

The Geography of Electoral History: A Dataset of Recent Mexican Election Returns and Quantities of Analytical Interest

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The advent of competition in Mexican politics produced a wealth of government data for the analysis of public policy and politics. Data is distributed at the municipal level and smaller geographic units of aggregation (such as census tracts or similar levels), and in some cases at the individual level. This has spawned fertile areas of new research in education (Hoyos, Espino and García 2012), public health (Imai, King and Nall 2009; King, Gakidou, Ravishankar, Moore, Lakin, Vargas, Rojo, Ávila, Ávila and Llamas 2007), poverty relief (Díaz Cayeros, Estévez and Magaloni 2016; Molinar Horcasitas and Weldon 1994), legislative politics (Cantú, Desposato and Magar 2014; Rosas and Langston 2011), and electoral regulation (Estévez, Magar and Rosas 2008), to name a few.

1952–1967 1965–1976

This paper's focus are vote returns. Electoral data has been distributed for much longer than the information discussed above. It is also better-known and has received a good deal of attention since seminal studies of the PRI's support bases in the states in federal elections of the 1950s and 1960s (Ames 1970) and the correlation of modernization measures ant voting and turnout in federal districts between 1965 and 1976 (Lehr and Pedroza 1985). This paper describes a repository...

Some of the distributed data is elementary and available elsewhere, such as the number of valid votes cast for parties in congressional races since 1991 in single-member districts, in municipalities, and in sub-municipal units of aggregation. shares by party and their change since last election) at the municipal and sub-municipal levels. Offers a cross-section time-series of dip fed returns at two levels of aggregation: municipalities and secciones electorales.

More abstract
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This note presents, discusses, and distributes statistics (available here) of party performance in Mexico's competitive era. I elaborate two quantities of interest: *voting forecasts* based on recent electoral history and measures of parties' *core support*. The procedure produces summary measures of recent electoral history in relatively small geographic units, municipalities ($N \approx 2500$) and /secciones electorales/ ($N \approx 66000$) throughout Mexico. I apply the methodology to four federal congressional elections between 2009 and 2018 (I will soon apply it to municipal races too), using results since 1994 as historical input.

The note starts by showing the statistics in action to get a glimpse of their descriptive and analytic potential. By summarizing recent electoral history and its geography, the quantities offer a scenic view of a critical aspect of contemporary Mexican politics.

Later sections offer methodological detail on the estimation of these quantities of interest and are increasingly technical.

1 Municipal governments

1.1 Policy making authority

Mexico's 2,477 (as of January 2025) municipios or municipio-equivalents, into which 31 states and Mexico City are subdivided, are the bottom tier of elected governments. Municipal governments have constitutional authority over community police, zoning and construction permits, water supply, sewerage and waste disposal, street lighting, pavement, and park management, and regulate public markets, slaughterhouses, and cemeteries. They appoint municipal staff and subcontract personnel to carry these responsibilities, key sources of patronage in a spoils system, making them links of potential importance to political communities in the maintenance of state and national parties (Key 1964; Sorauf 1959).

Municipalities have authority to collect property taxes and fees from public services. State capacity is heterogeneous (Garfias 2018), many municipalities, especially in rural Mexico, remain fiscally unorganized and obtain the lion's share of their financial resources from federal revenue sharing and earmarked federal investments (Díaz Cayeros 2006; Figueroa Mansur 2024).

1.2 Government structure

Municipal authority is vested in the *Ayuntamiento*, a popularly-elected board deciding by majority rule (Robles Martínez 2009). A municipal council (*cabildo*) and a mayor (*presidente municipal* or *primer regidor*) make up the Ayuntamiento. The mayor is executive officer, presides council sessions with voice and the tie-breaking vote, and holds variable municipal appointment powers. Councils, variable in size depending on population, are made up of (1) ranked *regidores* (also called *concejales*), who propose and vote municipal policy through edicts and rulebooks, and (2) possibly one or more *síndicos*, officers in charge of the Treasury and the municipio's legal representation. Where present,¹ síndicos can be elected officers, or council-appointed from among regidores. Municipalities have no judicial power. States do.

Mexico City has a special status. Before 1997, the mayor of the Federal District was a presidential appointee, who would in turn appoint delegates for the city's 16 administrative jurisdictions (called *delegaciones*). A decentralizing reform made all these elected offices in 1997. The Federal District did not, however, gain status as a state, and delegations remained as quasi-municipalities with an elected executive with no fiscal powers (taxation remains in the hands of the city executive) and no elected council. The city further reformed in 2016, adding a council to the quasi-municipalities (now called *alcaldías*) and dropping the name Federal District, becoming simply Mexico City (Rabell García 2017).

¹One state at least (Sinaloa, see Ramírez Millán 2000) has no síndicos.

1.3 Modal electoral institutions

Presidents and síndicos (where elected) are elected by plurality. Regidores are elected in two groups (of variable sizes across states), one group by plurality, the other by proportional representation.²

Municipal officers are elected in fused tickets. Voters have a single vote, which they cast for a list of candidates including a municipal president on top, ranked regidores, and possibly síndicos. The vote is fused as it simultaneously affects the vote totals of candidates running for different offices (see Cox 1997:42): the presidency, plurality regidores, and síndicos (where applicable) are allocated to the most voted list. Remaining regidores are distributed to lists proportionally. Split ticket voting is therefore not technically possible.

1.4 Exceptional electoral institutions

Two notable exceptions are Chihuahua since 1998 and Nayarit since 2008. Chihuahua's voters have two votes, one to elect the síndico by plurality, another for the remaining municipal officers as described above. This makes split ticket voting possible.

Nayarit's voters also have dual votes. One vote elects a president and the municipal síndicos by plurality from fused tickets in municipio-wide elections. Another vote elects plurality regidores in single-member districts (municipios are subdivided into districts called *demarcaciones* for the purpose). These other votes are then pooled in a secondary district (the whole municipio) to distribute proportional representation regidores.

1.5 Term limits

Municipal governments have three-year terms.³ Up to 2018, all were single-term limited, like elected officeholders nationwide since the 1930s. Reform in 2014 let states opt for two-term limits in their municipalities. All states bar Hidalgo did so, the reform kicking off in 2018 in twenty-three states. Ayuntamiento incumbents in the other eight reforming states have been able run for consecutive reelection gradually since. The last will be Veracruz's 212 municipalities in 2025.

Reelection could produce a seismic shift in municipal politics. Six consecutive years in office falls short of qualifying as the long run, but extending Ayuntamientos' time horizons up from just three years should encourage more enterprising policy. More fundamentally, the need to win reelection should encourage ambitious mayors and regidores to keep their electoral alliances alive and mobilized, nurturing responsiveness (Cain, Ferejohn and Fiorina 1987; Cox and McCubbins 1986; Jacobson and Kernell 1983).

The removal of single-term limits was surprising given the Mexican elite's anti-reelection rhetoric and might well prove short-lived. Morena, the new partisan Goliath since 2018, has repeatedly voiced determination to reinstate single terms across the board. Regardless, the reform offers an interesting laboratory to study institutional change.

²As of 2010, the mean Ayuntamiento had two-thirds of majority seats, with considerable variance. Guanajuato's municipalities, the lowest, had 20 percent. Tabasco's, the highest, had 81 percent. See Gil Ramírez (2010:14).

³Four-year terms were found in Coahuila between 2005 and 2016, in Hidalgo since 2016, and in Veracruz between 2013 and 2024. State electoral calendars changed numerous times in the period, exceptionally distorting three-year terms slightly. See Magar (2017) and <https://github.com/emagar/calendarioReeleccion>.

1.6 Usos y costumbres

eric esto falta: preguntarle a Federico dónde se estudia el origen de los 570 municipios.

Oaxaca has 570 municipalities, almost one out of four nationwide. Their origin is colonial, Antequera diffusing ethno-linguistic tensions by creating tiny (in both size and population) majority-minority municipalities (Elizarrarás 2002).

These amount to much fewer formal powers than local governments in other systems. Mexican municipalities have no jurisdiction over public education and health, lack authority to collect other taxes, and must negotiate some fiscal resources with the state government, who may be tempted to bias redistribution of revenue sharing to municipalities (Timmons and Broid 2013)

Still, the institutional heterogeneity and variable socio-economic conditions make them very interesting for social science.

But interest in Mexico's municipal government has nonetheless grown

But, with much heterogeneity, municipal governments grew in importance between 1990 and 2010. Percent of public spending they exert... making them, and the variance they manifest, attractive areas for the study of politics and policy.

2 Municipal election data

This research note introduces a dataset of municipal election vote returns in recent decades. The dataset is distributed in a repository, publicly available at <https://github.com/emagar/elecRetrns>, that also includes returns to gubernatorial races and federal elections at different levels of aggregation.⁴

The municipal election dataset has been under construction for some time. The original seed for the 1970s and 1980s was compiled by Molinar (1991) from official vote returns by the Interior Ministry's Registro Nacional de Electores. The primary source was systematized by Magar (1994) for northern Mexico and then by Varela (2004) nationwide. Data from the 1990s onwards was compiled from the new state election regulators, who more or less routinely report vote returns since. When that was not the case, other sources were consulted, most notably *Voz y voto : política y elecciones* (1993) and *Centro de Estudios de la Democracia y Elecciones* (1991).

The unit of observation is the municipality, reporting the votes each party or electoral coalition won in periodic elections.

Data is available in a handful of states since the early 1970s, but the full cross-sectional time-series in the dataset really begins in the 1979–1981 trienium. This period, inaugurated by a major federal electoral reform (the LFOPPE), lowered legal entry barriers and adopted a more proportional electoral formula in Congress (Molinar 1991:116). As a result, half a dozen new parties entered the electoral arena. Table 1 summarizes data coverage by state, reporting the number of municipalities (which increased over the years in most states)⁵ Mexico City's populous units are included in the data despite their special status.

⁴The *Recent Mexican Election Vote Returns* repository is publicly available at <https://github.com/emagar/elecRetrns>.

⁵File `ancillary/mun.yrs.csv` in the repository reports the full listing of municipalities in each election cycle with available municipal election returns. And file `ancillary/new-mun-parents-1989on.csv` reports the parent municipalities from which the new units seceded. State abbreviations are different than those used by Mexican government agencies, some were slightly altered so that sorting them in a standard spreadsheet retains the actual

	State (abbreviation)	Number of municipalities	Years
1	Aguascalientes (ags)	9–11	1977–2024
2	Baja California (bc)	4–7	1971–2024
3	Baja California Sur (bcs)	3–5	1974–2024
4	Campeche (cam)	8–13	1979–2024
5	Coahuila (coa)	38	1978–2024
6	Colima (col)	10	1976–2024
7	Chiapas [†] (cps)	110–126	1976–2024
8	Chihuahua (cua)	67	1974–2024
9	Distrito Federal/Mexico City [‡] (df)	16	1997–2024
10	Durango (dgo)	38–39	1971–2024
11	Guanajuato (gua)	46	1979–2024
12	Guerrero [†] (gue)	75–85	1977–2024
13	Hidalgo (hgo)	84	1981–2024
14	Jalisco (jal)	124–125	1976–2024
15	México (mex)	121–125	1978–2024
16	Michoacán [†] (mic)	113	1977–2024
17	Morelos [‡] (mor)	33–36	1976–2024
18	Nayarit (nay)	19–20	1972–2024
19	Nuevo León (nl)	51	1973–2024
20	Oaxaca [†] (oax)	570	1977–2024
21	Puebla (pue)	217	1980–2024
22	Querétaro (que)	18	1973–2024
23	Quintana Roo (qui)	7–11	1978–2024
24	San Luis Potosí (san)	56–58	1970–2024
25	Sinaloa (sin)	17–20	1971–2024
26	Sonora (son)	69–72	1976–2024
27	Tabasco (tab)	17	1976–2024
28	Tamaulipas (tam)	43	1971–2024
29	Tlaxcala (tla)	44–60	1979–2024
30	Veracruz (ver)	203–212	1976–2024
31	Yucatán (yuc)	106	1981–2024
32	Zacatecas (zac)	56–58	1970–2024
Municipalities nationwide by election cycle		2375–2477	1970–2024

Table 1: Coverage of the election returns data at the municipal level. [†] Reform in these states withdrew so-called ‘usos y costumbres’ municipalities from the periodic electoral process: one municipality in Chiapas since 2021, one in Guerrero since 2018 and another since 2024, one in Michoacán since 2011, three in Morelos since 2021, and between 412 and 418 in Oaxaca since 1995. [‡] Administrative jurisdictions in the Federal District became elected offices since 1997, see the text for details.

C	D	E	F	G	J	K	L	M	N	O
yr	inegi	ife	mun	edon	v01	l01	v02	l02	v03	l03
1998	2001	2001	ENSENADA	2	30660 pan		31951 pri		12441 prd	
1998	2002	2002	MEXICALI	2	89354 pan		81676 pri		13899 prd	
1998	2003	2003	TECATE	2	4590 pan		9353 pri		4983 prd	
1998	2004	2004	TIJUANA	2	116244 pan		98669 pri		25065 prd	
1998	2005	2005	PLAYAS DE ROSARITO	2	6055 pan		5058 pri		1367 prd	
2001	2001	2001	ENSENADA	2	32262 pan-pvem		31582 pri		12048 prd	
2001	2002	2002	MEXICALI	2	95674 pan-pvem		67434 pri		11615 prd	
2001	2003	2003	TECATE	2	7796 pan-pvem		7862 pri		2066 prd	
2001	2004	2004	TIJUANA	2	108921 pan-pvem		87433 pri		13928 prd	
2001	2005	2005	PLAYAS DE ROSARITO	2	6324 pan-pvem		3141 pri		348 prd	
2004	2001	2001	ENSENADA	2	32604 pan		30839 pri-pvem-pt-pebc		13537 prd	
2004	2002	2002	MEXICALI	2	63855 pan		63892 pri-pvem-pt-pebc		9021 prd	
2004	2003	2003	TECATE	2	9216 pan		10331 pri-pvem-pt-pebc		1112 prd	
2004	2004	2004	TIJUANA	2	134428 pan		139230 pri-pvem-pt-pebc		9887 prd	
2004	2005	2005	PLAYAS DE ROSARITO	2	7056 pan		4170 pri-pvem-pt-pebc		4539 prd	

Figure 1: Screenshot with a sample of the data organization

Municipal election vote returns are distributed as a large cross-section time-series. Data is stored as text in comma-separated-values format, easily accessible for inspection with spreadsheet software such as Microsoft Excel or open-source Libreoffice Calc.⁶ In the data matrix, each row is a municipality in a given electoral year. Columns are data fields, including unit identifiers (the municipality’s name, state, census bureau ID, etc.), the election date, and the vote total that each party or coalition won.⁷

Vote returns appear in column pairs for each party or coalition: columns v01, v02, ... report raw vote totals, columns l01, l02, ... report the label of the party the votes belong to. So where PAN won 1,500 and PRI State party systems over four decades are too heterogeneous

Vote returns appear in columns v01, v02, ... and l01, l02, ..., which are paired. Columns v... report raw vote totals, columns l... report the party or coalition label the votes belong to. So a hypothetical municipality where the PAN won 1,500 and PRI State party systems over four decades are too heterogeneous

Organization of the raw data.

Figure 2 summarizes municipal elections since 1979. Plot shares PAN PRI PRD Morena Other each year: tiny points, mean and 80band

Coaliciones and candidatos comunes.

Winners in the incumbents dataset.

3 Reelection as insurance policy

Also discusses another dataset in the repository, incumbents.

alphabetical ordering of the states (e.g. Guanajuato and Guerrero are abbreviated gua and gue instead of the official gto and gro).

⁶Text is stored in UTF-8 character encryption. Care has been taken to drop most Latin American special characters, such as accented vowels, from text strings. The letter Ñ remains, and may appear as a garbled character in machines with other default encryption systems. See <https://docs.python.org/3/howto/unicode.html> for a primer on character encryption.

⁷The repository’s README.md file includes a detailed codebook describing what is in each spreadsheet column/field.

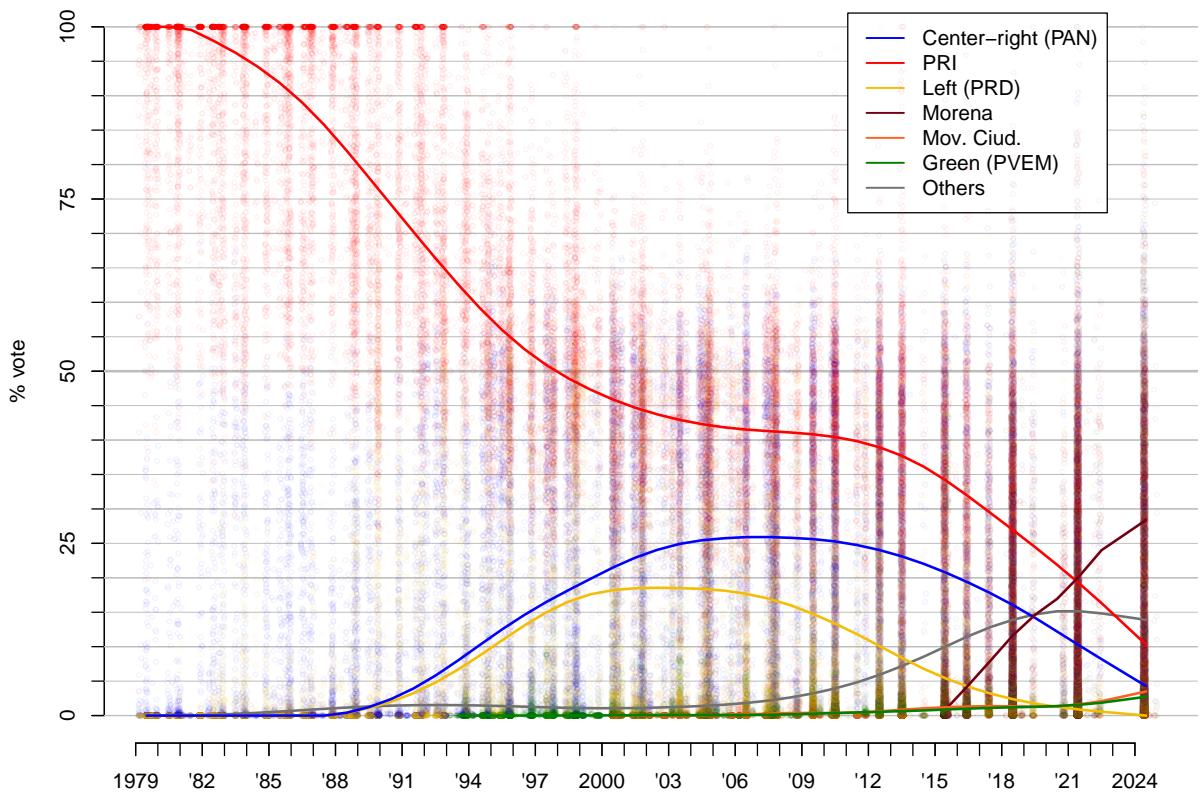


Figure 2: The evolution of electoral parties in municipal races 1979–2024. Lines are the vote percentage each party won in the median municipality across time (the trend is smoothed for clarity). Each color-coded tiny circle is one individual party’s vote percentage in one municipal election (slightly x-jittered for visibility and excluding the residual ‘others’ category).

4 The measurement of electoral history

Also discusses another dataset in the repository, `vhats`.

5 Non-fused tickets in Nayarit

Also discusses another dataset in the repository, `nayreg`.

Table [[fig:1]] presents two pairs of diagrams for the 2015 (below) and 2018 (above) congressional elections. Each dot represents one municipality, colored according to the winning party, with coordinates in the ternary plot according to the relative votes of the PAN, the PRI, and the left in the federal deputy race (other smaller parties are excluded).⁸

The left side shows the /vote forecasts/. The idea behind this statistic is summarizing the evolution of relative votes in the municipality in five previous elections (2003–2015 in the case of 2018) and using the tendency to project a vote forecast for the current year. Plots in the right side show the actual results observed in both elections.

Three features are noteworthy in 2018. The first is the discrepancy between the left and right plots. Either the model does a poor job forecasting, or 2018 was an extraordinary election. History gave license to expect a comfortable PRI victory, both in the number of municipalities won and in margins of victory. Municipalities outside the dotted bands are won by margins of 15 points or more, and the bulk of secure municipalities are red in the forecast, with Morena in a distant second place. In fact, although a significant number of municipalities migrated towards the PAN, it was Morena who showed a clear advantage. PRI was the underachiever. In contrast, the lower left and right plots reveal fewer differences between them—2015 was a more normal election, the past offering much better grounds to forecast.

Second, observed municipalities fled the edges and triangle vertices in 2018. Observations in vertices show a party that has no significant challenger. While those on the edges were bipartisan, whether more (inside dotted bands) or less (outside the bands) symmetric. It is also plain in forecasts that only the PAN–Morena edge was expected to be unpopulated. In practice, however, third party vote rarely collapsed to zero, there was much more dis-coordination than in the past. In fact, the intersection of dotted bands appeared denser and more homogeneous in the right than the left diagram.

Third, the PAN /vs/ left competition was legal tender in 2018. The pattern in competitive municipalities in the last two decades, still visible in the 2015 plots, involved either PRI–PAN or PRI–left rivalries, and rarely PAN–izquierda. It was this pattern that eased electoral alliances between PAN and PRD in sub national races since 2010 that culminated in the Frente they formed in 2018 to nominate a joint presidential candidate.

Plots in Table [[fig:4]] report /secciones electorales/ and therefore offer much finer-grained than the previous portraits. They introduce the other quantity of interest in this note: parties' /core support/. The idea behind this statistic is measuring the size of the group that has historically supported the party consistently, in good but also in bad years.

The horizontal axis in each plot measures the size of party core support groups as a proportion

⁸I must note that, for the left's electoral history (which I arbitrarily call “Morena” in the plots and distributed data), I systematically added up the votes of the PRD, PT, and MC up to 2015. I also added Morena's and PES's votes that year. In 2018 the left consisted of Morena, PT, and PES jointly.

of the /sección/’s electorate. The PRI enjoyed a clear edge over the rest of the parties in the period, with sizable cores in /all/ secciones nationwide. The distributions of the PAN and the left, in contrast, appear concentrated towards the zero—they have relatively few secciones with some unconditional support.

The vertical axis reports the three parties’ performance in 2018 (the difference between the observed vote and the forecast). Positive values indicate that the party excelled expectations in the /sección/, negative ones that it under-performed its expectation. The PRI’s electoral disaster appears all too clearly in the red plot. There were a few secciones with positive performance, but the density concentrates massively below the horizontal zero line, something that Table [[fig:1]] had hinted. What is truly remarkable is that the dismal performance is directly proportional to the size of the PRI core. President Peña and candidate Meade achieved what seemed, if not impossible, extremely improbable: they alienated the PRI’s unconditional voters in 2018. The PAN and the left met expectations in secciones where they have enjoyed with groups of support. Both (especially Morena) over-achieved where they lack important cores, taking away PRI voters.

The note elaborates how statistics were prepared (replication code can be found [[<https://github.com/emagar/mx-data-for-maps.r>][here]]).

* First differences One common approach to study electoral change is through first differences. Denoting v_t the party’s vote share in the municipality or the /sección/, in period t , the first difference is simply $d_t = v_t - v_{t-1}$.

d_t is an intuitive quantity, showing the sign and magnitude of change from one election to the next. But, precisely because it compares pairs of consecutive elections only, it misses more dynamic processes in the units. One example, well documented by electoral sociology, is the regression to the mean (Campbell 1991; Segovia 1979). Its detection requires observing the unit through at least three consecutive periods to verify contrary signs in d_{t+1} and d_t . The study of secular change in the Mexican party system in the last quarter of century calls for deeper historical perspective.

(First differences appear in the fields `d.pan` , `d.pri` , and `d.morena` in the distributed data.)

* The recent linear tendency One way of adopting it is with /vote forecasting/ from tendencies discernible in the previous five congressional races (Magar 2012). I summarize the central tendency of the recent historical vote by means of linear estimation in time, fitting a straight line for each year analyzed and each party in the municipality or /sección electoral/.

The slope of the fitted line (the tendency) serves to extrapolate the party’s electoral support to the future. For instance, to get the vote share that the recent past predicts for a party in unit u for 2018, I estimate the following equation

$$v_{ut} = a_u + b_u \times t + \text{error}_{ut}, \quad t = 2003, \dots, 2015 \quad (1)$$

that I then use to predict $\hat{v}_{u2018} = \hat{a}_u + \hat{b}_u \times 2018$. This is an out-of-sample prediction of the party’s vote share, it can be compared to the party’s actual vote share in 2018 to gauge whether or not the unit approximates the historical record. For the 2015 forecast the sample shifts one period to become $t = 2000, \dots, 2012$, and so on and so forth for previous years. I distribute forecasts for 2009, 2012, 2015, and 2018, which involved fitting about 10 thousand municipal regressions and more than 250 thousand sección-level.

(Vote forecasts appear in the fields `vhat.pan` , `vhat.pri` , and `vhat.morena` of the distributed

data.)

* The party's support core The other historical statistic is the parties' core support in the unit. Its definition stems from classifying voters in three categories: (1) support groups, that in the past have consistently supported the party; (2) opposition groups, that have consistently supported another party; and (3) swing groups, that have neither consistently supported nor consistently opposed the party (Cox and McCubbins 1986). The party core consists of the support groups.

I use the procedure by Díaz Cayeros /et al/. (2016) to estimate this core. If \bar{v}_t denotes the party's mean support across all units in period t ,⁹ for each party in each unit I fit

$$v_{ut} = \alpha_u + \beta_u \times \bar{v}_t + \text{error}_{ut}, \quad t = 1994, \dots, 2018. \quad (2)$$

β_u measures the effect that national party tides have on the party's vote in unit u . For instance, $\hat{\beta}_u = 1$ estimates that for every percentage point that the party wins or loses nationally in year t , it also wins or loses one percentage point in the unit; $\hat{\beta}_u = 0$, on the other hand, would indicate the unit's full isolation from national swings. It is therefore a measure of party volatility in the municipality or /sección/ (analogous to "beta volatility" in the financial literature).

The α coefficient estimates the core size: expected support in unit u in the hypothetical case that the party receives no vote at the national level. For instance, $\hat{\alpha} = .4$ would indicate that, in the starker of scenarios, 40

A critique that can be anticipated towards this measure of the party's support core is its extreme counter-factual nature (King and Zeng 2006). It deserves rigorous scrutiny, something I plan doing in the near future.

(The parties' core support appears in the fields `alphahat.pan`, `alphahat.pri`, and `alphahat.morena` of the distributed data. Party volatility in `betahat.pan`, `betahat.pri`, and `betahat.morena`.)

* Compositional variables I close with an important feature of the model specifications, associated with the *compositional* nature of electoral returns. Compositional variable are quantitative descriptions of the parts of a whole. They therefore have two characteristics: (1) they are proportions that (2) add up to unity.¹⁰

When estimating parties separately, the challenge of equations 1 and 2 is to avoid forecasting vote shares less than zero or greater than one; and that the sum of party forecasts equals 1. To achieve this, Aitchison (1986) proposes substituting vote shares by log-ratios in the analysis. Arbitrarily setting the PRI as the reference party, define party p 's vote relative to the PRI as

$$r_p = \frac{v_p}{v_{\text{pri}}}.$$

A value $r_p = 1$ would indicate a tie between the party and the PRI, while $r_p > 1$ that it finished ahead of the PRI in the proportion that the value reveals.

Thus, equation 1 is re-specified as

$$\ln r_{put} = a + b \times t + \text{error}$$

y equation 2 as

⁹The analyzed unit u should be dropped from period t 's mean in order to not include the dependent variable in the right side of equation 5. I do not drop it due to the large number of municipal or seccional units (each contributing a fraction to the mean) and the use of vote shares (so large units are watered down): this refinement's impact should be negligible in each mean value.

¹⁰Formally, the compositional are random variables subject to two constraints: $0 \leq v_p \leq 1 \forall p \in P$ and $\sum_P v_p = 1..$

$$\ln r_{put} = \alpha + \beta \times \bar{r}_{pt} + \text{error.}$$

Applying the natural logarithm attenuates the effect of extreme values of the regressor on the dependent variable, similar as a logit regression would. Models fitting was done with ordinary least squares.

Coefficient estimates requires transformation to collect party vote shares. Illustrating with a three-party caste, it is trivial that

$$\hat{v}_p = \frac{\hat{r}_p}{1 + \hat{r}_{pan} + \hat{r}_{morena}} \text{ and } \hat{v}_{pri} = \frac{1}{1 + \hat{r}_{pan} + \hat{r}_{morena}}. \quad (3)$$

These are the quantities that the distributed data report.

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