Going It Alone? An Empirical Study of Coalition Formation in Elections*

Sergio Montero
University of Rochester†

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Abstract

This paper studies electoral coalition formation and quantifies its impact on election outcomes. I estimate a model of electoral competition in which: (i) parties can form coalitions to coordinate their candidate nominations, and (ii) parties invest in campaign activities in support of their candidates. The model is estimated using data from the 2012 Mexican Chamber of Deputies election, which offers district-level variation in coalition formation. A comparison of election outcomes under counterfactual coalitional scenarios uncovers equilibrium savings in campaign expenditures from coalition formation, as well as significant electoral gains benefitting weaker partners.

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†Email: smontero@rochester.edu.

1 Introduction

Electoral coalitions are common in most democracies (Golder, 2006). In hopes of influencing election outcomes, like-minded political parties often coordinate their electoral strategies, typically by fielding joint candidates for office. This manipulation of the electoral supply—i.e., the alternatives available to voters—may significantly affect representation and post-election policy choices. Despite its prevalence, however, there is little evidence documenting the impact of coalition formation on election outcomes.[1]

This paper studies coalition formation in the context of legislative elections where co-ordination among coalition partners takes the form of joint candidate nominations across distinct constituencies—e.g., electoral districts. Most electoral coalitions throughout the world arise in this context (Ferrara and Herron, 2005; Golder, 2006). Specifically, I develop and estimate a structural model of electoral competition in which: (i) parties can make coalition formation commitments, which determine the menu of candidates competing in each constituency, and (ii) parties invest in campaign activities in support of their candidates. The model is used to simulate election outcomes under counterfactual coalitional scenarios. The goal is to quantitatively assess the tradeoffs involved in coalition formation as well as how it affects parties' campaign expenditures, voter behavior, and the post-election distribution of legislative power. To my knowledge, this paper is the first to address these questions empirically.

The model is estimated using data from the 2012 Mexican Chamber of Deputies election, which is appealing for two reasons. First, the Mexican Chamber of Deputies follows a mixed electoral rule whereby three fifths of the seats in the chamber are contested in first-past-the-post district races, and the remaining seats are allocated to registered parties in accordance with a national proportional representation (PR) rule. While there is considerable

[1]Existing studies of electoral (also called pre-electoral) coalitions/alliances have focused on comparing their prevalence across electoral systems, or on their role in shaping post-election government formation in parliamentary democracies (e.g., Ferrara and Herron, 2005; Golder, 2006; Carroll and Cox, 2007; Bandyopadhyay, Chatterjee, and Sjöström, 2011). With the exception of Kaminski (2001), there is no systematic evidence available of the influence of coalition formation on election outcomes.

heterogeneity across countries, most legislative elections are held under either a pure first-past-the-post system, a pure PR system, or some combination of the two (Bormann and Golder, 2013). From an institutional design perspective, studying coalition formation in a mixed electoral system such as Mexico's can help shed light on the separate roles of the two components of the election in shaping coalition formation incentives and its consequences.

Second, while elections in most democracies usually offer a single observation of coalition formation, parties in Mexico are allowed to form partial coalitions in national legislative elections: i.e., coalition partners may nominate joint candidates in only a fraction of the contested races, while running independently elsewhere.[2] In particular, in the 2012 Chamber of Deputies election, two parties, the Institutional Revolutionary Party (*Partido Revolucionario Institucional*, PRI) and the Ecologist Green Party of Mexico (*Partido Verde Ecologista de México*, PVEM), nominated joint coalition candidates in only two thirds of the electoral districts. As a result, this election offers a sample of district races, otherwise virtually identical in terms of the underlying electoral environment, where outcomes with and without coalition candidates can be observed. The structural model leverages this variation and examines PRI and PVEM's strategic choice of coalition configuration. To quantify the tradeoffs entailed by this choice as well as its impact on the election, I use the estimated model to simulate election outcomes under counterfactual PRI-PVEM coalitional scenarios.[3]

The estimation strategy mirrors the structure of the model and proceeds in three stages, exploiting insights from the empirical literature on entry and competition in markets with differentiated products. First, voters' preferences are estimated from district-level voting data following the aggregate discrete-choice approach to demand estimation popularized by Berry (1994) and Berry, Levinsohn, and Pakes (1995). Second, the parameters of parties' payoffs driving their campaign spending decisions are estimated using equilibrium necessary conditions of the campaign spending game played by parties across the electoral districts.

[2]This is not unique to Mexico: France (Blais and Indridason, 2007) and India (Bandyopadhyay, Chatterjee, and Sjöström, 2011), for instance, permit similar arrangements.

[3]While potentially interesting, an analysis of counterfactual coalitional scenarios involving other parties would be implausible due to institutional/ideological constraints discussed in Section 3.

Lastly, the remaining parameters of parties' payoffs relevant for coalition formation decisions are partially identified from moment inequalities analogous to market entry conditions.[4,5]

With the estimated structural parameters, I conduct two counterfactual experiments: I simulate the outcomes that would have prevailed in the 2012 election had PRI and PVEM either not formed a coalition or formed a total coalition instead (nominating joint candidates in all districts). These experiments yield three key findings. First, the results document substantial electoral gains for coalition partners. In terms of jointly held seats in the Chamber of Deputies, PRI and PVEM's partial coalition allowed them to close the gap to obtaining a legislative majority by almost half; and they would have closed it by 60% had they run together in all districts. These gains underscore the most basic rationale for coalition formation under first-past-the-post voting (Duverger, 1954): by nominating joint candidates, the two coalition partners avoid splitting the vote and thus raise their likelihood of victory in the district races.

Second, coalition formation impacts coalition partners asymmetrically. In fact, PRI and PVEM's joint electoral gains accrue at the expense of the stronger partner, PRI. Relative to not forming a coalition, PRI lost 6% of its seats by running with PVEM as observed in the data; and it would have lost an additional 2% had they formed a total coalition. Thus, PRI and PVEM's partial coalition arrangement constituted a compromise in balancing net gains to the coalition with PRI's losses. The offsetting pressure on the extent to which PRI and PVEM joined forces arises from the PR component of the election. Due to the way in which supporters of coalition candidates are allowed to split their vote between the nominating parties for the PR component (described in detail below), PRI's vote share suffers considerably under coalition candidacies, resulting in an overall loss of seats for PRI

[4] These entry conditions require computation of the set of campaign spending equilibria. At the estimated parameter values obtained from the first two stages, the campaign spending game played by parties exhibits (strict) strategic complementarities, facilitating computation of all equilibria (Echenique, 2007).

[5] I follow the two-step procedure of Shi and Shum (2015) for inference in this setting where only a subset of the model's parameters is partially identified via moment inequalities. See, e.g., Chernozhukov, Hong, and Tamer (2007), Beresteanu, Molchanov, and Molinari (2011), and Pakes et al. (2015) for more on estimation and inference in partially identified models.

despite significant gains for the coalition in the district races.

Finally, with regard to campaign expenditures, the counterfactual experiments uncover equilibrium savings from coalition formation. PRI and PVEM's total spending in the election was 8% lower than it would have been had the two parties not formed a coalition. By joining forces in all districts, PRI and PVEM would have saved only an additional 1%. While not explicitly modeled given the available data, these results are consistent with the intuition that the incentives to invest in campaign advertising increase with ideological proximity (e.g., Ashworth and Bueno de Mesquita, 2009). In particular, in districts where PRI and PVEM chose to run independently, their lower return to coalition formation in terms of campaign savings results from more intense competition with their ideologically closest rival. Overall, this paper is the first to empirically complement recent theoretical work examining how electoral institutions simultaneously shape strategic entry and the intensity of campaign competition (Iaryczower and Mattozzi, 2013).

The paper proceeds as follows. Section 2 describes the institutional background and provides a preliminary analysis of the data. Section 3 introduces the model. Section 4 describes the empirical strategy. Section 5 summarizes the estimation results, and Section 6, the counterfactual experiments. Section 7 discusses the main findings and concludes.

2 Mexican Elections: Background and Data

2.1 Institutional Background

Mexico is a federal republic with 31 states and the capital, Mexico City. The executive branch of the federal government is headed by the president, and legislative power is vested in a bicameral Congress. Federal elections are held every 6 years to elect a new president and new members of both chambers of Congress. Midterm federal elections to the lower chamber, the Chamber of Deputies, are held in the third year of every presidential term. No incumbent can stand for consecutive re-election.[6]

As discussed previously, the Chamber of Deputies election is held under a mixed electoral system. For electoral purposes, Mexico is divided into 300 districts.[7] The Chamber of Deputies has 500 total members, 300 of whom directly represent a district after being elected by direct ballot under first-past-the-post voting. The remaining 200 seats in the chamber are allocated proportionally to the national political parties as follows: the votes cast across the 300 district races are pooled nationally, and each party is given a share of the 200 seats proportional to the share of votes received by the party's candidates in the district races.[8] This allocation is subject to disproportionality restrictions that preclude any party from obtaining more than 300 total seats or a share of total seats that exceeds by more than 8 percentage points the party's national vote share, in which case the excess proportional representation (PR) seats are divided proportionally among the remaining parties.[9]

At stake in each Chamber of Deputies election, in addition to the composition of the legislature, is Mexican parties' funding for the subsequent three years. By law, registered parties are funded primarily from the federal budget. The baseline amount to be distributed yearly to the parties equals 65% of Mexico City's daily minimum wage multiplied by the number of registered voters in the country.[10] For campaign purposes, an additional 50% of the year's baseline is provided to the parties in presidential election years, while 30% is provided in midterm election years. The final amount is distributed as follows: 30% is divided equally among all registered parties, and the remaining 70% is divided in proportion to their national vote shares in the most recent Chamber of Deputies election. To ensure the primacy of public funding, funds from other sources are capped at 2% of the year's public

[6]Presidential re-election is prohibited. Legislators can be re-elected in non-consecutive terms.

[7]The current district lines were drawn in 2005 by the national electoral authority with the objective of equalizing population while preserving state boundaries and ensuring each state (including Mexico city) a minimum of two districts.

[8]The largest remainder method with Hare quotas (Bormann and Golder, 2013) is employed to allocate the seats. Only parties that secure at least 2% of the national vote are eligible to hold seats in the legislature; otherwise, they lose their registration and their votes are annulled.

[9]This adjustment is performed only once: if a party exceeds the 8-percentage-points restriction after an initial round of adjustment, the process does not iterate. See Section 6 for details.

[10]This totaled about 250 million USD in 2012.

funding. Thus, Mexican parties compete in this election to secure not only seats in the legislature but also their funding for day-to-day operations and campaign activities for the following three years.

Prior to each Chamber of Deputies election, parties may form coalitions, which enable them to coordinate their candidate nominations for the direct-representation (DR) district races. Coalition partners may not coordinate, however, on the PR component of the election: national lists of up to 200 PR candidates must be submitted independently by each party.

Coalition agreements are negotiated by the parties' national leadership and must be publicly registered before the national electoral authority, the National Electoral Institute (*Instituto Nacional Electoral*, INE), prior to the selection of individual candidates. The agreements constitute binding commitments specifying, for each electoral district: (i) whether the coalition partners will nominate a joint candidate or independent candidates, and (ii) in the case of a joint nomination, from which party's ranks will the coalition candidate be drawn.[11] After the election, coalition agreements imply no formal obligations for coalition victors in the legislature, who retain their original party affiliation. Thus, by supporting a partner's candidate via a joint nomination, the remaining coalition partners forgo the corresponding district seat in the chamber.

A model of coalition formation in this environment must begin by capturing this key feature of party leaders' decision problem: by running independently in a district, coalition partners risk splitting the vote and losing the district to a rival party, but a joint nomination entails an agreement about which partners should stand down altogether. Moreover, while coalition partners may not coordinate on the PR component of the election, the decision of where to run together and independently may affect the parties' national vote shares and, consequently, their share of PR seats and future funding.

[11] In 2012, prospective coalition partners had a choice from two available formats: they could either form a *partial* coalition, enabling them to nominate joint candidates in at most 200 districts, or they could from a *total* coalition, which would require them to nominate a joint candidate in every district. The PRI-PVEM coalition that is the focus of this paper was not in practice bound by the size constraint on partial coalitions, and the counterfactual experiments of Section 6 consider only the no-coalition and total-coalition extremes, so this constraint is ignored in what follows.

When deciding whether to vote for a coalition candidate, Mexican voters in fact have some control over how their vote should be counted for PR (and funding) purposes. The ballots presented to the voters on election day feature one box per registered party containing the name of the party's candidate for that district.[12] If a candidate is nominated by a coalition, their name appears inside each of the coalition partners' boxes. To cast their vote in favor of a coalition candidate, voters can mark any subset of the coalition's boxes on the ballot. Regardless of the chosen subset, the vote is counted as a single vote in favor of the coalition candidate for the purpose of selecting that district's DR deputy. However, the vote is split equally among the chosen subset for PR purposes.

For instance, a citizen who wishes to vote for a candidate nominated by parties A, B, and C could mark all three boxes on the ballot: while the candidate would receive 1 vote for the district seat, each party would get a third of her vote for PR purposes. The voter alternatively could mark only A and B's boxes, in which case A and B would each get 50% of her vote but C would get zero. Or she could just mark party A's box giving A 100% of her vote. This feature of the Mexican Chamber of Deputies election contrasts with joint-list PR systems, where votes in favor of a coalition are simply aggregated and each partner's share of PR seats is determined by the composition of their joint list (i.e., the ranking of candidates), over which the partners bargain prior to the election. In Mexico, voters have more control over the PR component of the election, and prospective coalition partners must accordingly anticipate voters' behavior to forecast their PR standing in the election.

Events in an election year unfold as follows. First, as described, coalitions are publicly registered. Next, candidates are selected and formally nominated. Campaigns then take place within a fixed timeframe, and, finally, ballots are cast.

Due to term limits and the constraints on parties' funding described above, fundraising by candidates is effectively absent from the Chamber of Deputies election.[13] Party leaders

[12]Independent candidacies or write-in campaigns are also allowed, but their vote shares are negligible. Moreover, voters supporting independent or write-in candidates effectively forgo participation in the PR component of the election.

[13]Private contributions, including candidates' personal funds, account for less than 1% of expenditures.

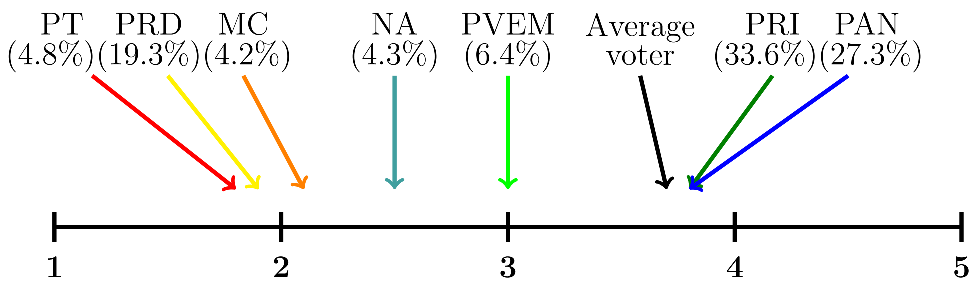
finance their candidates' campaigns directly, making a centralized decision of how much to spend in each district. In the case of coalition candidates, partners may share campaign expenditures freely, which may incentivize coalition formation. The net effect of coalition candidacies on campaign expenditures, however, depends on equilibrium responses by rival parties and is ultimately an empirical question.

2.2 The 2012 Election: Preliminary Data Analysis

Seven parties participated in the 2012 Chamber of Deputies election: 2 parties, the National Action Party (*Partido Acción Nacional*, PAN) and the New Alliance Party (*Partido Nueva Alianza*, NA), participated independently; 3 parties, the Party of the Democratic Revolution (*Partido de la Revolución Democrática*, PRD), the Labor Party (*Partido del Trabajo*, PT), and the Citizens' Movement (*Movimiento Ciudadano*, MC), joined forces in all districts in a coalition called Progressive Movement (*Movimiento Progresista*, MP); and PRI and PVEM formed a partial coalition called Commitment for Mexico (*Compromiso por México*, CM), joining forces in only 199 districts. PRI and PVEM jointly nominated a PRI candidate in 156 districts and a PVEM candidate in 43 districts (see Figure 1).

Figure 1: Districts with joint PRI-PVEM candidacies

As shown in Figure 2, which is based on a national poll of ideological identification conducted by a leading public opinion consultancy in 2012, the parties can be placed on a one-dimensional ideology spectrum as follows: from left to right, the MP parties, NA, PVEM, PRI, and PAN. Figure 2 also presents the parties' national vote shares in the 2012 election to illustrate their relative sizes. PRI, PAN, and PRD are the main political forces, in that order; together they account for more than 80% of votes nationally. Of the smaller parties, the centrist PVEM is the strongest, with nearly a third of PRD's vote share. The shares in Figure 2, however, were shaped by the coalitions that formed prior to the election. The goal of this paper is to quantify this effect.



Source: Consulta Mitofsky (2012). One thousand registered voters were asked in December 2012 to place the parties and themselves on a five-point, left-right ideology scale. Arrows point to national averages. Parties' national vote shares in the 2012 Chamber of Deputies election are shown in parentheses.

Figure 2: Left-right ideological identification of Mexican parties and voters

District-level election outcomes are published by INE. As a coalition, PRI and PVEM were quite successful, winning 122 of the 199 districts they shared: 103 victories with a joint PRI candidate (out of 156 districts) and 16 victories with a joint PVEM candidate (out of 43). Independently, PRI obtained 52 additional victories and PVEM obtained 3 (out of 101 districts). The final composition of the Chamber of Deputies, including the PR seats, is presented in Table 1 (hereafter, I treat the total coalition MP as a single party[14]). Note that PRI's proportionally smaller share of the PR seats is a consequence of the disproportionality restriction described above, which precludes any party's total share of seats from exceeding by more than 8 percentage points its national vote share. Without this constraint, PRI

[14]Historically, and in terms of policy goals, the MP parties effectively acted as a single party. In 2012, they also nominated coalition candidates in the presidential and all Senate races.

would have obtained 67 PR seats instead of 49.

Table 1: Composition of the Chamber of Deputies after the 2012 election

Party	Direct representation seats	Proportional representation seats	Total
PRI	158	49	207
PVEM	19	15	34
PAN	52	62	114
MP	71	64	135
NA		10	10
Total	300	200	500

Table 2 breaks down election outcomes by type of candidate ran by PRI and PVEM. Victory rates and average vote shares are computed for each party in each subsample of districts. For PRI and PVEM, three notable comparisons emerge. First, Table 2 suggests that, in terms of victory rates, PRI-PVEM coalition candidates outperformed their independent counterparts, underscoring the most basic rationale for coalition formation under first-past-the-post voting. Second, despite the higher victory rates, PRI and PVEM's joint vote share appears to have suffered under coalition candidacies. The two partners commanded on average a per district joint vote share of 41.6% with independent candidates, but their average joint vote share was only 40.2% with a joint PRI candidate, and 36.5% with a joint PVEM candidate. This suggests joint nominations led to a net loss of votes to rival parties.

Lastly, Table 2 also exhibits a transfer of votes between the coalition partners as a result of joint nominations: PVEM's vote share benefitted significantly from joint nominations at the expense of PRI's. To examine this transfer more closely, Table 3 shows how PRI-PVEM coalition supporters decided to split their vote between the two partners as explained in Section 2.1. While most supporters gave their vote fully to one of the two parties, in proportions roughly similar to the parties' vote shares with independent candidates, a substantial fraction of coalition supporters opted for the 50-50 split, creating a considerable tradeoff for PRI. Joint PRI candidate nominations appear to have increased the likelihood of victory for

PRI at the expense of decreasing its vote share and, thus, its share of PR seats and future funding. For PVEM, on the other hand, joint PVEM candidate nominations seem to have been unambiguously beneficial. In Section 6, these effects are reexamined after accounting for PRI and PVEM's strategic choice of where and how to run together, influenced by differences in the electorate and the competitive environment across districts.

Table 2: Election outcomes by PRI-PVEM coalition configuration

Party	Districts with distinct PRI, PVEM candidates		Districts with joint PRI candidate		Districts with joint PVEM candidate	
	Victory rate (%)	Avg. vote share (%)	Victory rate (%)	Avg. vote share (%)	Victory rate (%)	Avg. vote share (%)
PRI	51.5	36.7	66.0	33.2	-	28.7
PVEM	3.0	4.9	-	7.0	37.2	7.7
PAN	22.8	27.6	10.9	26.4	27.9	28.4
MP	22.8	25.5	21.2	29.4	34.9	31.4
NA	0	5.3	0	3.9	0	3.8

Table 3: Votes in support of PRI-PVEM coalition candidates

Type of vote	Districts with joint PRI candidate	Districts with joint PVEM candidate
	Avg. vote share (%)	Avg. vote share (%)
PRI	30.0	25.7
PVEM	3.8	4.6
50-50 split	6.4	6.1

The first two rows correspond to voters who gave 100% of their vote to the respective party (see Section 2.1). Thus, adding half of the third row to the other two yields the vote shares in Table 2.

To describe the electorate, district-level demographics from the 2010 population census are available from the National Statistics and Geography Institute (*Instituto Nacional de Estadística y Geografía*, INEGI). Table A1 in Appendix A.1 provides a summary description of the districts by type of candidate ran by PRI and PVEM, as in Table 2. The only noticeable difference in demographics across the three types of PRI-PVEM candidacies, though not statistically significant, concerns the percentage of rural neighborhoods in each district. Table A1 suggests that the coalition partners were more likely to nominate independent candidates or a joint PRI candidate in more rural districts, consistent with PRI's historical dominance among rural voters.

Finally, Table 4 summarizes campaign spending in the district races—i.e., total expenditures in support of a candidate—by type of candidate ran by PRI and PVEM. The data can be requested from INE.[15] While obtaining a detailed account of campaign activities (e.g., town hall meetings, media advertising, billboards, etc.) would be preferable, as well as information about the content of campaign advertising, the available data provide only a coarse description of monetary expenses. Consequently, I focus on total spending per candidate as a broad measure of the intensity of campaign efforts.

The model presented below features party leaders making strategic campaign spending decisions on a district-by-district basis, as opposed to simply dividing up resources by state or regionally. To evaluate this assumption, Figure A1 in Appendix A.1 maps each party's geographic distribution of campaign expenditures. As expected, there is substantial variation across neighboring districts, beyond what could be driven solely by differences in campaign costs, considering that any relatively high-spending district for one party is a relatively low-spending district for another (and vice versa).[16]

Before turning to the description of the model, I discuss a final key assumption, namely, that the identities of eventual candidates are unknown to party leaders at the time coalition formation decisions are made. Two observations lend support to this assumption. First,

[15]Campaign expenditures are self-reported by the parties to the electoral authority. These reports are subject to audits by INE, but audited data after 2006 are not yet available. For comparison, campaign expenditures were *over*reported by about 4% in 2006, while no discrepancies were found in 2003.

[16]In contrast, spending variation driven solely by cost differences would affect parties symmetrically.

Table 4: Campaign expenditures (thousands of USD)

	Districts with distinct PRI, PVEM candidates		Districts with joint PRI candidate		Districts with joint PVEM candidate	
Party	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
PRI	54.9	11.0	80.6	27.3	94.3	40.9
PVEM	18.3	7.6				
PAN	38.0	10.4	41.4	12.7	44.6	14.2
MP	56.4	19.7	55.1	11.7	56.6	14.3
NA	19.7	8.5	16.7	4.4	19.1	8.5

while party leaders may have some information regarding potential candidates, internal candidate selection processes are inherently random and thus difficult to anticipate precisely. Parties use a combination of procedures to select their candidates—most notably, primaries and appointments by local committees—which are beyond the direct control of the national leadership. Second, candidates for the district races are relatively inexperienced compared to PR candidates.[17] Career politicians with substantial influence within their party and national exposure generally don't seek district seats; they rather attempt to secure a favorable position on their party's PR list, which virtually guarantees them participation in the legislature. Indeed, this concern has fueled recent calls for reducing the number of PR legislators.[18]

3 A Model of Competition in Legislative Elections

Recall that the timing of events in the Mexican Chamber of Deputies election is as follows. First, party leaders make public coalition formation commitments. In accordance with these agreements, candidates are selected and nominated. Campaigns then take place, and finally ballots are cast. The model I develop to quantify the impact of coalition formation captures this timing in three stages: a coalition formation stage, a campaign stage, and a voting stage.

[17] Less than 3% of DR candidates in 2012 had previous experience in a federal election.

[18] One of the current president's campaign proposals in 2012 was cutting in half the number of PR seats in the Chamber of Deputies.

As mentioned previously, for the coalition formation stage, the analysis that follows focuses on PRI and PVEM's choice of coalition configuration and conditions on all other parties running as observed in the data. While potentially intriguing, alternative coalitional scenarios would not be plausible in light of ideological incompatibilities and the electoral rule's disproportionality restrictions (described in Section 2.1), which discourage coalition formation among large parties.

Before introducing the model, I develop some useful notation.

Notation. Districts are indexed by d, parties by p, and voters by i. The indicator $M_d \in \{\text{PRI}, \text{PVEM}, \text{IND}\}$ describes the menu of candidates available to voters in district d as a result of PRI and PVEM's coalition configuration: $M_d = \text{PRI}$ indicates that PRI and PVEM jointly nominate a PRI candidate in district d, $M_d = \text{PVEM}$ indicates that they jointly nominate a PVEM candidate, and $M_d = \text{IND}$ indicates that they nominate distinct candidates and thus run independently.[19]

Voting stage. Recall from Section 2.1 that, with a single ballot, voters simultaneously choose a candidate and a PR party list. If a candidate is nominated by a coalition, voters may split their vote among the nominating parties' lists. However, the selection of a candidate is the preeminent choice. The voting stage is therefore modeled as a two-tier decision: voters first select a candidate and then, if necessary, how to split their vote.

When choosing a candidate, voters care about both the nominating parties' policy platforms and the candidates' quality or valence. The policy platforms summarize the legislative objectives that each party or coalition hopes to achieve and that their candidates are expected to support if elected. Candidate quality, on the other hand, represents candidate characteristics that all voters in a district may find appealing, such as charisma, intelligence, or competence (Groseclose, 2001); it may be interpreted as individual ability to represent the district's interests in legislative bargaining. Lastly, voters may also be influenced by the

[19] Each of the three menus includes an MP candidate, an NA candidate, and a PAN candidate.

intensity of campaign efforts in support of a candidate.

Given the menu of candidates $M_d = m \in \{\text{PRI}, \text{PVEM}, \text{IND}\}$ available to voters in district d, voter i's utility from voting for candidate $j \in m$ takes the form

$$\begin{aligned} u_{ijd}^m \quad = & \quad \underbrace{\alpha_1 c_{jd} + \alpha_2 c_{jd}^2}_{\text{effect of campaign spending}} \quad + \quad \underbrace{x_d' \beta_j^m}_{\text{policy platform}} \\ & + \quad \underbrace{\xi_{jd}^m}_{\text{candidate quality}} \quad + \quad \underbrace{\epsilon_{ijd}^m}_{\text{partisanship shock}} \quad , \end{aligned} \tag{1}$$

where c_{jd} denotes campaign spending in support of candidate j, x_d is a vector of district demographics, ξ_{jd}^m measures candidate quality, and ϵ_{ijd}^m is a random utility or partisanship shock that is independent of the other components of i's utility and captures individual heterogeneity. Policy platforms influence local voting preferences by means of interactions between district demographics and menu-dependent party or coalition fixed effects; thus, the term $x_d' \beta_j^m$ measures the relative appeal—with respect to other available candidates—of j's platform for the electorate of district d. The coefficients α_1 and α_2 are common across candidates and menus. The underlying assumption is that all parties potentially have access to the same campaigning technology but spend varying amounts of effort (i.e., money) trying to persuade voters. The quadratic term $\alpha_2 c_{jd}^2$ is introduced to capture diminishing marginal returns to spending. Having common coefficients, however, does not imply a constant—across candidates, menus, or districts—marginal effect of campaign spending on vote shares (see (7) below). The effectiveness of a party's spending depends on all other components of voters' utilities.

In the style of probabilistic voting models with aggregate popularity shocks (e.g., Persson and Tabellini, 2000, chap. 3), the random utility term is assumed to have the following structure:

$$\epsilon_{ijd}^m = \eta_j^m + e_{ijd}^m, \tag{2}$$

where η_j^m and e_{ijd}^m are independently distributed with a zero-mean Type-I Extreme Value distribution. Thus,

$$\delta_{jd}^{m} = \alpha_1 c_{jd} + \alpha_2 c_{jd}^2 + x_d' \beta_j^m + \xi_{jd}^m + \eta_j^m \tag{3}$$

represents mean voter utility from voting for candidate j in district d. The term η_j^m is an aggregate—national—popularity shock; it can be viewed as a random component of voters' tastes for j's policy platform.

In every menu, voters additionally have available a compound outside option, $j = 0$, of either not voting, casting a null vote, or writing in the name of an unregistered candidate. As is standard, the mean utility of this outside option is normalized to zero: $\delta_{0d}^m = 0$. This normalization is without loss of generality for within-menu choices. Imposing a common normalization across menus provides a shared baseline against which to interpret the menu-dependent coefficients. How voters respond to changes in the electoral supply can thus be inferred from a comparison of coefficients across menus.

To complete the specification of the first tier of the voting stage, voters are assumed to behave expressively or sincerely, i.e., they choose the alternative they prefer the most without any strategic considerations. This defines a homogeneous logit model of demand in the spirit of Berry, Levinsohn, and Pakes (1995).[20] While accounting for strategic voting behavior is beyond the scope of this paper, the reward structure for parties following the Chamber of Deputies election (specifically, the proportional allocation of seats and future funding) arguably encourages expressive voting and warrants this assumption (Ferrara, 2006).[21] Moreover, the menu-dependent structure of voters' preferences implicitly allows for potentially strategic responses to changes in the electoral supply.[22]

The second tier of the voting stage takes a similar form: if the menu of candidates

[20] In related work, Gillen et al. (2015) explore alternative formulations of voters' preferences—including the workhorse random coefficients logit model of demand—using the same data from the 2012 Mexican Chamber of Deputies election. As discussed there, the results of Section 5 are fairly robust to different specifications and to the selection of demographic controls in x_d.

[21] See Kawai and Watanabe (2013) for a recent example of the challenges involved in identifying strategic voting.

[22] That is, changes in voters' attitudes based heuristically on their perception of who is likely to win in their district.

available to voters in district d contains a PRI-PVEM coalition candidate, i.e., $M_d = m \neq$ IND, then voters must decide whether to split their vote 50-50 between the coalition partners or give 100% of their vote to one of them, where voter i's utility from choosing alternative j out of these three options is

$$u_{ijd}^{\mathrm{ST},m} = x_d' \beta_j^{\mathrm{ST},m} + \xi_{jd}^{\mathrm{ST},m} + \epsilon_{ijd}^{\mathrm{ST},m}. \tag{4}$$

Here, $\beta_j^{\mathrm{ST},m}$ and $\xi_{jd}^{\mathrm{ST},m}$ are the second tier (ST) analogs of β_j^m and ξ_{jd}^m from the first tier, respectively, and $\epsilon_{ijd}^{\mathrm{ST},m}$ has the same structure as in (2) above.[23] The only difference between the two tiers is that the second tier is unaffected by campaign spending. Campaigns are candidate-centric and, as such, are assumed to affect only the first-tier candidate choice.

Campaign stage. This stage follows the coalition formation stage and corresponding candidate nominations. The objective for parties is to decide how much to spend in support of their registered candidates. Given $M_d = m$, determined in the coalition formation stage, the candidate quality terms ξ_{jd}^m are commonly observed by all parties (but unobserved by the researcher), and party leaders can tailor their spending to their candidates' relative strengths. The voters' random utility shocks, however, are unknown to the parties (and the researcher); only their distribution is known.

As discussed in Section 2, party leaders care not only about winning district races but also about their final vote share, as it determines their share of PR seats and future funding. Thus, when deciding how much to spend in each district, party leaders take into consideration both their probability of winning the district seat and their expected vote share in the district.

For analytical convenience, I assume that parties face a flexible national budget constraint. In particular, parties are assumed to make independent spending decisions across districts. The estimation strategy described below ensures that the spending levels predicted

[23]That is: $\epsilon_{ijd}^{\mathrm{ST},m} = \eta_j^{\mathrm{ST},m} + e_{ijd}^{\mathrm{ST},m}$, independently distributed with a zero-mean Type-I Extreme Value distribution.

by the model conform to the levels observed in the data. But, rather than imposing a hard national budget constraint which would significantly complicate the analysis, the model allows certain flexibility with respect to the parties' total spending under counterfactual scenarios. This assumption is not unreasonable, particularly for the 2012 election, which coincided with the senate and presidential contests. Indeed, parties are free to transfer resources between elections. While the senate and presidential contests are outside the scope of this paper, any opportunity costs of such transfers are implicitly captured by the payoff structure described below.

The campaign stage therefore features party leaders playing an independent campaign spending game in each district. The parties' payoffs are defined as follows. Given $M_d = m$, if party p enters a candidate in district d, its payoff is

$$\pi_{pd}^{m} = \theta_p^{\mathrm{PW}} \log\left(PW_{pd}^{m}\right) + \theta_p^{\mathrm{ES}} \log\left(ES_{pd}^{m}\right) - c_{pd}, \tag{5}$$

where PW_{pd}^{m} and ES_{pd}^{m} denote, respectively, party p's probability of winning and expected vote share in the district (derivations of which can be found in Appendix A.2), and c_{pd} is p's spending in support of its candidate. Thus, the coefficients θ_p^{PW} and θ_p^{ES} measure the monetary value of (the log of) PW_{pd}^{m} and ES_{pd}^{m}. This value incorporates any opportunity costs of c_{pd} as discussed above, reflecting the magnitude of each party's available resources.

For the coalition partners, if $p \in \{\mathrm{PRI}, \mathrm{PVEM}\}$ doesn't enter a candidate in district d, i.e., if $m \notin \{p, \mathrm{IND}\}$, then p's payoff is

$$\pi_{pd}^{m} = \theta_p^{\mathrm{NC}} + \theta_p^{\mathrm{ES}} \log\left(ES_{pd}^{m}\right) - c_{pd}. \tag{6}$$

In this case, the coefficient θ_p^{NC} measures the payoff from not fielding a candidate (NC: no candidate) to support one's partner's candidate instead.[24]

[24]This formulation allows partners to potentially prefer a joint nomination over having negligible chances of winning a district—by avoiding any fixed administrative or operational costs of candidate nominations.

When PRI and PVEM nominate a joint candidate, i.e., $M_d = m \neq \text{IND}$, they must jointly decide how much to spend to support her. Only their joint spending $c_{\text{PRI},d} + c_{\text{PVEM},d}$ enters (1) and determines the candidate's probability of winning and their expected vote shares. Given the quasilinear structure of parties' payoffs, I remain agnostic about how PRI and PVEM divide this amount between them and simply assume that it maximizes their joint surplus $\pi^m_{\text{PRI},d} + \pi^m_{\text{PVEM},d}$. In other words, joint spending is assumed to be Pareto optimal for the coalition. Thus, in districts where $M_d = m \neq \text{IND}$, PRI and PVEM act as a single player in the spending game against other parties, who chooses $c_{\text{PRI},d} + c_{\text{PVEM},d}$ with joint payoff $\pi^m_{\text{PRI},d} + \pi^m_{\text{PVEM},d}$.

At the estimated parameter values of the voting stage and the parties' payoffs, and regardless of the menu of candidates, the resulting campaign spending game played in each district exhibits *strict* strategic complementarities (see Appendix A.2 for details). A formal definition of this class of games can be found in Echenique and Edlin (2004). It suffices here to point out three key properties of such games. First, existence of equilibrium is guaranteed (Vives, 1990). Second, mixed-strategy equilibria are not good predictions in these games, so their omission is justified (Echenique and Edlin, 2004). Third, the set of all pure-strategy equilibria can be feasibly computed (Echenique, 2007). This implies that full consideration of potential multiplicity of equilibria is feasible. At the estimated parameter values, however, the campaign spending games also exhibit unique equilibria. Therefore, for ease of exposition, I proceed with the description of the model and the empirical strategy under the presumption that the spending game in each district has a unique equilibrium.

Coalition formation stage. This stage completes the description of the model. As noted, this stage focuses on PRI and PVEM's optimal choice of coalition configuration, i.e., where to run together and the party affiliation of coalition candidates.

Coalition formation decisions precede the candidate selection process. Thus, at this stage, PRI and PVEM don't yet know the candidate quality profiles $(\xi^m_j)_{j,m}$, only their distribution.[25] Similarly to joint spending decisions, M_d is chosen in each district to maximize PRI and PVEM's ex-ante expected joint surplus, i.e., $M_d \in \arg\max_m \mathrm{E}(\pi^m_{\mathrm{PRI},d} + \pi^m_{\mathrm{PVEM},d} | x_d)$. The expectation here is taken with respect to the campaign spending equilibrium and corresponding election outcomes induced by realizations of the candidate quality profiles.[26] This resembles nonnegative-profit entry conditions in models of market entry.

4 Empirical Strategy

The estimation strategy mirrors the model's three-stage structure. Step 1 recovers the voting stage parameters in (1) and (4). Step 2 obtains the coefficients θ^{PW}_p and θ^{ES}_p of the parties' payoffs by matching the spending levels observed in the data with the model's predictions from the campaign stage. Finally, the entry conditions of the coalition formation stage are exploited in Step 3 to partially recover $\theta^{\mathrm{NC}}_{\mathrm{PRI}}$ and $\theta^{\mathrm{NC}}_{\mathrm{PVEM}}$.

Step 1. The voting stage is estimated following the discrete choice approach to demand estimation (Berry, Levinsohn, and Pakes, 1995). Given that districts are large (>185,000 registered voters), by a law of large numbers approximation, candidate j's observed vote share in district d can be written in the familiar multinomial logit form:

$$S^{M_d}_{jd} = \frac{\exp(\delta^{M_d}_{jd})}{1 + \sum_{k \neq 0} \exp(\delta^{M_d}_{kd})}. \tag{7}$$

After taking logs and subtracting the logged share of the outside option, (7) yields the linear demand system:

$$\log(S^{M_d}_{jd}) - \log(S^{M_d}_{0d}) = \delta^{M_d}_{jd} = \alpha_1 c_{jd} + \alpha_2 c^2_{jd} + x'_d \beta^{M_d}_j + \xi^{M_d}_{jd} + \eta^{M_d}_j. \tag{8}$$

[25]The ξ^m_j are independent, following a Normal distribution with mean zero and standard deviation σ^m_j.

[26]Given the structure of the model, there is a unique optimal coalition configuration almost surely.

The second-tier coefficients in (4) are recovered analogously: letting $S_{pd}^{\mathrm{ST},m}$ and $S_{0d}^{\mathrm{ST},m}$ denote, respectively, the shares of PRI-PVEM coalition supporters who give their vote fully to $p \in \{\mathrm{PRI}, \mathrm{PVEM}\}$ or who split their vote 50-50, it follows that

$$\log(S_{pd}^{\mathrm{ST},M_d}) - \log(S_{0d}^{\mathrm{ST},M_d}) = \delta_{jd}^{\mathrm{ST},M_d} = x'_d \beta_j^{\mathrm{ST},M_d} + \xi_{jd}^{\mathrm{ST},M_d} + \eta_j^{\mathrm{ST},M_d}. \tag{9}$$

Identification of the voting stage parameters is obtained as follows. First, recall from the coalition formation stage that PRI and PVEM's choice of coalition configuration, M_d, conditions only on observable district characteristics, x_d; all other components of voters' utilities in (1) and (4) are unknown to the coalition partners at the time of their decision. This selection on observables implies that, for all menus m, ξ_{jd}^m and η_j^m (and their ST counterparts) are independent of M_d conditional on x_d, ensuring no correlation between observables (excluding campaign spending) and the error terms in (8) and (9). To see this, given that $x'_d \beta_j^{M_d} = \sum_m (x'_d \cdot \mathbf{1}_{M_d=m}) \beta_j^m$, $\xi_{jd}^{M_d} = \sum_m \xi_{jd}^m \cdot \mathbf{1}_{M_d=m}$, and $\mathrm{E}(\xi_{jd}^m | x_d, M_d) = 0$, iterating expectations yields $\mathrm{E}[(x'_d \cdot \mathbf{1}_{M_d=m}) \xi_{jd}^{M_d}] = \mathrm{E}[(x'_d \cdot \mathbf{1}_{M_d=m}) \xi_{jd}^m] = \mathrm{E}[(x'_d \cdot \mathbf{1}_{M_d=m}) \mathrm{E}(\xi_{jd}^m | x_d, M_d)] = 0$. A similar argument holds for $\eta_j^{M_d}$.

Second, instrumental variables are required to tackle the endogeneity of c_{jd} and identify α_1 and α_2. Here, I exploit the prohibition of consecutive re-election as well as the scarcity of candidates competing in consecutive elections (less than 1%) to instrument for c_{jd} using campaign spending data from the 2009 Chamber of Deputies election. The validity of this instrument relies on adequately controlling for persistent determinants of local partisanship via x_d, which induce district-level correlation in spending across time, while assuming that the determinants of candidate valence are independent across elections. The lack of incumbents or experienced candidates provide support for this assumption. A potential concern is that candidates or other unobservables may have a persistent influence on local partisanship. As these effects are likely to decay over time, in future iterations of the paper I intend to test this concern by collecting spending data from elections further back in time.

In addition to spending data from the 2009 election, I also use district surface area as a cost shifter driving variability in campaign spending through its impact on candidates' travel costs. To mitigate concerns of a direct impact of surface area on partisanship, I control for broad geographic and socioeconomic characteristics of the districts via x_d, as well as directly for the percentage of the electorate living in rural communities, which is a strong predictor of support for PRI (e.g., Larreguy, Marshall, and Querubin, 2016).

Estimation of (8)-(9) and inference proceed using standard methods for linear random-effects (due to the aggregate popularity shocks) panel data models. The residuals of (8) and (9)—demeaned for each (j, m) pair to difference out the random effects η_j^m and $\eta_j^{\text{ST},m}$—deliver consistent estimates of $\xi_{jd}^{M_d}$ and ξ_{jd}^{ST,M_d}, which are required for Step 2. Moreover, the standard deviations of these residuals yield estimates of their population counterparts—recall that $\xi_{jd}^m \overset{\text{i.i.d.}}{\sim} N(0, (\sigma_j^m)^2)$, and similarly $\xi_{jd}^{\text{ST},m} \overset{\text{i.i.d.}}{\sim} N(0, (\sigma_j^{\text{ST},m})^2)$—which are necessary to simulate counterfactuals.

Step 2. The parameters θ_p^{PW} and θ_p^{ES} driving party leaders' campaign spending decisions are estimated by fitting predicted to observed campaign spending levels. These parameters are identified from variation in party leaders' targeting of different district races. A party that cares relatively more about winning, θ_p^{PW}, than about their vote share, θ_p^{ES}, is expected to carry out more targeted spending, focusing on competitive races. In contrast, a party that cares relatively more about their vote share is likely to spend more evenly across districts.

Estimation of θ_p^{PW} and θ_p^{ES} proceeds as follows. For each party $p \notin \{\text{PRI}, \text{PVEM}\}$, let $\hat{c}_p = (\hat{c}_{pd})_{d \in \{1,\ldots,300\}}$ denote the party's spending levels as observed in the data, and let $\tilde{c}_p = (\tilde{c}_{pd})_{d \in \{1,\ldots,300\}}$ denote their predicted counterparts. These predictions are computed as equilibrium best responses to observed spending. That is, given the estimates of the voting stage and candidate qualities obtained from Step 1, and for each possible value of $\theta_p = (\theta_p^{\text{PW}}, \theta_p^{\text{ES}}) \in \mathbb{R}_+^2$, I simulate p's best responses to its rivals' observed spending in each district, collected in $\tilde{c}_p$. I omit the dependence of these predictions on the estimates from

Step 1 and simply write $\tilde{c}_p = \tilde{c}_p(\theta_p)$. Then θ_p is estimated by minimizing the distance between $\hat{c}_p$ and $\tilde{c}_p(\theta_p)$, i.e., by minimizing the norm:

$$Q_p(\theta_p) = \big(\hat{c}_p - \tilde{c}_p(\theta_p)\big)' W_p \big(\hat{c}_p - \tilde{c}_p(\theta_p)\big),$$

where W_p is a positive definite, diagonal weighting matrix. I initially estimate θ_p using the identity as weighting matrix. I then re-weight each district d by the reciprocal of the variance of the prediction error for the subsample of districts with the same menu of candidates as d.

For PRI and PVEM, $\theta_{\text{PRI}} = (\theta^{\text{PW}}_{\text{PRI}}, \theta^{\text{ES}}_{\text{PRI}})$ and $\theta_{\text{PVEM}} = (\theta^{\text{PW}}_{\text{PVEM}}, \theta^{\text{ES}}_{\text{PVEM}})$ are estimated similarly. Let $\hat{c}$ be a stacking of PRI and PVEM's observed joint spending levels along with their observed individual spending levels. That is, $\hat{c}$ contains 199 observations corresponding to the districts where PRI and PVEM ran together, plus 2×101 observations corresponding to the 101 districts where they ran independently. Let $\tilde{c}$ collect their predicted counterparts. Then θ_{PRI} and θ_{PVEM} are estimated by minimizing

$$Q_{\text{PRI-PVEM}}(\theta_{\text{PRI}}, \theta_{\text{PVEM}}) = \big(\hat{c} - \tilde{c}(\theta_{\text{PRI}}, \theta_{\text{PVEM}})\big)' W_{\text{PRI-PVEM}} \big(\hat{c} - \tilde{c}(\theta_{\text{PRI}}, \theta_{\text{PVEM}})\big),$$

as before.

Bootstrapped standard errors, accounting for the estimation error from Step 1, are obtained for these estimates.

Step 3. Finally, the parameters $\theta^{\text{NC}}_{\text{PRI}}$ and $\theta^{\text{NC}}_{\text{PVEM}}$ are partially identified from the moment inequalities implied by the optimality of M_d for the PRI-PVEM coalition in each district. Recall from Section 3 that $M_d \in \arg\max_m \text{E}(\pi^m_{\text{PRI},d} + \pi^m_{\text{PVEM},d} | x_d)$. This implies that $\text{E}(\pi^{M_d}_{\text{PRI},d} + \pi^{M_d}_{\text{PVEM},d} | x_d) \geq \text{E}(\pi^m_{\text{PRI},d} + \pi^m_{\text{PVEM},d} | x_d)$ for all $m \in \{\text{PRI}, \text{PVEM}, \text{IND}\}$, which in turn implies the unconditional moment inequality

$$\text{E}\big(\pi^{M_d}_{\text{PRI},d} + \pi^{M_d}_{\text{PVEM},d} - (\pi^m_{\text{PRI},d} + \pi^m_{\text{PVEM},d})\big) \geq 0 \tag{10}$$

for each m. Computation of (10) is via simulation, and it involves the estimates from Steps 1 and 2.

Shi and Shum (2015) propose a simple inference procedure for models with such a structure: i.e., models where a subset of parameters is point identified and estimated in a preliminary stage—in this case, Steps 1 and 2—and the remaining parameters are related to the point-identified parameters via inequality/equality restrictions—in this case, the inequalities in (10). To implement their procedure, which requires both equalities and inequalities, I introduce slackness parameters as suggested by Shi and Shum: for each m, (10) becomes an equality restriction,

$$\mathrm{E}\big(\pi^{M_d}_{\mathrm{PRI},d} + \pi^{M_d}_{\mathrm{PVEM},d} - (\pi^{m}_{\mathrm{PRI},d} + \pi^{m}_{\mathrm{PVEM},d})\big) + \gamma_m = 0,$$

and the slackness parameters must satisfy $\gamma_m \geq 0$. A criterion function is constructed as follows. With a slight abuse of notation, let β be a vector collecting the output of Steps 1 and 2, and let $\theta = (\theta^{\mathrm{NC}}_{\mathrm{PRI}}, \theta^{\mathrm{NC}}_{\mathrm{PRI}}, \gamma_{\mathrm{PRI}}, \gamma_{\mathrm{PVEM}}, \gamma_{\mathrm{IND}})$. Then, following Shi and Shum's notation, define $g^e(\theta, \beta) = (g^e_m(\theta, \beta))_{m\in\{\mathrm{PRI},\mathrm{PVEM},\mathrm{IND}\}}$ by

$$g^e_m(\theta, \beta) = \mathrm{E}\big(\pi^{M_d}_{\mathrm{PRI},d} + \pi^{M_d}_{\mathrm{PVEM},d} - (\pi^{m}_{\mathrm{PRI},d} + \pi^{m}_{\mathrm{PVEM},d})\big) + \gamma_m,$$

and let $g^{ie}(\theta) = (g^{ie}_m(\theta))_{m\in\{\mathrm{PRI},\mathrm{PVEM},\mathrm{IND}\}} = (\gamma_m)_{m\in\{\mathrm{PRI},\mathrm{PVEM},\mathrm{IND}\}}$. Thus, g^e summarizes the equality restrictions involving all the parameters of the model, and g^{ie} summarizes the inequality restrictions involving only θ. Letting β_0 denote the true value of β, the identified set of θ is

$$\Theta_0 = \{\theta : g^e(\theta, \beta_0) = 0 \text{ and } g^{ie}(\theta) \geq 0\}.$$

The criterion function is defined by

$$Q(\theta, \beta; W) = g^e(\theta, \beta)' W g^e(\theta, \beta),$$

where W is a positive definite matrix. It follows that $\Theta_0 = \arg\min_\theta Q(\theta, \beta_0; W)$ subject to $g^{ie}(\theta) \geq 0$. Shi and Shum show that the following is a confidence set of level $\alpha \in (0,1)$ for Θ_0:

$$CS = \{\theta : g^{ie}(\theta) \geq 0 \text{ and } Q(\theta, \hat{\beta}, \hat{W}) \leq \chi^2_{(3)}(\alpha)/N\},$$

where $\chi^2_{(3)}(\alpha)$ is the α-th quantile of the χ^2 distribution with 3 degrees of freedom (the number of restrictions in g^e), $\hat{\beta}$ a consistent estimator of β_0 (obtained from Steps 1 and 2), N is the number of observations used to estimate $\hat{\beta}$, and

$$\hat{W} = \left[G(\theta, \hat{\beta})\hat{V}_\beta G(\theta, \hat{\beta})'\right]^{-1}$$

with $G(\theta, \hat{\beta}) = \partial g^e(\theta, \hat{\beta})/\partial \beta'$ and $\hat{V}_\beta$ a consistent estimate of the asymptotic variance of $\hat{\beta}$.

As $g^e(\theta, \beta)$ and $g^{ie}(\theta)$ are in fact linear in θ (recall (6)), $Q(\theta, \hat{\beta}; \hat{W})$ has a unique minimizer subject to $g^{ie}(\theta) \geq 0$, which provides a useful point estimate for the counterfactual experiments of Section 6. Moreover, CS is convex, so upper and lower bounds of marginal confidence intervals for $\theta^{\text{NC}}_{\text{PRI}}$ and $\theta^{\text{NC}}_{\text{PRI}}$ can be computed by optimizing $f_p(\theta) = \theta^{\text{NC}}_p$ subject to $\theta \in CS$.[27]

5 Estimation Results

This section summarizes the main estimation results. The discussion follows the structure of the model, beginning with the voting stage. A goodness of fit evaluation of the model is also provided.

Estimates of voters' preferences. Tables A2-A4 in Appendix A.1 present estimates of the coefficients β^m_j capturing voters' menu-dependent preferences for candidate j's policy platform across the three menus $M_d = m \in \{\text{PRI}, \text{PVEM}, \text{IND}\}$. The estimates are overall

[27] As discussed by Shi and Shum, the slackness parameters, γ_m, are nuisance parameters which may lead to conservative confidence sets for the parameters of interest. This does not seem to be a problem in this application, however, as the confidence intervals reported in Section 5 are fairly tight.

consistent with well-known historic patterns of partisanship in Mexico: e.g., older voters tend to support the establishment parties, PRI and PAN; Mexico City (in Region 4) is a key MP stronghold; and rural voters tend to support PRI.

Regarding the second-tier choice for PRI-PVEM coalition supporters of how to split their vote between the two parties, Tables A5 and A6 show estimates of the coefficients describing the choice of giving 100% of their vote to one of the two parties. The outside option here is splitting the vote 50-50. Again, older voters and rural voters tend to support PRI.

Table 5 reports estimates of α_1 and α_2, the parameters describing the persuasive effect of campaign spending on voters' preferences. The first column presents ordinary least squares (OLS) estimates, while the second column controls for the endogeneity of spending via two-stage least squares (2SLS), as explained in Section 4. Both sets of estimates indicate that campaign spending has a significant and positive effect on voters' preferences, mitigated by diminishing marginal returns. However, OLS considerably underestimates the overall persuasiveness of campaign spending. The 2SLS estimates imply that, for a candidate with an average vote share ($\sim$23%) and average spending ($\sim$45,000 USD), a 1% increase in campaign spending raises her vote share by about 1.4%. In contrast, the same calculation using the OLS estimates yields an increase of only 0.15%.

One of the key features of the model described in Section 3 is that party leaders play independent campaign spending games across districts. Of particular concern for this assumption is the potential for media spillovers across neighboring districts. To test for the presence of spillovers, the third column of Table 5 presents estimates from an alternative specification of (8) that adds a term, $\alpha_3 \bar{c}_{jd}$, capturing the effect of j's average spending in neighboring districts, $\bar{c}_{jd}$, on j's vote share in district d. As shown in Table 5, the 2SLS estimate of α_3 is small and statistically insignificant, providing no evidence of considerable media spillovers.

Table 5: Estimates of effect of campaign spending on vote shares

Coefficient	OLS (1)	2SLS (2)	2SLS (3)
Spending	0.078	0.664	0.780
	(0.018)	(0.336)	(0.359)
Spending^2	-0.004	-0.030	-0.035
	(0.001)	(0.016)	(0.016)
Spending in neighboring districts			-0.019
			(0.047)
R-squared		0.835	0.824
First-stage F test (p-value)		0.000	0.000
Observations	1301	1301	1301

Ordinary (column 1) and two-stage least squares (column 2) estimates of the persuasive effect of campaign spending from equation (8) with robust standard errors clustered by district in parentheses. Column 3 tests for the presence of media spillovers across neighboring districts.

Estimates of parties' payoffs. Table 6 presents estimates of the coefficients θ_p^{PW} and θ_p^{ES} of parties' payoffs measuring the relative weight they place on their probability of winning or expected vote share. With the sole exception of NA, the results suggest that parties care primarily about their expected vote share when deciding how much to spend in a district. This is not surprising considering that their funding for the following three years and the number of PR seats they receive are both tied to their final vote share in the election. NA appears to have placed substantial weight on its probability of winning, though it was ultimately unsuccessful in the district races.

Table 7 reports 95% confidence intervals for the partially identified parameters $\theta_{\text{PRI}}^{\text{NC}}$ and $\theta_{\text{PVEM}}^{\text{NC}}$ of PRI and PVEM's payoffs when they don't enter a candidate in a district. Point estimates, which are necessary for the counterfactual experiments of Section 6, can be obtained as $\theta_{\text{PRI}}^{\text{NC}} = -1.951$ and $\theta_{\text{PVEM}}^{\text{NC}} = -0.650$. These values can be interpreted as direct compensation (in tens of thousands of USD) the parties demand in exchange for supporting their partner's candidate, revealing their relative bargaining power in the choice of

Table 6: Estimates of parties' payoffs

Party	θ_p^{PW}	θ_p^{ES}
MP	0.002	5.215
	(0.195)	(2.065)
NA	1.857	0.001
	(0.498)	(0.307)
PVEM	0.001	2.289
	(0.320)	(1.152)
PRI	0.623	4.571
	(0.311)	(2.677)
PAN	0.986	2.707
	(0.605)	(1.477)

Estimates of weights on probability of winning and expected vote share. Bootstrapped standard errors in parentheses.

coalition candidates.

Goodness of fit. To evaluate the performance of the model, Table 8 provides a comparison of the model's main predictions with their counterparts in the data. The predictions are computed from an ex-ante perspective—i.e., before candidate qualities are known—as follows. Conditional on PRI and PVEM's observed coalition configuration, one thousand elections are simulated by drawing candidate qualities for each district, calculating the campaign spending equilibria played by the parties, and computing the resulting election outcomes.

Table 7: Confidence set for $\theta_{\text{PRI}}^{\text{NC}}$ and $\theta_{\text{PVEM}}^{\text{NC}}$

	θ_p^{NC}
Party	Confidence interval (95%)
PVEM	$[-2.052, -0.027]$
PRI	$[-2.180, -0.351]$

From these simulations, 95% confidence intervals are constructed for each party's final vote share and number of seats, as shown in Table 8.

Despite its parsimonious structure, the model overall fits the data well; it only slightly underestimates PAN and NA's performance.

Table 8: Goodness of fit: observed versus predicted seats and vote shares

	Vote share (%)		Seats	
Party	Observed	Predicted (95% conf. interval)	Observed	Predicted (95% conf. interval)
PRI	33.6	$[33.4, 35.6]$	207	$[205, 217]$
PVEM	6.4	$[6.0, 6.7]$	34	$[31, 43]$
PAN	27.3	$[25.5, 27.0]$	114	$[90, 112]$
MP	28.3	$[27.9, 30.2]$	135	$[131, 155]$
NA	4.3	$[3.7, 4.1]$	10	$[8, 10]$

6 Counterfactual Experiments

To quantify the extent to which the PRI-PVEM partial coalition affected election outcomes and the composition of the Chamber of Deputies in 2012, I conduct two counterfactual experiments. First, I study what would have happened had PRI and PVEM not formed a coalition. That is, I simulate election outcomes (as described above) imposing $M_d = \text{IND}$ in all districts where PRI and PVEM nominated a joint coalition candidate. Second, at the other extreme, I examine the effects of constraining PRI and PVEM to form a *total* coalition. For this experiment, in all districts where PRI and PVEM ran independently, I force PRI and PVEM to run together by restricting the choices available to them in the coalition formation stage of the model to $M_d \in \{\text{PRI}, \text{PVEM}\}$. Thus, PRI and PVEM are constrained to run together in all districts, but they optimally select the party affiliation of their coalition candidates.

Before turning to the aggregate election results, I take a district-level look at the tradeoffs the coalition partners faced when choosing their coalition configuration. For each electoral district, I simulate PRI and PVEM's expected equilibrium spending and vote shares across the three possible menu choices $m \in \{\mathrm{PRI}, \mathrm{PVEM}, \mathrm{IND}\}$. To illustrate the main patterns that emerge, Figure 3 presents a national average of PRI and PVEM's vote shares under the three choices. As noted in Section 2.2, by nominating joint candidates and not splitting the vote, PRI and PVEM raise their likelihood of winning in the district races by increasing their candidates' vote share. For PVEM, the increase is vast: while independent PVEM candidates have negligible chances of winning their district with a 4.3% average vote share, coalition PVEM candidates are competitive in most districts. For PRI candidates, an increase in average vote share from 36.2% to 40.3% is sufficient to secure a number of victories in competitive districts as discussed below.

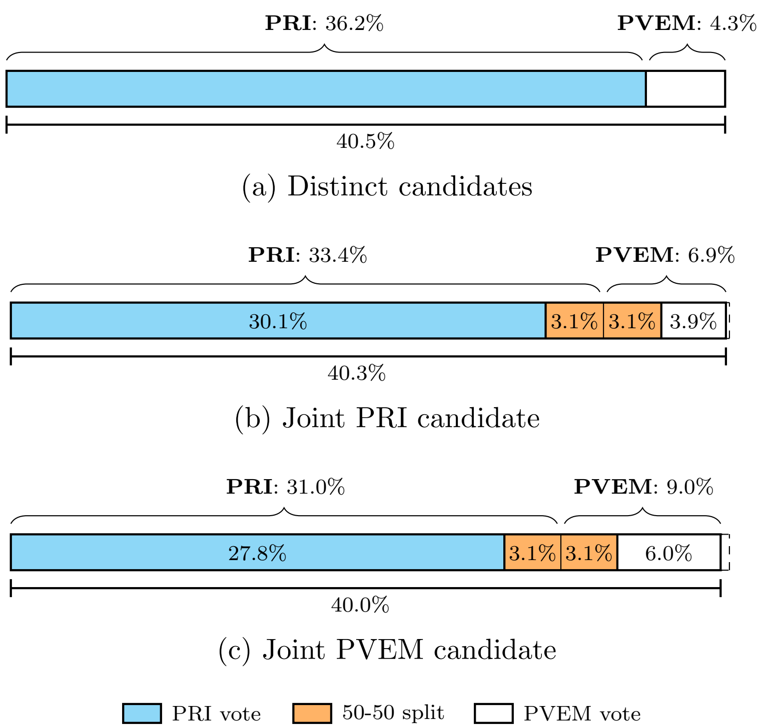


Figure 3: Counterfactual vote shares by type of candidate nomination

Figure 3 also confirms the tradeoff for PRI previewed in Section 2.2: with coalition candidates, PRI's vote share drops considerably as a result of coalition supporters splitting their vote between the two partners for the PR component of the election. Not surprisingly, each party performs better in terms of vote share with a coalition candidate drawn from its own ranks.

Finally, with regard to district-level equilibrium campaign expenditures, a comparison of PRI and PVEM's joint spending under the three types of candidacies yields two key findings. First, in over 90% of the districts, PRI and PVEM's equilibrium spending is lower with coalition candidates than with independent candidates. Moreover, consistent with the intuition that the incentives to invest in campaign advertising increase with ideological proximity (Ashworth and Bueno de Mesquita, 2009), the savings from coalition formation are larger with a PVEM coalition candidate, who is closer ideologically to a weaker party, NA (see Figure 2), than with a PRI coalition candidate, who is closer ideologically to a stronger party, PAN. PRI and PVEM save on average 11% with a PVEM coalition candidate and 6.7% with a PRI coalition candidate.

In sum, for PVEM, coalition formation is unambiguously beneficial, considering that independent PVEM candidates are unlikely to win, so that forgoing a district by supporting a PRI candidate imposes little to no cost on PVEM while increasing its vote share and lowering expenditures. For PRI, however, coalition candidacies result in substantial campaign savings, and PRI coalition candidates have an increased likelihood of winning their district, but these benefits come at the expense of a reduced vote share that negatively impacts PRI's future funding and share of PR seats. The two partners' observed coalition configuration (101 districts with independent candidates, 156 with joint PRI candidates, and 43 with joint PVEM candidates) constituted a compromise in optimally balancing these tradeoffs. Had the parties been constrained to join forces in all districts, they would have nominated joint PRI candidates in 94 of the 101 districts where they ran independently.

Turning now to the aggregate election results, Table 9 reports the main results of the two counterfactual experiments described above. For comparison, the first column reproduces the outcomes observed in the data. The second column reports predicted counterfactual vote shares and seats for each party under the no PRI-PVEM coalition treatment, and the third column reports their counterparts under the total PRI-PVEM coalition treatment. Relative to not forming a coalition, by running with PRI as observed in the data, PVEM managed to secure almost thrice as many seats—13 versus 34—and to increase its vote share by about 49%—from 4.3% to 6.4%. Forming a total coalition would have given PVEM 6 additional seats and raised its vote share to 7.5%. On the other hand, by running as observed, PRI lost 6% of its seats—221 versus 207—and 7% of its vote share—36.2% versus 33.6%. By running together with PVEM in all districts, PRI would have additionally lost 3 seats and 0.7 percentage points in vote share. Overall, however, the PRI-PVEM coalition obtained net gains in terms of jointly held seats in the chamber. By running as observed, PRI and PVEM closed the gap to obtaining a legislative majority (i.e., 251 seats) by almost half—from 17 seats to 10; and they would have closed it by 59% had they run together in all districts—from 17 to 7 seats .

Table 10 breaks down the seat counts in Table 9 by type of seat—i.e., direct representation (DR) seats and PR seats. The DR seat counts reveal that there are relatively few competitive districts in Mexico. Relative to not forming a coalition, PRI and PVEM managed to steal 12 district seats from their rivals with their partial coalition; and they could have doubled these gains by joining forces in all districts. PRI, however, is severely constrained by the disproportionality restriction on the PR component of the election described in Section 2. The exact form of the restriction is as follows: if a party's vote share is S_p, it cannot hold more than $\lfloor 500(S_p + 0.08) \rfloor$ total seats. Notice that, across the three columns of Table 9, PRI is bound by this restriction, which undermines the coalition's DR seat gains.[28]

With regard to total expenditures in the election, Table 11 shows how each party's average spending per district would have changed under the two counterfactual scenarios. PRI and PVEM saved 8% with their partial coalition compared to the no coalition scenario;

[28]That is, $207 = \lfloor 500(0.335953 + 0.08) \rfloor$, $221 = \lfloor 500(0.362 + 0.08) \rfloor$, and $204 = \lfloor 500(0.329 + 0.08) \rfloor$.

Table 9: Counterfactual outcomes under no coalition or total coalition

	Vote share (%)		
Party	Observed	No coalition	Total coalition
PRI	33.6	(+2.6 =) 36.2	(−0.7 =) 32.9
PVEM	6.4	(−2.1 =) 4.3	(+1.1 =) 7.5
PAN	27.3	(−0.1 =) 27.2	(−0.5 =) 26.8
MP	28.3	(−0.8 =) 27.5	(+0.6 =) 28.9
NA	4.3	(+0.5 =) 4.8	(−0.4 =) 3.9
	Seats		
Party	Observed	No coalition	Total coalition
PRI	207	(+14 =) 221	(−3 =) 204
PVEM	34	(−21 =) 13	(+6 =) 40
PAN	114	(+3 =) 117	(−6 =) 108
MP	135	(+3 =) 138	(+3 =) 138
NA	10	(+1 =) 11	(+0 =) 10

Differences in parentheses are with respect to first column. Second and third columns correspond to counterfactual outcomes had PRI and PVEM run independently or together in all districts, respectively.

Table 10: Counterfactual outcomes by type of seat

	Observed		No coalition		Total coalition	
Party	DR seats	PR seats	DR seats	PR seats	DR seats	PR seats
PRI	158	49	162	59	167	37
PVEM	19	15	3	10	22	18
PAN	52	62	57	60	43	65
MP	71	64	78	60	68	70
NA		10		11		10

and they would have saved only an additional 1% with a total coalition. As Table 10 shows, joining forces in the districts where they chose to run independently would have required competing primarily with PAN, their strongest ideological neighbor, resulting in more intense campaign competition as evidenced by their lower returns to coalition formation in terms of campaign savings. It is also interesting to note that, with the sole exception of MP, spending is increasing in the number of competing candidates, again consistent with the intuition that a more crowded—and hence less polarized—field fosters more intense competition.

Table 11: Counterfactual spending (in thousands of USD)

	Average spending per district		
Party	Observed	No coalition	Total coalition
PRI+PVEM	80.1	86.6	79.4
PAN	40.7	41.7	40.6
MP	55.8	55.3	55.8
NA	18.1	18.6	17.9

Finally, in terms of total surplus for the coalition partners, the model reveals that, had the two parties been constrained to choose only between not forming a coalition or forming a total one, as is the case in many countries, they would have nonetheless joined forces in the election.

7 Concluding Remarks

This paper studies electoral coalition formation and quantifies its impact on election outcomes. I propose and estimate a structural model of electoral competition, using Mexican legislative election data, and utilize it to examine the effects of counterfactual coalitional scenarios. The results document significant electoral gains from coalition formation, and in particular the willingness of an electorally strong but capacity-constrained party to sacrifice its individual position in order to substantially build up a weaker partner. The results also uncover considerable savings in campaign expenditures from coalition formation.

While post-election legislative bargaining is not explicitly considered in this paper, the results are suggestive of the importance of electoral coalition formation as a preliminary stage of the legislative bargaining process. Parties may use electoral coalitions to pre-select and foster legislative bargaining partners. However, electoral coalitions are not mergers, and post-election disagreements among electoral coalition partners are not uncommon. Further research is needed to study the dynamics of these interactions in order to fully understand the role of electoral institutions in shaping both electoral and legislative output.

The potential for financial incentives in coalition formation had been previously unrecognized. In settings where parties and candidates are not publicly funded, these incentives may be even stronger, as coalition partners can share the burdens of fundraising. Moreover, potential donors may be more willing to back coalition candidates with broader support, further prompting parties to make joint nominations. Understanding the role of fundraising in coalition formation is left for future research.

Lastly, the results indicate that coalition formation can lead to an overall reduction in total campaign expenditures. The net welfare impact of this effect hinges on whether campaign advertising provides valuable information to voters. Martin (2014) finds, using data from U.S. Senate and gubernatorial elections, that the informational content of campaign advertising is limited: political campaigns have a primarily persuasive, rather than informative, effect on voter behavior. As noted by Iaryczower and Mattozzi (2013), however, the equilibrium relationship between the number of competing candidates and the intensity of campaign competition may be very sensitive to the institutional environment.

Appendix

A.1 Figures and Tables

Table A1: District characteristics

Variable	Districts with distinct PRI, PVEM candidates		Districts with joint PRI candidate		Districts with joint PVEM candidate	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Female voting-age population (% voting-age pop.)	51.9	1.5	52.3	1.4	52.7	1.3
Pop. 18 to 24 (% voting-age pop.)	20.0	1.5	19.9	2.2	19.1	2.2
Pop. over 64 (% voting-age pop.)	10.6	2.6	9.5	2.8	10.1	2.5
Voting-age pop. with no post-elementary education (% voting-age pop.)	67.9	12.5	63.6	13.4	57.0	14.0
Unemployment rate	4.7	1.6	4.4	1.1	4.6	1.0
Households with a fridge (%)	79.7	16.3	80.7	15.2	87.3	11.1
Households with a car (% total)	45.3	17.7	41.0	14.7	47.9	14.0
Rural neighborhoods (%)	36.4	25.9	23.7	25.3	18.3	25.3

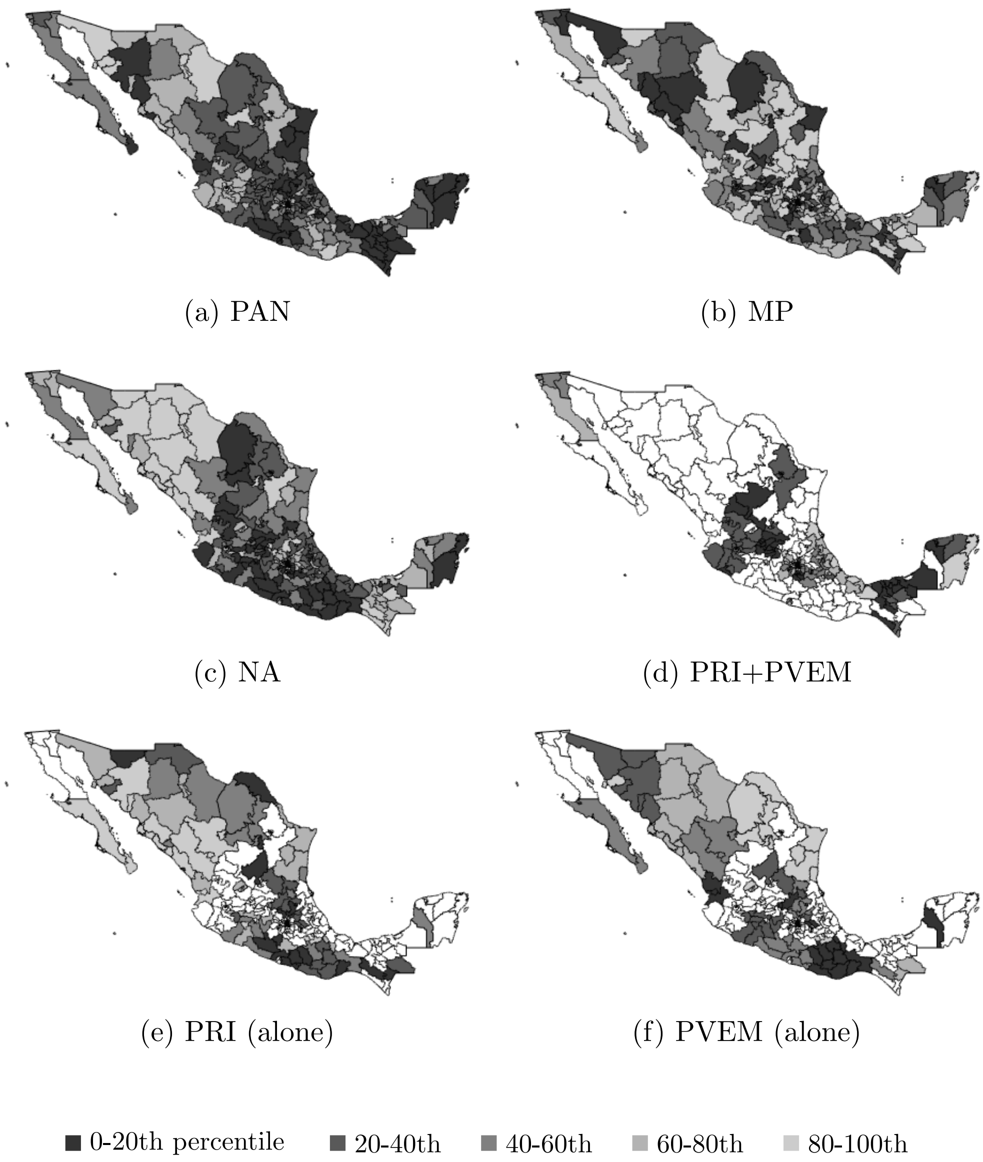


Figure A1: Geographic distribution of campaign spending by party

■ Region 1 ■ Region 2 □ Region 3 ■ Region 4 ■ Region 5

Figure A2: Mexican electoral regions and districts (delimited)

Table A2: Estimates of preference parameters β_j^m for candidate j given menu $m = \text{IND}$

Coefficient	$j = \text{MP}$	$j = \text{NA}$	$j = \text{PVEM}$	$j = \text{PRI}$	$j = \text{PAN}$
Intercept	-7.755	-3.604	-7.888	1.395	11.419
	(4.441)	(3.845)	(3.954)	(2.860)	(4.286)
Region 1	0.132	-0.134	-0.220	-0.144	-0.341
	(0.269)	(0.331)	(0.241)	(0.231)	(0.303)
Region 2	-0.149	0.343	-0.242	0.127	0.287
	(0.186)	(0.217)	(0.347)	(0.156)	(0.195)
Region 3	-0.058	0.329	0.549	0.178	-0.149
	(0.203)	(0.382)	(0.293)	(0.186)	(0.188)
Region 4	0.309	0.464	-0.229	0.287	-0.140
	(0.179)	(0.316)	(0.256)	(0.269)	(0.212)
Female	16.732	6.924	7.103	-5.581	-17.171
	(7.761)	(7.175)	(6.530)	(5.290)	(7.778)
18 to 24	-12.969	-9.682	4.128	-4.143	-10.367
	(6.783)	(7.569)	(6.219)	(4.020)	(4.637)
Over 65	-9.380	-7.573	-5.593	-0.032	-2.196
	(4.977)	(4.789)	(3.927)	(2.759)	(3.435)
No post-elem. educ.	-1.201	-2.379	-0.391	-2.149	-3.443
	(0.845)	(0.993)	(0.937)	(0.673)	(0.785)
Unemployment	-6.481	-0.839	0.231	2.182	6.511
	(6.188)	(5.651)	(4.690)	(3.786)	(4.300)
Owns a fridge	0.725	-1.015	0.268	0.300	-1.960
	(0.658)	(0.955)	(0.938)	(0.615)	(0.694)
Owns a car	-2.493	0.875	-0.897	-1.096	-0.327
	(0.663)	(0.736)	(0.780)	(0.537)	(0.642)
Rural	0.985	1.528	0.976	1.081	1.073
	(0.406)	(0.417)	(0.463)	(0.271)	(0.576)

Two-stage least squares estimates of random effects model (8) with robust standard errors clustered by district in parentheses. Demographics as in Table A1.

Table A3: Estimates of preference parameters β_j^m for candidate j given menu $m = \text{PRI}$

Coefficient	$j = \text{MP}$	$j = \text{NA}$	$j = \text{PRI}$	$j = \text{PAN}$
Intercept	1.472	-4.130	-1.765	-11.050
	(2.968)	(2.893)	(2.778)	(4.389)
Region 1	0.255	-0.245	-0.107	-0.398
	(0.252)	(0.195)	(0.159)	(0.216)
Region 2	-0.711	-0.022	-0.020	-0.108
	(0.167)	(0.161)	(0.167)	(0.188)
Region 3	-0.127	-0.438	-0.247	0.816
	(0.174)	(0.145)	(0.144)	(0.248)
Region 4	0.101	-0.112	-0.391	-0.438
	(0.120)	(0.149)	(0.218)	(0.173)
Female	-6.317	2.324	-4.334	11.996
	(3.541)	(4.093)	(3.563)	(4.375)
18 to 24	2.950	0.519	6.173	-4.224
	(4.447)	(3.565)	(4.137)	(4.140)
Over 65	1.976	-0.595	4.662	3.921
	(2.499)	(2.094)	(2.206)	(2.776)
No post-elem. educ.	-2.870	0.588	-1.288	3.547
	(0.981)	(0.857)	(0.805)	(1.210)
Unemployment	9.811	-7.796	-5.927	-12.681
	(4.928)	(4.117)	(3.493)	(4.535)
Owns a fridge	0.081	-1.487	0.128	-1.121
	(0.629)	(0.604)	(0.633)	(0.773)
Owns a car	-2.681	0.961	-0.631	3.431
	(0.825)	(0.653)	(0.726)	(0.679)
Rural	0.029	-0.324	0.569	-0.511
	(0.503)	(0.295)	(0.357)	(0.350)

Two-stage least squares estimates of random effects model (8) with robust standard errors clustered by district in parentheses. Demographics as in Table A1.

Table A4: Estimates of preference parameters β_j^m for candidate j given menu $m =$ PVEM

Coefficient	$j =$ MP	$j =$ NA	$j =$ PVEM	$j =$ PAN
Intercept	-2.451	-6.167	-7.542	-6.911
	(4.500)	(3.602)	(4.719)	(3.526)
Region 1	-0.097	-0.561	0.375	0.296
	(0.410)	(0.368)	(0.384)	(0.328)
Region 2	-0.557	-0.299	0.262	0.481
	(0.253)	(0.306)	(0.334)	(0.201)
Region 3	0.151	-0.617	0.148	0.468
	(0.299)	(0.400)	(0.291)	(0.288)
Region 4	0.517	-0.561	-0.230	-0.894
	(0.256)	(0.326)	(0.314)	(0.415)
Female	-5.780	-1.175	11.699	11.692
	(8.092)	(7.981)	(9.544)	(7.561)
18 to 24	12.866	5.078	-5.670	-7.996
	(12.382)	(12.119)	(7.510)	(6.477)
Over 65	7.091	2.381	-3.169	1.750
	(7.359)	(8.066)	(5.090)	(3.217)
No post-elem. educ.	-2.022	1.206	0.041	1.288
	(1.229)	(1.238)	(1.005)	(1.266)
Unemployment	28.614	2.136	2.295	-2.834
	(13.400)	(12.654)	(8.095)	(9.333)
Owns a fridge	-0.524	1.996	-1.240	-2.880
	(1.416)	(1.547)	(1.464)	(1.952)
Owns a car	-1.658	-0.962	-0.276	1.779
	(1.100)	(1.077)	(0.911)	(1.798)
Rural	-1.170	-0.431	0.425	-0.329
	(1.280)	(1.303)	(0.833)	(0.866)

Two-stage least squares estimates of random effects model (8) with robust standard errors clustered by district in parentheses. Demographics as in Table A1.

Table A5: Estimates of preference parameters $\beta_j^{\mathrm{ST},m}$ for party j conditional on voting for coalition candidate given menu $m = \mathrm{PRI}$

Coefficient	$j = \mathrm{PVEM}$	$j = \mathrm{PRI}$
Intercept	0.421	4.981
	(2.920)	(1.878)
Region 1	0.548	0.044
	(0.212)	(0.122)
Region 2	0.931	0.301
	(0.201)	(0.110)
Region 3	0.259	0.163
	(0.158)	(0.076)
Region 4	0.432	-0.227
	(0.132)	(0.069)
Female	-4.530	-7.046
	(4.531)	(2.200)
18 to 24	12.895	2.232
	(5.512)	(2.722)
Over 65	2.611	4.379
	(2.803)	(1.716)
No post-elem. educ.	-2.570	-0.804
	(1.274)	(0.556)
Unemployment	-4.322	-2.224
	(5.886)	(2.484)
Owns a fridge	0.689	-0.154
	(0.928)	(0.365)
Owns a car	-1.744	-0.006
	(0.976)	(0.441)
Rural	0.425	0.423
	(0.391)	(0.174)

GLS estimates of random effects model (9) with robust standard errors clustered by district in parentheses. Outside option is 50-50 vote split between PRI and PVEM. Demographics as in Table A1.

Table A6: Estimates of preference parameters $\beta_j^{\mathrm{ST},m}$ for party j conditional on voting for coalition candidate given menu $m = \mathrm{PVEM}$

Coefficient	$j = \mathrm{PVEM}$	$j = \mathrm{PRI}$
Intercept	-5.779	4.460
	(4.246)	(2.949)
Region 1	1.142	0.040
	(0.410)	(0.228)
Region 2	1.378	0.269
	(0.325)	(0.145)
Region 3	0.338	-0.083
	(0.419)	(0.275)
Region 4	0.209	-0.198
	(0.269)	(0.132)
Female	19.125	-7.530
	(8.331)	(6.149)
18 to 24	4.321	1.437
	(7.777)	(4.390)
Over 65	6.343	6.804
	(4.687)	(2.105)
No post-elem. educ.	0.559	0.126
	(1.275)	(0.721)
Unemployment	-1.116	-0.161
	(11.188)	(7.703)
Owns a fridge	-7.590	-0.196
	(2.141)	(1.181)
Owns a car	0.169	0.094
	(0.974)	(0.746)
Rural	-3.053	0.315
	(0.946)	(0.589)

GLS estimates of random effects model (9) with robust standard errors clustered by district in parentheses. Outside option is 50-50 vote split between PRI and PVEM. Demographics as in Table A1.

A.2 Campaign Stage Details

Closed-form expressions for the candidates' probability of winning can be obtained as follows. Recall from (7) that candidate j's vote share can be written as

$$S_{jd}^{m} = \frac{\exp(\bar{\delta}_{jd}^{m} + \eta_{j}^{m})}{1 + \sum_{k \neq 0} \exp(\bar{\delta}_{kd}^{m} + \eta_{k}^{m})}, \tag{11}$$

where $\bar{\delta}_{kd}^{m} = \alpha_1 c_{kd} + \alpha_2 c_{kd}^2 + x_d' \beta_k^m + \xi_{kd}^m$. Since $(\eta_k^m)_{k \neq 0}$ are i.i.d. with a Type-I Extreme Value distribution, ties occur with probability zero, and j's probability of winning also takes a multinomial logit form:

$$\begin{aligned} PW_{jd}^{m} &= \Pr\left(\cap_{k \notin \{j,0\}} \{S_{jd}^{m} > S_{kd}^{m}\}\right) \\ &= \Pr\left(\cap_{k \notin \{j,0\}} \{\bar{\delta}_{jd}^{m} + \eta_j^m > \bar{\delta}_{kd}^{m} + \eta_k^m\}\right) \\ &= \frac{\exp(\bar{\delta}_{jd}^{m})}{\sum_{k \neq 0} \exp(\bar{\delta}_{kd}^{m})}. \end{aligned} \tag{12}$$

Candidate j's expected vote share is obtained by integrating (11) with respect to the distribution of $(\eta_k^m)_{k \neq 0}$, which can be easily simulated.

Computation of PRI and PVEM's individual vote shares when they nominate a joint coalition candidate involves the second tier of the voting stage. As in the first tier, let $\delta_{jd}^{\mathrm{ST},m} = \bar{\delta}_{jd}^{\mathrm{ST},m} + \eta_j^{\mathrm{ST},m} = x_d' \beta_j^{\mathrm{ST},m} + \xi_{jd}^{\mathrm{ST},m} + \eta_j^{\mathrm{ST},m}$ represent mean voter utility from selecting alternative j in the second tier of the voting stage. Normalizing to zero the mean utility of splitting the vote 50-50 between PRI and PVEM, and denoting by $j = p \in \{\mathrm{PRI}, \mathrm{PVEM}\}$ the option of giving party p 100% of the vote, p's vote share is given by

$$S_{pd}^{m} = S_{\text{PRI-PVEM},d}^{m} \left(\frac{0.5 + \exp(\bar{\delta}_{pd}^{\mathrm{ST},m} + \eta_p^{\mathrm{ST},m})}{1 + \sum_{j \in \{\mathrm{PRI},\mathrm{PVEM}\}} \exp(\bar{\delta}_{jd}^{\mathrm{ST},m} + \eta_j^{\mathrm{ST},m})} \right), \tag{13}$$

where $S_{\text{PRI-PVEM},d}^{m}$ is the coalition candidate's total share of votes in accordance with (11). Integration of (13) with respect to the distribution of $(\eta_k^m)_{k \neq 0}$ and $(\eta_j^{\mathrm{ST},m})_{j \in \{\mathrm{PRI},\mathrm{PVEM}\}}$ yields p's expected vote share.

Games with strategic complementarities. Formally, the campaign spending game played in each district is described as follows. As discussed in Section 3, the set of players is composed of all 5 parties when M_d = IND, and PRI and PVEM act as a single player when $M_d \neq$ IND. The strategy space available to each player is $\mathbb{R}_+$, the set of nonnegative expenditure levels, and the players' payoffs are defined in (5) and (6).

While I refer the reader to Echenique and Edlin (2004) for a formal definition of games with strict strategic complementarities (GSSC), I discuss here properties of the parties' payoff functions, satisfied at the estimated parameter values, which imply that the spending games belong to this class. First, since $\alpha_1 > 0 > \alpha_2$ (see Table 5), the effect of campaign spending on $\bar{\delta}_{jd}^m$ is maximized at $\bar{c} = -\alpha_1/(2\alpha_2)$. Given that candidate j's vote share and probability of winning are strictly increasing in $\bar{\delta}_{jd}^m$, they are also maximized at $\bar{c}$. It then follows that spending more than $\bar{c}$ is a strictly dominated strategy for all players in the spending games. That is, regardless of their rivals' spending, each player's payoff is higher at $\bar{c}$ than at any level exceeding $\bar{c}$. Thus, the players' effective strategy space is $[0, \bar{c}]$, a compact interval, which satisfies condition 1 of the definition of GSSC in Echenique and Edlin (2004). Second, it can be verified that, at the estimated parameter values, the parties' payoff functions are twice differentiable with positive cross partial derivatives, which implies the remaining conditions of the definition of GSSC.

As noted in Section 3, GSSC have three useful properties. First, existence of equilibrium is guaranteed (Vives, 1990). Second, mixed-strategy equilibria are unstable, so their omission is justified (Echenique and Edlin, 2004). Lastly, Echenique (2007) provides a simple and fast algorithm for computing the set of all pure-strategy equilibria. This set has an additional key property; it has a largest and a smallest equilibrium, providing a simple test of uniqueness: if the largest and smallest equilibria coincide, the resulting strategy profile is the unique equilibrium of the game. These extremal equilibria can be easily computed by iterating best responses; see Echenique (2007) for details. As previewed in Section 3, the largest and smallest equilibria of the campaign spending games analyzed here always coincide.

References

Ashworth, S. and E. Bueno de Mesquita. 2009. "Elections with platform and valence competition." *Games and Economic Behavior* 67:191–216.

Bandyopadhyay, S., K. Chatterjee, and T. Sjöström. 2011. "Pre-Electoral Coalitions and Post-Election Bargaining." *Quarterly Journal of Political Science* 6 (1):1–53.

Beresteanu, A., I. Molchanov, and F. Molinari. 2011. "Sharp Identification Regions in Models with Convex Moment Predictions." *Econometrica* 79 (6):1785–1821.

Berry, S., J. Levinsohn, and A. Pakes. 1995. "Automobile Prices in Market Equilibrium." *Econometrica* 63 (4):841–890.

Berry, S. T. 1994. "Estimating Discrete-Choice Models of Product Differentiation." *RAND Journal of Economics* 25 (2):242–262.

Blais, A. and I. H. Indridason. 2007. "Making Candidates Count: The Logic of Electoral Alliances in Two-Round Legislative Elections." *Journal of Politics* 69 (1):193–205.

Bormann, N.-C. and M. Golder. 2013. "Democratic Electoral Systems around the world, 1946-2011." *Electoral Studies* 32:360–369.

Carroll, R. and G. W. Cox. 2007. "The Logic of Gamson's Law: Pre-election Coalitions and Portfolio Allocations." *American Journal of Political Science* 51 (2):300–313.

Chernozhukov, V., H. Hong, and E. Tamer. 2007. "Estimation and Confidence Regions for Parameter Sets in Econometric Models." *Econometrica* 75 (5):1243–1284.

Consulta Mitofsky. 2012. "*Geometría electoral en México* (Electoral geometry in Mexico)." Public Opinion Poll, `http://www.consulta.mx/web/images/MexicoOpina/2013/NA_GEOMETRIA_ELECTORAL.pdf` (in Spanish),.

Duverger, M. 1954. *Political Parties: Their Organisation and Activity in the Modern State.* Wiley.

Echenique, F. 2007. "Finding All Equilibria in Games of Strategic Complements." *Journal of Economic Theory* 135 (1):514–532.

Echenique, F. and A. Edlin. 2004. "Mixed equilibria are unstable in games of strategic complements." *Journal of Economic Theory* 118 (1):61–79.

Ferrara, F. 2006. "Two in one: Party competition in the Italian single ballot mixed system." *Electoral Studies* 25:329–350.

Ferrara, F. and E. S. Herron. 2005. "Going It Alone? Strategic Entry under Mixed Electoral Rules." *American Journal of Political Science* 49 (1):16–31.

Gillen, B., S. Montero, H. R. Moon, and M. Shum. 2015. "BLP-Lasso for Aggregate Discrete-Choice Models Applied to Elections with Rich Demographic Covariates." Working Paper. California Institute of Technology.

Golder, S. N. 2006. *The Logic of Pre-Electoral Coalition Formation.* Columbus: Ohio State University Press.

Groseclose, T. 2001. "A Model of Candidate Location When One Candidate Has a Valence Advantage." *American Journal of Political Science* 45 (4):862–886.

Iaryczower, M. and A. Mattozzi. 2013. "On the Nature of Competition in Alternative Electoral Systems." *Journal of Politics* 75 (3):743–756.

Kaminski, M. M. 2001. "Coalitional Stability of Multi-Party Systems: Evidence from Poland." *American Journal of Political Science* 45 (2):294–312.

Kawai, K. and Y. Watanabe. 2013. "Inferring Strategic Voting." *American Economic Review* 103 (2):624–662.

Larreguy, H., J. Marshall, and P. Querubin. 2016. "Parties, Brokers and Voter Mobilization: How Turnout Buying Depends Upon the Party's Capacity to Monitor Brokers." *American Political Science Review* 110 (1):160–179.

Martin, G. J. 2014. "The Informational Content of Campaign Advertising." Working Paper. Emory University.

Pakes, A., J. Porter, K. Ho, and J. Ishii. 2015. "Moment Inequalities and Their Application." *Econometrica* 83 (1):315–334.

Persson, T. and G. Tabellini. 2000. *Political Economics: Explaining Economic Policy.* MIT Press.

Shi, X. and M. Shum. 2015. "Simple Two-Stage Inference for a Class of Partially Identified Models." *Econometric Theory* 31 (3):493–520.

Vives, X. 1990. "Nash Equilibrium with Strategic Complementarities." *Journal of Mathematical Economics* 19:305–321.