002)	(0.002)
N District-Years	2685	3711
N Districts	405	541
N Countries	19	20
Wald χ^2	26.78***	30.6***
Cross-Nested Multi-Level Model with Standard Errors in Parentheses ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001		

Appendix 4: Results Excluding Especially Large Changes in District Magnitudes

One question the reader might have is whether any specific outliers are driving the results. While the overall descriptive statistics are in Appendix 2, we focus here on breaking down the changes in district magnitude in the sample. As noted in the text reforms of district magnitude are more common here than are other national-level election reforms but most district magnitudes do not change by election. In 74.7 percent of cases, the district magnitude is unchanged. Then most changes that do occur are very small: 81.2 percent of all changes that occur were either adding or subtracting a single seat while 93.4 percent involve additions or subtractions of two seats or fewer:

Change in M	Freq.	Percent
-7	1	0.03
-6	1	0.03
-5	2	0.05
-4	1	0.03
-3	5	0.13
-2	49	1.3
-1	393	10.45
0	2,811	74.72
1	379	10.07
2	67	1.78
3	25	0.66
4	16	0.43
5	3	0.08
6	2	0.05
7	3	0.08
8	1	0.03
9	2	0.05
10	1	0.03



Yet there are some large changes that cluster in a handful of countries. The following countries have districts where at least one district had a change of 3 seats or more.

	# Districts where $\|\Delta M\| \geq 3$
Brazil	3
Costa Rica	2

Denmark	2
Iceland	3
Italy	27
Latvia	1
Norway	1
Portugal	1
South Africa	2
Sweden	20
Switzerland	1

These large swings raise the possibility that these results are being driven entirely by these outliers and that smaller changes in district magnitude have no effect. We thus have performed three robustness checks, presented below, to ensure that our story is not dependent upon these large changes. In the first, we dropped all elections where district magnitude had changed by more than 2 seats to drop the most extreme cases. In the second, we perform an even more conservative analysis and look at changes of only a single seat. Finally, in the third column we code all additions, no matter how large, as a "1" and all subtractions as a "-1". In all three cases, changing the number of seats changes the effective number of parties winning votes (the coefficient in the third column is different because the variable is not logged). The implication is that even if we ignore the largest changes, the conclusion that changing district magnitude increases electoral fragmentation remains the same.

Table A5: The Effect of Changing District Magnitude on Changes in the Ln(ENPV), Controlling for Possible Outliers

	Only Changes Between 2 and -2	Only Changes Between 1 and -1	All Decreases Coded as -1, All Increases as 1
Δ(Natural Logged) District Magnitude	0.088**	0.101***	
	(0.028)	(0.030)	
District Magnitude Got Bigger or Smaller or Stayed the Same?			0.014*
			(0.006)
Δ(Logged) Valid Votes Cast	0.091**	0.092**	0.104***
	(0.031)	(0.031)	(0.029)
Presidential Election Year	-0.025	-0.025	-0.023
	(0.021)	(0.022)	(0.021)
First 4 Elections	-0.019	-0.019	-0.020
	(0.012)	(0.012)	(0.012)
Ethno-Linguistic Fragmentation	0.066	0.069	0.070
	(0.075)	(0.075)	(0.075)
Constant	0.021	0.021	0.021
	(0.024)	(0.024)	(0.024)
Variance Components			

Country	0.006	0.006	0.006
	(0.002)	(0.002)	(0.002)
Year	0.008	0.007	0.008
	(0.002)	(0.002)	(0.002)
District	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
District-Year	0.034	0.035	0.034
	(0.001)	(0.001)	(0.001)
χ^2	23.18***	24.88***	21.77***
N District-Elections	3,648	3,532	3,711
N Districts	541	539	541
N Countries	20	20	20
Cross-Nested Multi-Level Model with Standard Errors in Parentheses ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001			

Table A6: The Effect of Changing District Magnitude on Changes in the Ln(Number of Parties Running), Controlling for Possible Outliers

	Only Changes Between 2 and -2	Only Changes Between 1 and -1	All Decreases Coded as -1, All Increases as 1
Δ(Natural Logged) District Magnitude	0.086°	0.102°	
	(0.051)	(0.055)	
District Magnitude Got Bigger or Smaller or Stayed the Same?			0.005
			(0.011)
Δ(Logged) Valid Votes Cast	-0.145*	-0.149*	-0.111°
	(0.070)	(0.071)	(0.057)
Presidential Election Year	0.195***	0.188***	0.169***
	(0.045)	(0.046)	(0.042)
First 4 Elections	-0.065*	-0.068*	-0.055*
	(0.028)	(0.029)	(0.023)
Ethno-Linguistic Fragmentation	-0.252	-0.322	-0.201
	(0.219)	(0.204)	(0.257)
Constant	0.064	0.070	0.059
	(0.064)	(0.060)	(0.073)
Variance Components			
Country	0.051	0.042	0.077
	(0.020)	(0.016)	(0.027)
Year	0.037	0.036	0.040
	(0.008)	(0.008)	(0.008)
District	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
District-Year	0.088	0.092	0.087

	(0.003)	(0.003)	(0.002)
χ^2	31.21***	31.10***	26.41***
N District-Elections	2,531	2386	3091
N Districts	423	416	480
N Countries	19	19	20
Cross-Nested Multi-Level Model with Standard Errors in Parentheses ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001			

Appendix 5: Modeling Electoral Fragmentation Using Fixed Effects

We are interested in isolating changes in electoral institutions and their effects. The first differences models used in the paper do that, but fixed effects models (as used by Singer (2015)) also isolate only the variation within cases while also controlling for any unmeasured district characteristics that shape the party system. We use the first difference model with random effects because we want to interact changes in district magnitude with country-specific variables that, in some cases, are constants and thus would be excluded from a fixed effects model. But Table A7 below we estimate a levels model of ENPV with an ar(1) correction to show that the results are robust to model specification. As noted in the text, the effective number of parties data has significant autocorrelation that the first differenced series does not and so we add an correction for autocorrelation. Then for the number of parties running we use a negative binomial model with fixed effects-the Woolridge test for autocorrelation does not reject the null of no autocorrelation for the number of parties running (F= 0.260, p=0.611).

The results in Table A7 are consistent with those in the text. Increasing district magnitudes increases electoral fragmentation in subsequent elections as expected. We also see that increases in electorate size increase fragmentation, that controlling for national trends in the party system does not completely reduce the effect of electoral system reform, and that presidentialism increases fragmentation at the district-level once the national party system is controlled for. The only new finding in this specification is some evidence that the district party system is less fragmented in early elections than in later ones. But the main substantive conclusions are not a function of model choice-differences in electoral system permissiveness within cases are associated with changes in electoral fragmentation.

A similar story emerges from Table A8. Increasing district magnitudes are associated with more parties running within cases as expected. Interesting, as the national party system changes we do not see more parties running. We also see more candidates running as population increases (a result that diverges from the first difference models), fewer candidates in the first elections, and more candidates in presidential election years.

Table A7: Fixed Effects Model of Ln(Effective Number of Parties Winning Votes)

	[1]	[2]
Ln(M)	0.075**	0.067**
	(0.029)	(0.025)

Ln(Effective Number of Parties Winning Votes Nationally)		0.568*** (0.016)
Presidential Election Year	-0.020 (0.014)	0.065*** (0.012)
Log(Valid Votes Cast)	0.180*** (0.027)	0.109*** (0.023)
First Four Elections	-0.030** (0.010)	-0.002 (0.009)
Constant	0.177° (0.092)	-0.286*** (0.079)
F	19.81***	258.68***
N District-Years	3,722	3,722
Number of Districts	541	541
Fixed Effects Model with Ar(1) Correction ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001		

Table A8: Fixed Effects Model of Ln(Number of Candidates Running)

	[1]	[2]
Ln(M)	0.110° (0.057)	0.110° (0.057)
Ln(Effective Number of Parties Winning Votes Nationally)		0.018 (0.037)
Presidential Election Year	0.113** (0.043)	0.115** (0.043)
Log(Valid Votes Cast)	0.195*** (0.054)	0.192*** (0.054)
First Four Elections	-0.192*** (0.017)	-0.191*** (0.017)
Constant	2.131 (0.279)	2.115*** (0.280)
χ^2	206.90***	207.19***
N District-Years	3114	3114
Number of Districts	423	423
Fixed Effects Negative Binomial Model ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001		

Appendix 6: Modeling Changes in District Magnitude

In the text we claim that changes in district magnitude do not reflect or correlate with previous electoral fragmentation. Below we model changes in district magnitude as a function of the lagged electoral fragmentation in the district. District magnitudes tend to increase with increases in the franchise (as they should given their origins in population shifts) and, surprisingly, in presidential election years. But there is no correlation with previous levels of fragmentation,

which suggests that districts where there are multiple parties are not gaining more seats to further that advantage nor are districts with few parties gaining seats to facilitate multipartism.

Table A9: Modeling Changes in Ln(M)

	[1]	[2]
Ln(Effective Number of Parties)$_{t-1}$	0.003	0.000
	(0.006)	(0.006)
Δ(Logged) Valid Votes Cast		0.045*
		(0.018)
(Logged) Valid Votes Cast$_{t-1}$		0.003
		(0.004)
Presidential Election Year		0.018**
		(0.007)
First Four Elections		-0.003
		(0.007)
(Centered) Ethnolinguistic Fragmentation		-0.015
		(0.013)
Constant	-0.001	-0.018
	(0.008)	(0.020)
Random-effects Parameters		
Country	0.000	0.000
	(0.000)	(0.000)
Year	0.000	0.000
	(0.000)	(0.000)
District	0.000	0.000
	(0.000)	(0.000)
District-Year	0.014	0.014
	(0.000)	(0.000)
Wald χ^2	0.18	16.23*
N Countries	20	20
N Districts	541	541
N District Years	3711	3711
Cross-Nested Multi-Level Model with Standard Errors in Parentheses ° p<0.10, * p<0.05, ** p<0.01, *** p<0.001		