Representation Failure*

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Abstract

We use rich data on thousands of candidates in three Brazilian legislative elections to (i) quantify the relative value voters place on candidates' policy positions and valence attributes, (ii) evaluate voters' welfare given the set of candidates they face, and (iii) explain when and why candidates choose policy positions that diverge from voters' preferences. We find that the "supply side" of politics imposes large welfare losses on Brazilian voters: in half of the country, average voter welfare is at least 80% lower than an ideal benchmark. Through counterfactual experiments, we show that institutional reforms aimed at improving the quality of representation may have sizable unintended consequences, due to equilibrium policy adjustments.

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1 Introduction

In recent years, voters in the U.S., Brazil, Argentina, Spain, and other democracies around the world, have expressed discontent with the entire political system. From large public demonstrations to overwhelming disapproval in opinion polls, large fractions of voters seem dissatisfied with all the alternatives available to them. Such a systemic representation failure could severely undermine democracy. Shortages of palatable candidates can limit citizens' ability to elect public officials who can implement their preferred policies, or whom voters view as well qualified to be in office. More broadly, this can lead to general disenchantment of citizens with democratic institutions, paving the way for authoritarian attempts.

Democracy is, of course, bound to be imperfect. First, the set of individuals who decide to dedicate their lives to politics and public service is limited. Many talented or qualified individuals choose to remain in the private sector. Moreover, the political system may push away individuals who might otherwise consider a career in politics due to their gender or socioeconomic background. Second, the candidates that do run for office might not have incentives to put forth policies that represent their constituencies' best interests. The extent to which each of these factors impacts voters' welfare depends fundamentally on how much voters value them. Assessing representation failures in any given democracy, therefore, requires estimating voters' preferences over candidates' potential attributes.

In this paper, we take on this problem in the context of elections for the lower

house of Brazil's National Congress (Câmara dos Deputados). We use rich data on thousands of candidates in three recent elections to (i) quantify the relative value that voters give to policy and valence, and (ii) evaluate the welfare loss to voters brought by the characteristics and policy choices of the set of candidates they face. We then (iii) estimate a model of the "supply side" of politics to explain when and why candidates choose policy positions that diverge from voters' preferences.

Brazil's electoral system makes the country a natural focal point for this analysis. First, in Brazil's open-list proportional-representation (PR) system, voters cast their ballots overwhelmingly for individual candidates rather than parties. This allows us to link voters' decisions with individual candidates' characteristics rather than the characteristics of an entire list, as would be the case in a closed-list PR system like that of Argentina. Second, voters can typically choose from among a large number of candidates in each state, ranging from 46 in the state of Tocatins to more than 1,200 in São Paulo (2014 election). This richness of choice gives us great purchasing power to map candidates' characteristics to voters' preferences. Third, differently from majoritarian elections, this variant of PR elections minimizes incentives to vote strategically, removing another obstacle to estimating voters' preferences.

To carry out this exercise, we gather data on the 15,698 candidates running for a seat in the Câmara dos Deputados in the 2006, 2010, and 2014 elections, across all 27 legislative districts (26 states and the Distrito Federal). For each candidate running for office, we observe the number of votes obtained by the

candidate in each municipality, along with a rich set of individual characteristics, including their previous professional experience, political experience, education, and gender. For over 10,000 candidates, we are also able to obtain a measure of their policy positions using individual campaign contributions, following the methodology outlined in Bonica (2014).

To estimate voters' preferences, we use the random-coefficients logit model of Berry, Levinsohn, and Pakes (1995) (BLP). This approach relaxes the independence of irrelevant alternatives assumption of standard multinomial logit models, and enables us to estimate flexible but computationally feasible substitution patterns across candidates, which is essential for our analysis. Furthermore, it allows us to explicitly account for unobserved candidate heterogeneity in valence attributes (e.g., charisma).

Our preference estimates separately quantify the value voters place on candidates' policy positions and valence characteristics. With this information, we evaluate voters' welfare given the actual set of candidates they face in the data. We then compare this measure with an ideal (but attainable) benchmark, computed as the welfare derived from a hypothetical candidate with highest in-sample valence who adopts the voter's optimal policy. The results uncover a considerable failure of the Brazilian political system: across Brazil's 5,507 municipalities, we estimate an average welfare loss of 77% relative to the ideal benchmark.

Our estimates reveal that, in many districts, a significant fraction of the welfare loss is due to ideological incongruence between voters and politicians. To

understand why politicians' policy choices diverge from the preferences of their constituents, we estimate a model of the "supply side" of politics, in which candidates' policy positions emerge explicitly as equilibrium choices.

The estimates provide two important lessons. First, we find that candidates with valence advantages are able to put forth policies that are more in line with their own preferences, to the detriment of party interests and voter welfare. Second, we show that variation in candidates' power vis-a-vis parties explains a significant fraction of the welfare loss to voters that is due to ideological mismatch with politicians. In particular, districts in which parties are weak relative to their candidates tend to experience larger policy welfare losses.

As this discussion illustrates, candidate valence affects voters' welfare both directly and through its influence on policy choices. Thus, reforms aimed at improving the quality of representation (e.g., increasing candidates' education) could have unintended consequences leading to lower, or even negative, welfare changes. To evaluate this possibility, we simulate the effect of a positive shift in the distribution of candidates' valence. We show that, while the valence shock has an overwhelmingly positive direct effect on welfare, the indirect effect due to candidates' equilibrium policy adjustments reduces these gains on average, and leads to welfare losses for some voters. We further illustrate the importance of indirect equilibrium effects in a second counterfactual experiment where we restrict electoral competition to the largest parties.

2 Related Literature

The early literature on legislative bodies in Latin America focused on legislative autonomy under strong presidentialism (Linz 1990, Carey and Shugart 1995, O'Donnell 1998). As the threat of authoritarian reversals diminished, scholarly focus shifted to understanding how formal and informal institutions shape legislative behavior and legislative careers. These papers provided the basic characterization of the Brazilian political system we now have: (i) parties are weak, under-resourced, and often unable to constrain individual opportunistic behavior by individual legislators (Mainwaring 1999, Samuels 2003, Desposato 2006, Klašnja and Titiunik 2017), (ii) open-list proportional representation, and the lack of formal mechanisms channeling resources to congressional party leaders, promote candidate-centric legislative careers (Mainwaring, Scully, et al. 1995, Samuels 2003), and (iii) presidents have systematically used pork and cabinet positions to "buy" legislative support, leading to what is known as presidential coalitionism (Neto and da Matriz 1998, Neto 2006).

In part due to presidential coalitionism, the most common approaches to estimating legislators' preferences in the U.S., which rely on the assumption that legislators vote "sincerely," have been regarded as unreliable in the Brazilian context. To overcome this problem, Zucco (2009), Zucco and Lauderdale (2011), and Power and Zucco (2012) estimate legislators' ideal points using surveys (see Power (2010)), and use these estimates to ascertain the influence of external factors on legislators' voting behavior.

Research on voters' preferences, and how these connect with electoral choices, is more sparse.[1] Power and Rodrigues-Silveira (2019) leverage the legislative survey data to obtain a measure of voters' ideology at the municipality level. Specifically, they measure voters' ideology in a given municipality as a weighted average of the average ideological score of each party, with weights equal to the vote share of each party in the municipality. One issue with this approach is that the interpretation of this measure as reflecting voters' ideology assumes that voters' decisions are driven only by ideological considerations. Thus, any variation in candidates' valence attributes that translates to votes (incumbency, gender, experience, etc.) is incorrectly construed as ideology. Instead, our approach allows us to disentangle voters' ideological preferences from their tastes for valence attributes. Moreover, in doing so, we exploit variation in policy choices and valence at the candidate level (elected and non-elected).

Our estimation strategy builds on the random-coefficients logit model of Berry, Levinsohn, and Pakes (1995). This approach has been used extensively in economics to estimate demand for differentiated products but has received little attention in political science. We are aware of four papers that use the BLP approach in electoral contexts. Rekkas (2007) and Gordon and Hartmann (2013) use it to estimate the effect of campaign spending on electoral outcomes in Canadian (legislative) and U.S. (presidential) elections, respectively. Montero (2016) estimates the effect of coalition formation on electoral outcomes when parties invest in campaign activities, using data from the 2012 Mexican

[1] Ferraz and Finan (2008) study the effect of information about corruption on the electoral performance of majors. Klašnja and Titiunik (2017) estimate the electoral effect of incumbency, also at the municipal level.

Chamber of Deputies election. Finally, Ujhelyi, Chatterjee, and Szabó (2018) use the BLP approach to study protest votes in India. To our knowledge, our paper is the first to use this approach to recover voters' preferences for policy relative to valence, in any electoral context.

3 Data

3.1 Context

We focus on elections of representatives to the lower house of the Brazilian National Congress. The Câmara dos Deputados is composed of 513 representatives, who are elected in 27 multi-member electoral districts, corresponding to the country's 26 states and the Distrito Federal of Brasilia. The magnitude of each district is determined according to population, but no state may have fewer than eight or more than seventy seats.[2]

Elections take place under an open-list proportional-representation (PR) system. Each voter has one vote to cast, which can be given to a specific candidate or (rare) to a party or coalition list. In each district, votes given to candidates from each list are pooled and added to the votes received by the list to form a total list vote. Seats are then distributed among lists proportionally to their total list vote according to the D'Hondt method.[3] Within each list, seats are

[2]The lower bound is binding for eleven states, and the upper bound is binding only for the state of São Paulo. See Table A.1 in the Appendix.

[3]In each district, an electoral quotient is computed by dividing the total number of valid votes (i.e., excluding blank or void votes) by the number of available seats. Then each total list vote is divided by the electoral quotient. The result of this division, disregarding

assigned to candidates in descending order of votes received. Representatives are elected for four-year terms, with no constraints on reelection.[4]

The open-list PR system fosters a fragmented multiparty system (Mainwaring 1999). In the 2014 election, 28 parties placed candidates in the lower chamber.[5] The dispersion of votes across multiple parties is partly the result of regional vote concentration, but vote fragmentation occurs even at the local level. This can be seen in the left panel of Figure A.4 in the Appendix, which plots the empirical distribution of the effective number of parties for each district, using vote shares at the municipal level.

Brazil has large socioeconomic disparities, which make for 27 highly heterogeneous electoral districts. This is illustrated in Figure A.1 in the Appendix, where we plot the rural population share, median wage, and literacy rate at the municipality level. Broadly, the most striking differences are between the richer, more educated, and generally more urban south and southeast regions, and the poorer, more heavily (subsistence) agricultural, and less dense north and northeast regions. These disparities help explain some of the regional variation in electoral performance across parties. Poorer municipalities tend to vote overwhelmingly for the PT, which has pursued a progressive agenda that has favored poor constituencies (Samuels 2004, Bohn 2011). On the other hand, wealthier municipalities tend to favor the right-leaning PSDB (see Fig-

fractions, is the list quotient, which determines the number of deputies elected by the list. If there remain unallocated seats after the application of list quotients, these are distributed according to the highest averages method using the D'Hondt formula.

[4]Reelection rates are high for federal deputies, with over 74% of incumbents securing reelection in 2014.

[5]See Table A.2 in the Appendix for a list of all parties gaining seats in the Câmara dos Deputados in 2014, with their respective vote and seat shares.

ures A.2 and A.3 in the Appendix).

3.2 Legislative Candidates

Differently from closed-list PR systems, Brazil's electoral system puts individual candidates at the center of political choice. Indeed, the literature notes that Brazilian elections tend to be candidate-centric rather than party-centric, with voters effectively responding to candidate characteristics above party labels (Mainwaring, Scully, et al. 1995, Mainwaring 1999, Samuels 2003, Klašnja and Titiunik 2017). Understanding the drivers of voters' choices, therefore, requires that we analyze them at the candidate level.

To that end, we bring together data on all candidates running for a seat in the Câmara dos Deputados in the 2006, 2010, and 2014 elections. In total, across these three elections and all 27 legislative districts, there were 15,698 candidates: 4,944 in 2006, 4,887 in 2010, and 5,867 in 2014. For each candidate running for office, we observe the number of votes obtained by the candidate in each municipality, along with a rich set of individual characteristics including their previous professional experience, political experience, level of education, and gender.[6] For over 10,000 candidates, we are also able to obtain a measure of their policy positions using individual campaign contributions, following the methodology outlined in Bonica (2014). We describe this in detail below.

[6]This information can be obtained from the Brazilian electoral authority, the Tribunal Superior Eleitoral (TSE).

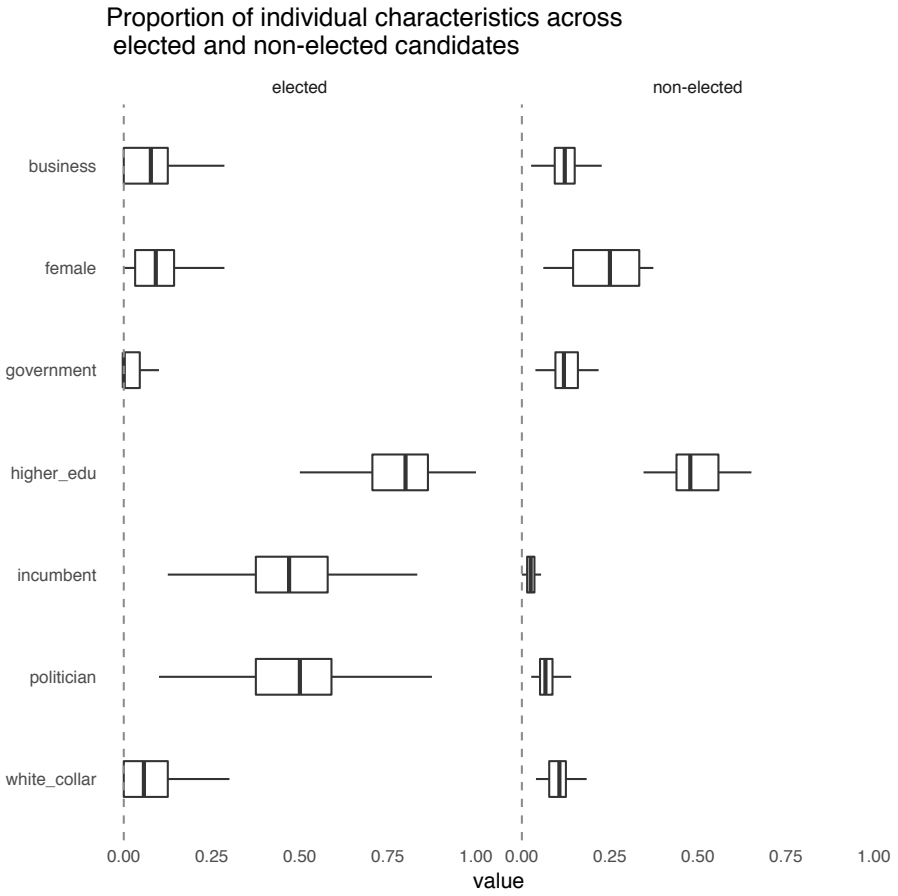


Figure 1: Candidates Observable Non-Policy (Valence) Characteristics.

Figure 1 provides summary statistics of candidates' observable non-policy characteristics (following standard practice, we refer to these non-policy attributes as valence). Overall, given the large number of candidates competing for seats, there is a low proportion of incumbents in the candidate pool. However, incumbents are disproportionately represented among candidates who secure a seat in the chamber. The same type of selection occurs along other attributes: while only about half of the candidates have higher education, this figure in-

creases to about 75% for elected candidates; women compose only about a quarter of total candidates, but an even far lower percentage of elected candidates; candidates with business or government (bureaucratic) experience make about 10% of the pool of candidates, and they represent a significantly lower proportion of elected candidates. Figure 2 further highlights these differences for incumbency, education, gender, and age in terms of candidates' vote shares.

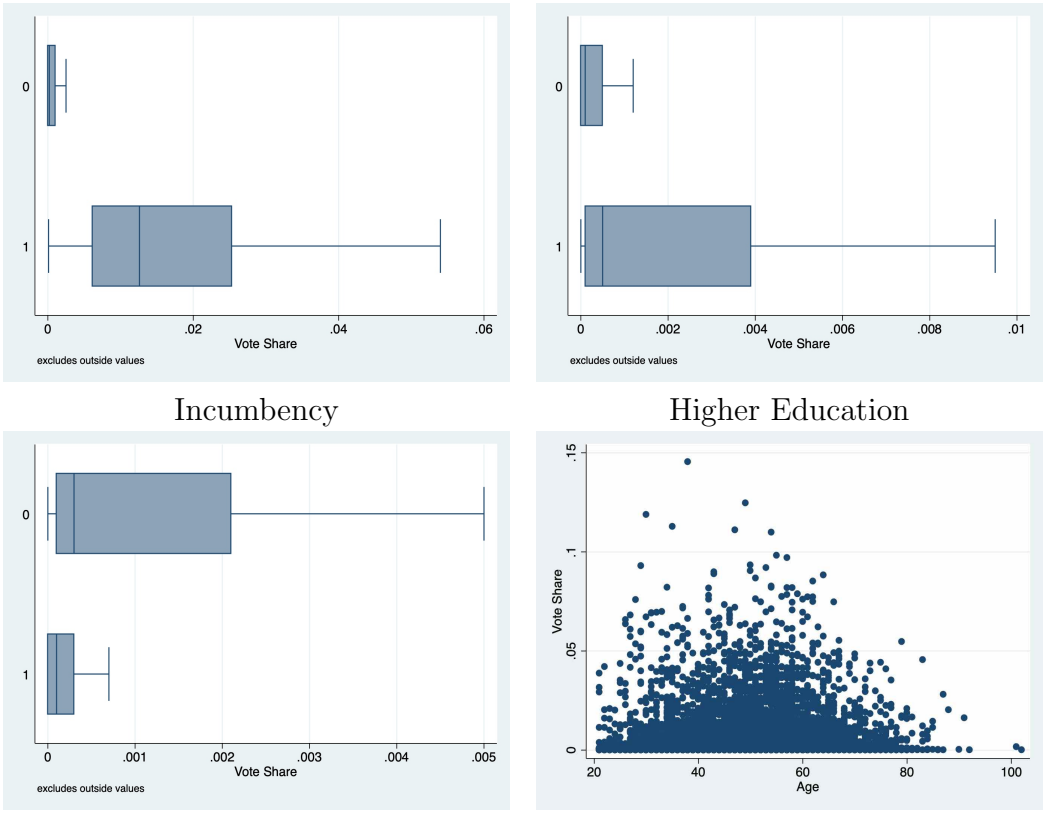


Figure 2: Candidate Vote Shares (among registered district voters) by Valence Attribute.

While the education, professional experience, gender, and other valence attributes of candidates seem clearly important to voters, the policy choices

candidates make can also be relevant. In particular, voters in the U.S. and elsewhere have been shown to be responsive to the ideological position candidates put forward.[7] Whether this is also true in Brazil, and how much weight voters put on ideology relative to valence, is an empirical question.

Measuring how voters' preferences for candidates vary with the policies the candidates embrace requires a measure of both elected and non-elected candidates' policy positions. Unfortunately, this information is hard to come by. Indeed, there are no currently available estimates of both incumbents' and challengers' policy positions for Brazilian legislative elections.[8] To address this problem, we follow the approach of Bonica (2014) to produce our own estimates of candidates' policy choices, using micro-level data on campaign contributions for 2004-2014. We also use this approach to estimate the policy positions of candidates in mayoral elections, which prove useful in the estimation of our main model, as discussed later.

The intuition for how campaign contributions can be used to estimate politicians' policy positions is similar in spirit to that behind DW-Nominate. The key assumption is that the contributor's marginal benefit of giving to a particular candidate is decreasing in the distance between the contributor's ideal policy and the candidate's choice. This implies that contributors give (weakly)

[7] See, e.g, Canes-Wrone, Brady, and Cogan (2002), Ansolabehere and Jones (2010), and Iaryczower, Moctezuma, and Meirowitz (2018).

[8] Zucco (2009), Zucco and Lauderdale (2011) and Power and Zucco (2012) estimate *legislators'* ideal points using surveys that ask them to place themselves and all the main political parties represented in the legislature on a left-right 10-point scale (see Power (2010)). As these papers suggest, estimation of incumbents' ideal points via DW-Nominate or *Ideal* is problematic due to widespread "vote-buying" of legislators through pork-barrel spending and cabinet allocations.

more money to candidates that are closer to their ideal point, which in turn allows us to rank candidates' positions in the policy space. Bonica interprets these estimates as politicians' policy preferences. We only make the assumption that these are the candidates' policy choices, which could or not correspond with their true preferences.[9]

To implement this approach, we use data on micro-level dyadic contributions, including both individual and corporate donations.[10] Since corporations may donate to candidates strategically, we exclude them from our data and focus on private contributions by non-partisans and non-politicians. In total, we leverage over 650 thousand unique contributions at the federal level, and 3.8 million unique contributions at the local level.[11] Because many non-viable candidates tend to receive a small number of contributions, we are forced to drop a sizable number of candidates from the database. Nevertheless, our final sample includes 10,752 candidates across the three elections.[12]

We perform a battery of sanity checks of the external and internal validity of our candidate policy estimates. The left panel of figure A.6 shows that

[9]Estimation is carried out by a modified correspondence analysis with a two-way frequency matrix, where rows correspond to unique contributors and columns to candidates. Each element in the matrix is the total amount of contributions made by contributor i to candidate j, for the time span of our data. We then perform a singular value decomposition to retrieve ideal points for contributors and recipients.

[10]The campaign contribution data is available since the 2002 election, when the TSE mandated the disclosure of electoral campaign contributions to candidates at all levels of government. Importantly, the dataset uniquely identifies both contributors and recipients.

[11]We estimate scores separately for local and federal candidates, pooling across electoral cycles.

[12]The candidates for whom we are able to recover policy positions make an overwhelming fraction of all candidates seriously contending for a seat in the Câmara dos Deputados (see Figure A.5 in the Appendix). In fact, only 0.02 % of the candidates for whom we don't have policy data were ultimately elected. Table A.3 in the Appendix summarizes coverage of the final dataset by state and electoral cycle.

there is a strong correlation between policy positions within the same party at both the local and federal level, while the right panel shows that our policy estimates are correlated with the ideology scores estimated by Zucco (2009) (on average, at the party level). Figure A.7, on the other hand, shows that our estimates capture the leftward ideological shift of voters and parties in the 2000s found in Latinobarometer surveys.[13]

In the next section, we use this information on candidates' valence characteristics and policy choices, along with voting outcomes at the individual candidate level, to estimate voters' preferences. The key for doing this, of course, is that voters can in principle give their vote to any candidate in the district, but choose to give it to one with some particular attributes. Another alternative that is de facto available to voters is to abstain or to cast a void vote. This "outside option" is thus effectively competing with all the candidates for votes. As Figure 3 illustrates, this, in itself, is a formidable alternative. The 29% average abstention rate and 8.6% average blank vote rate in what is formally a compulsory voting system provide suggestive evidence that voters are not enthusiastic about the candidates they face.

4 Voter Preferences

As noted, one of our main goals is to estimate voters' preferences over both candidates' policy choices and valence characteristics. To that end, we employ a random-coefficients logit model (BLP). The model treats candidates as bun-

[13] See Zucco and Lauderdale (2011).

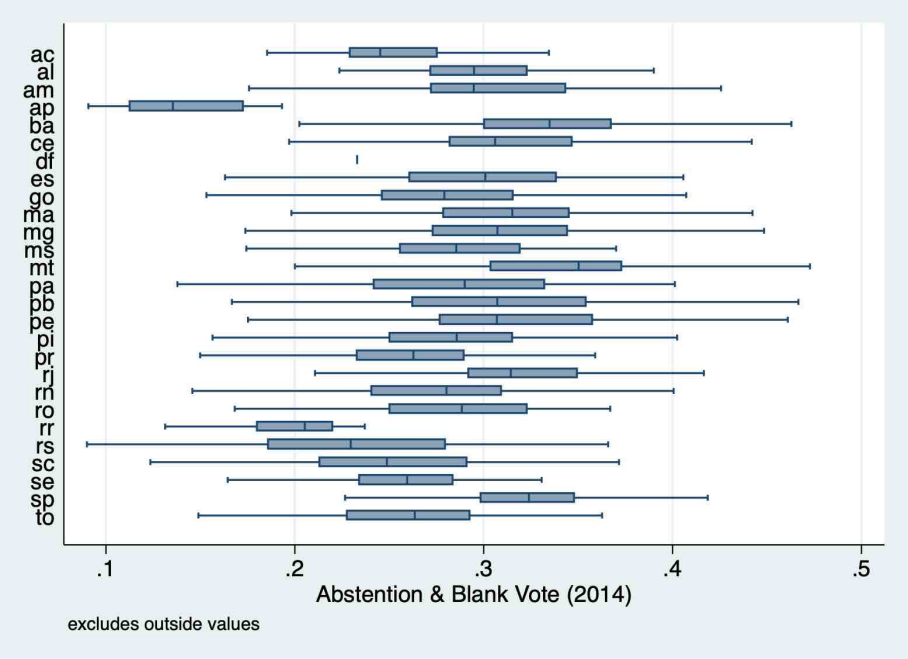


Figure 3: Distribution of Abstention and Blank Vote Shares (among registered voters) in Each Municipality, by State.

dles of characteristics. In other words, voter i's preference for candidate j can be expressed as an aggregation of the value that the voter places on each of the candidate's attributes (e.g., education, experience, policy position). This approach is well suited to our problem for four reasons.

First, as opposed to simply quantifying the relative value of voting for candidate j or j', focusing on voters' preferences for the underlying attributes of each candidate allows us to gauge how voters trade off valence characteristics for proximity in policy position. This, in turn, enables counterfactual analyses of voter choice and welfare under alternative assumptions about potential changes to the supply of candidates.

Second, the approach yields a substantial reduction in the dimensionality of

the problem. To appreciate this, note that, in our final sample, the 2014 election in the state of São Paulo alone features 870 candidates. Absent restrictions on preferences, attempting to capture how the policy choice of candidate j' affects candidate j's vote share would require 870×870 (almost one million) coefficients. The BLP formulation allows for rich heterogeneity in preferences with a parsimonious specification by introducing random coefficients to a multinomial logit random utility framework. This delivers flexible, but computationally feasible, substitution patterns across candidates that relax the independence of irrelevant alternatives (IIA) assumption present in standard multinomial logit models. This is particularly important in electoral politics, as IIA would imply, e.g., that a left-wing candidate and a right-wing candidate would benefit or lose equally (in percentage terms) from a change in the policy position of another right-wing candidate.

Third, the model allows for unobserved heterogeneity in candidate valence. This is key because, despite our access to detailed information about candidates, there remain electorally significant attributes, such as charisma or trustworthiness, that cannot be measured reliably or exhaustively. The BLP approach accounts explicitly for these unobservables as well as their influence on candidates' (endogenous) policy choices.

Finally, our problem and data are particularly well suited for this technique, as we have rich variability in valence characteristics and policy positions from over 10,000 candidates across multiple constituencies and electoral cycles. This, together with instrumental variables (IVs) described below, provides identifi-

cation and allows us to obtain precise estimates (Berry and Haile 2014).

4.1 Voter Preferences: Model

Voter i's utility from selecting candidate j in state (district) n is given by

$$u_{ijn} = \alpha_{1i} p_{jn} + \alpha_{2i} p_{jn}^2 + X_{jn}'\beta + \xi_{jn} + \epsilon_{ijn}, \tag{4.1}$$

where X_{jn} is a vector of observable (exogenous) candidate characteristics, $p_{jn} \in [-\overline{p}, \overline{p}]$ denotes candidate j's (endogenous) policy position, and ϵ_{ijn} is an i.i.d. mean-zero Type-I Extreme Value (TIEV) random utility shock.[14] The coefficients on the effect of the politician's ideology are voter-specific, and voter i's ideal point or policy can be recovered as $y_i = -\alpha_{1i}/(2\alpha_{2i})$.[15] There are other candidate characteristics not captured in X_{jn} that may affect voters' preferences but are unobserved by the analyst (e.g., charisma). The term ξ_{jn} explicitly accounts for this residual valence. While unobserved by the analyst, ξ_{jn} is known to candidates, parties, and voters and is therefore potentially correlated with j's policy position, p_{jn}.

We allow observed demographics to inform voters' policy preferences. Specifically, we assume that the coefficients $(\alpha_{1i}, \alpha_{2i})$ for voter i can be written as

$$\alpha_{ki} = \alpha_k + D_{n(i)}'\gamma_k + \sigma_k \nu_{ki}, \tag{4.2}$$

[14] We describe how $\overline{p} > 0$ is constructed in Footnote 20 below.

[15] Voters with (rare) convex policy preferences, i.e., $\alpha_{2i} \geq 0$, have ideal point $y_i = \overline{p}$ ($y_i = -\overline{p}$) if $\alpha_{1i} \geq 0$ ($\alpha_{1i} < 0$).

where $n(i)$ denotes the state in which voter i resides, D_n is a vector of demographic characteristics of state n, and $(\nu_{1i}, \nu_{2i})' \sim N(0, I_2)$ are (unobserved) i.i.d. idiosyncratic policy preference shocks. As we explain shortly, this rich heterogeneity in preferences relaxes IIA and yields flexible substitution patters across candidates. Note that, given this specification, the average voter utility from selecting candidate j in state n is

$$\delta_{jn} \equiv \sum_{k=1}^{2} (\alpha_k + D_n' \gamma_k) p_{jn}^k + X_{jn}' \beta + \xi_{jn}. \tag{4.3}$$

4.2 Voter Preferences: Estimation

Our estimation methodology implements the BLP strategy using the Mathematical Programming with Equilibrium Constraints (MPEC) approach of Su and Judd (2012) for computational efficiency. Here, we summarize the main ideas, emphasizing the intuition. For technical details, see Appendix B.

Consider first the simpler case where voters are homogeneous up to observed covariates, which boils down to a standard multinomial logit random utility model. Normalizing the average utility from abstaining or casting a void vote to $\delta_{0n} = 0$, candidate j's predicted vote share (among registered voters) can be written in the familiar form (McFadden 1973)

$$s_{jn} = \frac{\exp(\delta_{jn})}{1 + \sum_{j' \in J_n} \exp(\delta_{j'n})}, \tag{4.4}$$

where J_n denotes the set of candidates running in state n. Taking logs of (4.4),

we can "invert" predicted vote shares to express them in terms of average voter utilities: $\log(s_{jn}) - \log(s_{0n}) = \delta_{jn}$. Then, replacing predicted vote shares with their observed counterparts in the data, $\hat{s}_{jn}$, and using (4.3), we obtain

$$\log(\hat{s}_{jn}) - \log(\hat{s}_{0n}) = \sum_{k=1}^{2}(\alpha_k + D_n'\gamma_k)p_{jn}^k + X_{jn}'\beta + \xi_{jn}, \tag{4.5}$$

which is just a linear regression of the log-ratio of candidate j's vote share to the share of the "outside option" (abstaining or casting a void vote) on endogenous (p_{jn}) and exogenous covariates (D_n and X_{jn}).

Note that candidate j's unobserved valence, ξ_{jn}, corresponds to the residual of this regression. Thus, provided we have valid instruments Z_{jn} for the endogenous regressors, i.e., a vector of variables such that $E[Z_{jn}\xi_{jn}] = 0$, we can estimate the parameters α, γ, and β from this linear regression via two-stage least squares. Equation (4.5) makes transparent that the variation in the data that identifies the parameters is variation in valence characteristics and vote shares across candidates, together with variation in demographics and the exogenous variation in policy choices captured by the instruments.

While the multinomial logit model is simple and computationally straightforward to estimate, it also imposes strong assumptions on voter preferences. In particular, notice that $\log(s_{jn}/s_{j'n}) = \delta_{jn} - \delta_{j'n}$. Thus, the log-ratio of the vote shares of any two candidates j and j' does not depend on the characteristics of other candidates (this is the IIA property). An important implication is that, if one candidate changes her policy, all other candidates gain or lose votes by the same percentage. This makes little sense in a model of electoral politics,

as candidates on the same side of the ideology spectrum are naturally closer substitutes than diametrically opposed candidates.

The key insight of BLP is that introducing voter heterogeneity allows flexible substitution patterns to emerge. Voters with ideal points $y_i > 0$, for instance, are more likely to respond to a change in a right-wing candidate's policy than voters with $y_i < 0$, which plausibly leads to higher substitutability between right-wing candidates than between right versus left-wing candidates. This, however, requires an alternative estimation procedure.

When voters are heterogeneous, candidates' predicted vote shares integrate over the probability $P^i_{jn}(\nu_{1i}, \nu_{2i})$ that voter i in state n selects candidate j given her idiosyncratic policy preference shocks (ν_{1i}, ν_{2i}):

$$\begin{aligned} s_{jn} &= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} P^i_{jn}(\nu_{1i}, \nu_{2i}) d\Phi(\nu_{1i}) d\Phi(\nu_{2i}) \\ &= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \frac{\exp(\delta_{jn} + \sum_{k=1}^{2} \sigma_k \nu_{ki} p^k_{jn})}{1 + \sum_{j' \in J_n} \exp(\delta_{j'n} + \sum_{k=1}^{2} \sigma_k \nu_{ki} p^k_{j'n})} d\Phi(\nu_{1i}) d\Phi(\nu_{2i}), \quad (4.6) \end{aligned}$$

where Φ denotes the standard normal cumulative distribution function. Note that predicted vote shares in state n, $s_n = (s_{1n}, \ldots, s_{J_n n})$, now depend on average utilities $\delta_n = (\delta_{1n}, \ldots, \delta_{J_n n})$ as well as the policy-preference variance parameters $\sigma = (\sigma_1, \sigma_2)$. BLP show that, though the transformation does not have a closed-form solution as before, it is still possible to "invert" predicted vote shares to recover voters' average utilities. Specifically, given σ and observed vote shares $\hat{s}_n$, there exists a unique vector of average utilities $\delta_n(\sigma)$ such that predicted and observed vote shares match exactly, i.e., $\hat{s}_n = s_n(\delta_n(\sigma), \sigma)$.

Then, using (4.3) and given $\theta = (\alpha, \gamma, \beta, \sigma)$, we can compute the unobserved candidate valence consistent with $\delta_{jn}(\sigma)$:

$$\xi_{jn}(\theta) = \delta_{jn}(\sigma) - \sum_{k=1}^{2}(\alpha_k + D_n'\gamma_k)p_{jn}^k - X_{jn}'\beta. \tag{4.7}$$

As in the homogeneous logit case, an IV moment condition identifies the parameters of the model. Provided we have valid instruments Z_{jn}, i.e., a vector of variables such that

$$E[Z_{jn}\xi_{jn}(\theta)] = 0 \quad \text{if and only if} \quad \theta = \theta_0, \tag{4.8}$$

where θ_0 denotes the true value of the model parameters, a Generalized Method of Moments (GMM) estimator (Hansen 1982) can be constructed as follows. Let Z and $\xi(\theta)$ denote the matrix and vector that vertically stack Z_{jn}' and $\xi_{jn}(\theta)$ across candidates and elections in the data. Under standard technical regularity conditions, the sample moment conditions $\frac{1}{J^*}Z'\xi(\theta)$ converge to the population moment conditions in (4.8) as $J^* \to \infty$, where J^* denotes the total number of observations in the sample. Thus, given a positive-definite weighting matrix W_{J^*}, an asymptotically normal GMM estimator of θ_0 is obtained by minimizing the quadratic form

$$Q_{J^*}(\theta) = \xi(\theta)'ZW_{J^*}Z'\xi(\theta).$$

Inference follows standard GMM theory, including the choice of an optimal

weighting matrix.[16]

Computationally, the BLP estimation algorithm proceeds by iterating over two nested loops. Given a candidate value of θ, the "inner loop" inverts predicted vote shares to solve for the average utilities $\delta_n(\sigma)$ consistent with the data, which in turn are used to compute $\xi(\theta)$ according to (4.7). The "outer loop" then searches over θ to minimize $Q_{J^*}(\theta)$. This approach can be computationally inefficient, as the inner loop relies on costly fixed point calculations, and very sensitive to convergence criteria. Instead, we implement an MPEC version of the BLP estimator, which has been shown to yield better numerical performance (Dubé, Fox, and Su 2012). We describe our implementation and provide additional technical details in Appendix B.

Instruments. As discussed, valid instruments are indispensable to identify the parameters of the model. Importantly, a necessary condition for identification is that there must be at least as many variables in Z_{jn} as there are parameters to be estimated. Furthermore, in addition to satisfying the orthogonality restriction in (4.8), for precise inference a valid instrument should be highly correlated with the variable whose coefficient it is identifying (this is commonly known as instrument relevance). By assumption, candidates' observed valence characteristics are uncorrelated with unobserved valence and are therefore valid (in fact, optimal) instruments to identify β. We rely on auxiliary data and the structure of the model to obtain instruments for the

[16]We cluster standard errors at the district level, by electoral cycle, to allow for potential correlation in unobserved valence across candidates in the same race.

remaining parameters.

To identify α and γ, notice that, given any variable that is correlated with p_{jn} but uncorrelated with ξ_{jn}, natural choices for the remaining instruments are its square and corresponding interactions with state demographics. We consider two types of instruments for p_{jn}. First, we use the "BLP instruments," i.e., the average observed valence characteristics of other candidates in the state. These are uncorrelated with candidate j's unobserved valence by assumption but correlated with her policy choice in equilibrium given their influence on voter preferences.

Second, we exploit the policy positions of (proximate) mayoral candidates in the most recent local election in candidate j's state. As shown in Figure A.6, the policy positions of mayoral and federal legislative candidates serving the same constituency covary. This is unsurprising since both types of candidates respond to similar electoral/party environments. However, mayoral candidates' policy positions are plausibly uncorrelated with the charisma or other unobserved non-ideological attributes of federal legislative candidates. Thus, we use a weighted average of same-party mayoral candidates' positions to instrument for p_{jn}, giving a larger weight to mayoral candidates j' closer to j in terms of observed characteristics, i.e., with weights proportional to

$$\exp\{-(X_{jn} - X_{j'n})'\mathrm{Cov}(X)^{-1}(X_{jn} - X_{j'n})\},$$

where $\mathrm{Cov}(X)$ denotes the covariance matrix of candidate characteristics in the sample.

Finally, while the choice of instruments for (α, γ, β) follows standard intuition from linear regressions given (4.7), the policy-preference variance parameters (σ_1, σ_2) determine the nonlinear features of the model. Accordingly, we follow common practice by employing nonlinear transformations (second-degree polynomial) of the other instruments.

4.3 Voter Preferences: Estimates

In this section, we describe our first set of results. We begin by presenting our estimates of the parameters in (4.1) and (4.2).

Tables A.4, A.5, and A.6 report, respectively, parameter estimates corresponding to observable valence characteristics, party brands, and ideology. The first column of each table presents estimates from a multinomial logit model that does not account for voter demographics. This model rules out all ideological heterogeneity among voters, with the only source of heterogeneity being reduced to the individual random utility shocks ϵ_{ijn}, which are assumed to be distributed TIEV. The second column presents estimates from a multinomial logit model including voter demographics, which allows for ideological heterogeneity as a function of state-level covariates (in addition to ϵ_{ijn}). The third column presents estimates from the BLP model, which introduces ideological heterogeneity among voters conditional on covariates. As a quick examination of the tables reveals, the added complications of the BLP approach are worth pursuing, as they have considerable bite in the resulting estimates.[17]

[17]Indeed, note that the three models are nested: the model in the second column is obtained by setting $\sigma = 0$, and the model in the first column additionally sets $\gamma = 0$. Table

Table A.4 displays the estimates of preferences for observed candidate characteristics ($\beta^{valence}$). As suggested by Figure 1, these observable candidate characteristics are important for voters. Voters prefer candidates that are younger, more educated, and male. They also have a strong preference for incumbents in both 2010 and 2014. On the other hand, voters tend to dislike candidates with business experience or government bureaucrats.

Since the covariates are standardized, the coefficients can be compared at face value. The gender preference is comparable in magnitude to the preference against bureaucrats and slightly larger than the preference for candidates with higher education. The largest effect, however, is associated with incumbency, which is about four times as large as the gender preference.[18] While broadly consistent, these estimates exhibit notable differences across the three columns of Table A.4, which highlights the importance of accounting for sources of unobserved heterogeneity in voters' preferences that could otherwise confound the analysis.

Table A.5 displays estimates of the value of party brands (β^{brands}).[19] If a particular party brand is relevant for voters (carrying information or affect), the corresponding coefficient should be different from zero. The results in-

A.6 shows that both restrictions are rejected by the data.

[18]Potential sources of these incumbency effects include name recognition, accountability, clientelistic networks, influence within parties, campaign resources, and other advantages that incumbents might enjoy. While other scholars have studied these in isolation (see, e.g., Klašnja and Titiunik (2017)), we make no such attempt. Importantly, we allow incumbency status to bundle all persistent differences between incumbent and non-incumbent candidates, letting ξ_{jn} capture election-specific voter tastes for unobserved candidate characteristics.

[19]Electoral coalitions among parties in Brazil are very common and may even vary across districts within electoral cycle. We parsimoniously account for potential coalition effects by letting the "party brand" of coalition candidates be the sum of their own party's and the mean of other parties' brands in the coalition.

dicate, however, that with a few exceptions (DEM, MDB) party brands are generally not significant for voters' decisions. This corroborates existing findings in the literature on Brazilian politics that elections are fundamentally candidate-centric rather than party-centric.

Finally, Table A.6 presents the estimates of voters' ideological preferences (α, γ, σ). The first-order question here is, do Brazilian voters care at all about candidates' policy positions? We find that they do. A voter at the average value of demographic covariates and policy preference shocks υ_{ki} has a moderately left-wing ideal policy of -0.55 as well as decreasing utility for policies further away from this bliss point. But voters' ideal points vary significantly with, and conditional on, their characteristics. Note, for instance, that an increase in $\%rural$ makes voter i more left-wing whenever

$$\frac{\partial^2 u_{ij}}{\partial D_i^{rural} \partial p_{jn}} = \gamma_1^{rural} + 2\gamma_2^{rural} p_{jn} < 0.$$

Both γ_1^{rural} and γ_2^{rural} are statistically different from zero at conventional levels. Moreover, at the point estimates, the condition above boils down to $-17.426 + 1.642 p_{jn} < 0$, which is always satisfied since $p_{jn} \in [-5, 5]$ for all candidates in the sample. Thus, voters in more rural districts tend to be more left-leaning (see figure A.8 in the Appendix). Similarly, voters in districts that are older, less educated, and with lower employment levels tend to be more left-wing (although generally this depends on the policy level). Somewhat surprisingly, voters in districts with a higher wage also tend to be left-leaning on average.

Interestingly, we find that voters' policy preferences are heterogeneous even

conditional on demographic characteristics. While our point estimate of σ_1 is essentially zero (and imprecisely estimated), our estimate of σ_2 is positive (2.42) and statistically significant. At face value, this uncovers substantial within-district heterogeneity, which is magnified by the fact that it is the non-linear rather than the linear effect of policy on voters' preferences that exhibits individual-level heterogeneity. In contrast with some of the existing literature, this suggests ideological considerations are vibrant in Brazilian politics, and it implies rich patterns of substitutability between candidates that inform their (equilibrium) policy choices.

Evaluating our preference estimates at municipality-level covariates D_t, we recover the average voter's ideal point in each municipality.[20] This is depicted in Figure 4 (see also figure A.9 in the Appendix).

[20]Ideal points are constructed as follows. For each municipality, we simulate a sample registered voters, drawing for each voter i policy preference shocks (ν_{1i}, ν_{2i}) and random utility shocks ϵ_{ijn}. For voters with resulting concave policy preferences ($\alpha_{2i} < 0$), we compute $y_i = -\alpha_{1i}/(2\alpha_{2i})$. We then set $\overline{p} = \max\{|q_{0.5}(y)|, q_{99.5}(y)\}$, where $q_r(y)$ denotes the rth quantile of the y_is. Finally, we truncate y_i to lie in $[-\overline{p}, \overline{p}]$, and, for voters with convex policy preferences (fewer than 2.5%), we set $y_i = \overline{p}$ ($y_i = -\overline{p}$) if $\alpha_{1i} \geq 0$ ($\alpha_{1i} < 0$).

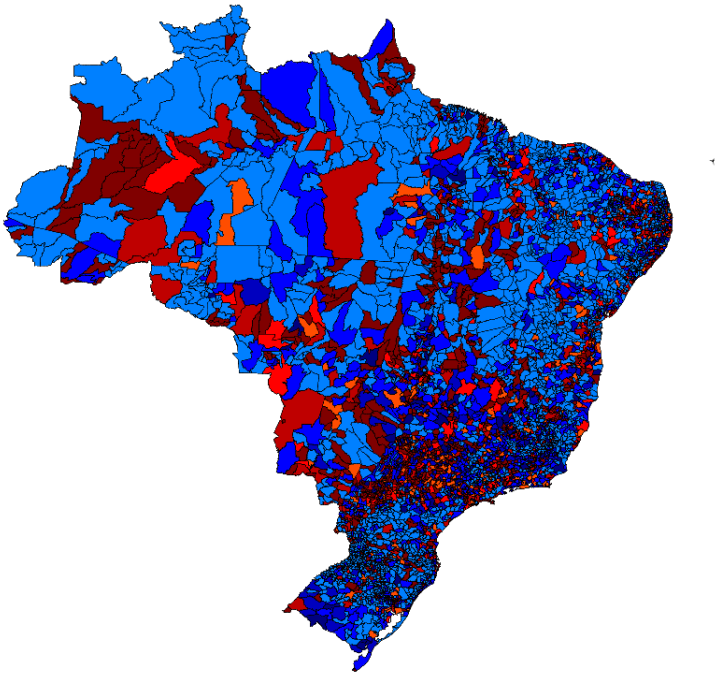


Figure 4: Voters' Ideological Preferences by Municipality (in 2014): darker blue (red) denotes more left-leaning (right) policy preference.

The estimates show a country broadly leaning left ideologically. This is consistent with the political platform of the national executive in our sample, which was held by Lula da Silva (PT) from 2003 to 2010, and by Dilma Rousseff (PT) from 2011 to 2016. But the municipal estimates also show a substantial amount of ideological heterogeneity across regions, and even within states. The northeast and, in particular, south regions are more uniformly left-wing. On the other hand, the southeast and central-west regions (São Paulo, Goias) tend to be more conservative but highly polarized. A similar picture emerges in the north, with states like Roraima leaning left and others like Tocatins

leaning right. Overall, this corroborates well-known patterns of partisanship in Brazil.[21]

4.4 Welfare Gap

With our estimates at hand, we can evaluate voters' welfare *given the actual set of candidates they face* in the data, and compare this welfare with an ideal (but attainable) benchmark.

To do this, we first use our preference estimates to compute expected voter welfare (4.1) per municipality, given the set of candidates who participated in the 2014 election. We approximate expected voter welfare in each municipality by simulating a sample registered voters, drawing for each voter i policy preference shocks (ν_{1i}, ν_{2i}) and random utility shocks ϵ_{ijn}. For each simulation, we compute voter i's welfare at her preferred candidate in the data given her realized shocks. We then average over simulations to approximate the expected welfare of each voter, and we finally average over voters in each municipality.

To compute the ideal benchmark, we average the utility voters would derive from a hypothetical candidate with highest observed and unobserved in-sample valence and policy at their ideal point. Using the realized and ideal measures of welfare, we compute a "welfare gap" as the percentage distance between the two measures. Figure 5 depicts the resulting welfare gap by municipality for the 2014 election.

[21] See, for instance, the 2014 map in Power and Rodrigues-Silveira (2019).

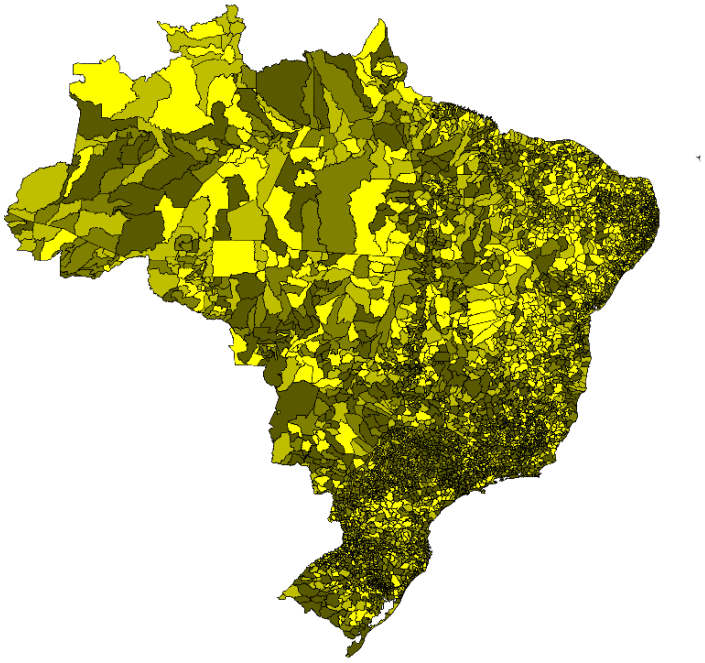


Figure 5: Welfare Gap from "Ideal" Benchmark (2014 election): lighter shade indicates observed welfare is closer to benchmark.

The results illustrate a considerable failure of the Brazilian political system. The mean welfare loss with respect to the ideal benchmark across the 5,507 municipalities is 77%. Moreover, more than 90% of municipalities suffer a welfare loss of at least 54%, while 25% of municipalities suffer a loss of at least 90% of the benchmark. Figure 6 plots the distribution of welfare losses across municipalities by state. Interestingly, two of the richest states (São Paulo and Rio de Janeiro), as well as the Distrito Federal and Mato Grosso do Sul, have a median welfare loss above 87% of the benchmark. On the other hand, the median welfare loss in Ceará, Amapá, and Rio Grande do Norte is below 70%.

While the education, experience, and other valence attributes of the pool of candidates can be taken as fixed in the short-run, candidates can freely choose

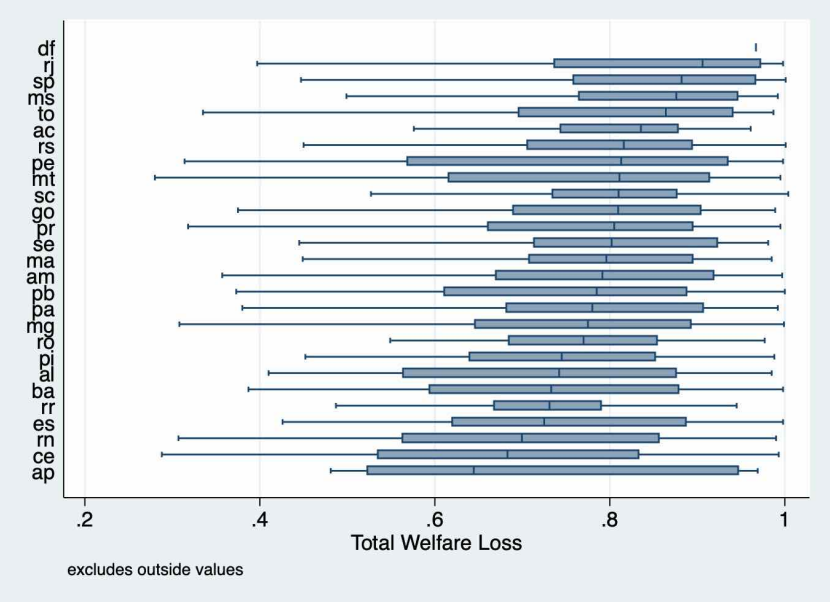


Figure 6: Distribution of Welfare Losses across Municipalities by State (as percentages of the benchmark).

their policy positions. An interesting question, then, is whether competitive forces lead candidates to make policy concessions to voters. If this were the case, the brunt of welfare losses would be due to deficiencies in valence characteristics, not to ideological incongruence between voters and politicians.

In fact, we observe significant heterogeneity in this regard across states. Figure 7 plots the congruence between candidates' policy positions and voters' policy preferences in Rio de Janeiro and Maranhão for PMDB, PSDB, and PT candidates. In Rio de Janeiro, the distribution of the policy positions of candidates from all three major parties tracks the distribution of voter preferences remarkably well. In Maranhão, however, the congruence between candidates and voters is notably lower. To further illustrate this heterogeneity, Figure

A.10 in the Appendix plots the average pointwise distance between the distribution of voters' ideal points and the distribution of candidates' positions for the three major parties in all states.

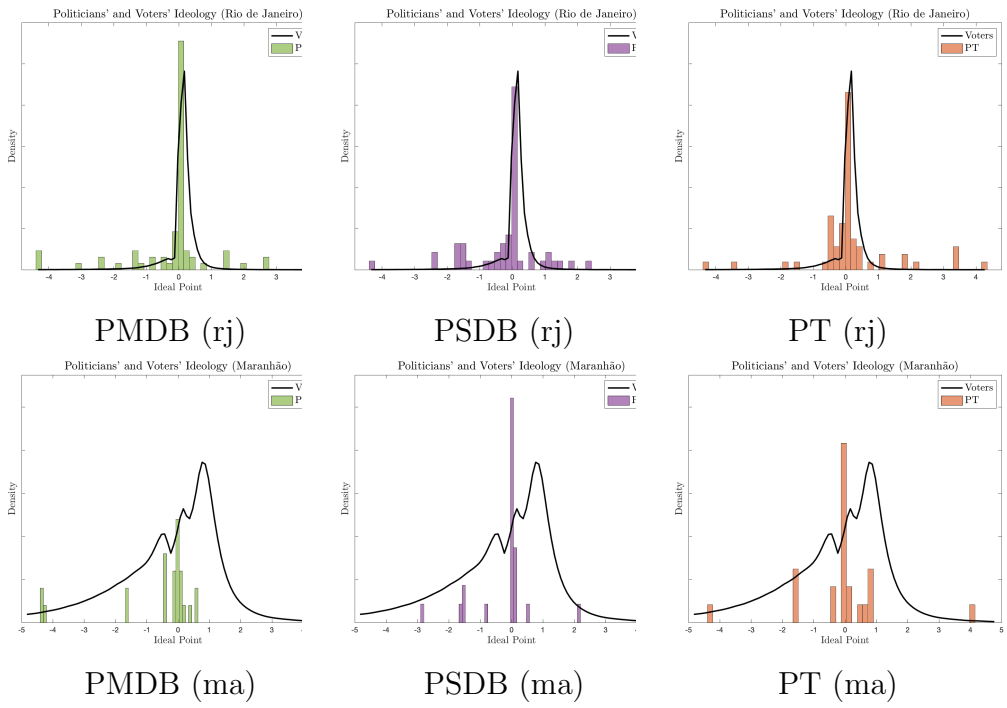


Figure 7: Distribution of Candidates' Policy Positions (bars) and Voters' Policy Preferences (line) in Rio de Janeiro and Maranhão for PMBD, PSDB, and PT Candidates.

To characterize how significant ideological incongruence is for welfare losses, we decompose the welfare gap as follows. We compute an intermediate level of welfare from a hypothetical election in which all candidates choose policies as in the 2014 election, but they all have highest in-sample valence as in the ideal benchmark. Thus, the percentage difference between welfare at the ideal benchmark and this intermediate welfare value can be interpreted as the fraction of the welfare gap due solely to ideological incongruence. Similarly,

the difference between the intermediate and realized welfare values can be attributed solely to valence.

The left panel of Figure 8 plots the distribution of the municipality welfare loss due to policy. In states like Santa Catarina, Rio Grande do Sul, Acre, Tocatins, and Roraima, a considerable fraction of the welfare loss is brought by a mismatch between voters' ideological preferences and candidates' policy positions. Instead, in Rio de Janeiro, Ceará, Pernambuco, and São Paulo, most of the welfare loss is due to shortages in candidates' valence. Casual inspection of this figure might suggest that the competitive pressures leading to ideological congruence may be systematically different in rural and urban states. The right panel of Figure 8 indicates that this is indeed the case. In fact, rural states are much more likely to be poorly served in terms of ideology.

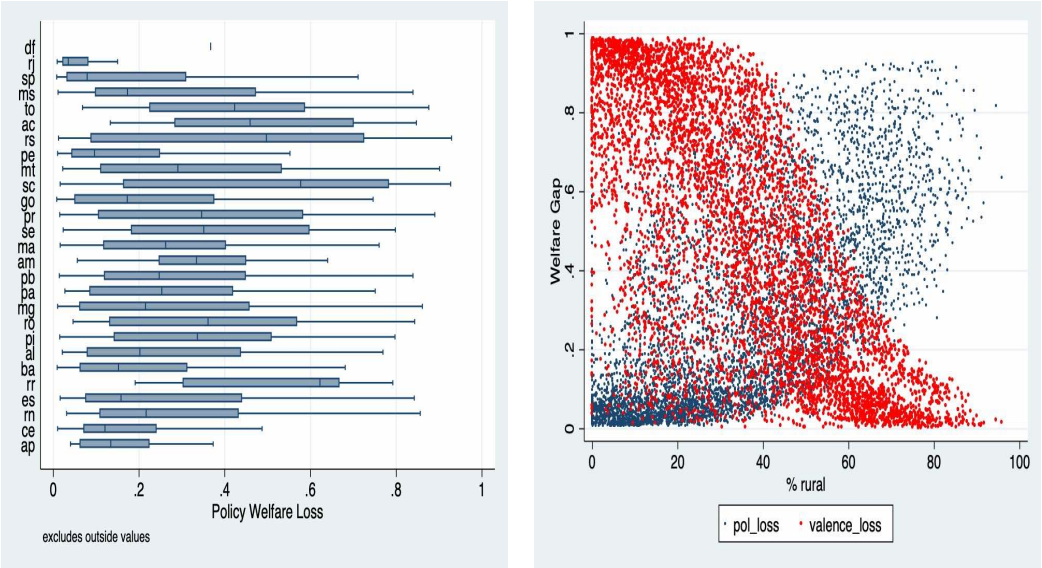


Figure 8: The left panel plots the distribution of the municipality welfare loss due to policy in each state. The right panel plots the policy welfare loss and valence welfare loss per municipality as a function of $\%rural$.

In the following section, we delve into the "supply side" of politics to understand why politicians make these choices.

5 Endogenous Policy Choice

The methodology for estimating voters' preferences described in Section 4 recognizes that candidates' policy positions are endogenous. The approach relies on IVs to deal with this endogeneity. We now take preference estimates as given, and turn to the task of estimating a model of the "supply side" of politics, in which candidates' positions emerge explicitly as equilibrium choices.

Understanding the considerations that lead candidates to diverge from voters' preferences is particularly important in light of the substantial welfare losses due to candidates' policy choices uncovered in Section 4.

We model candidates' policy positions as emerging from a balance – carried out at the party level – between candidates' own policy preferences and electability of the party list. In a first-past-the-post electoral system, individual candidates would fully internalize this tradeoff, contrasting the marginal benefit of an increase in vote share with the marginal cost of a policy concession to voters. In Brazil's open-list PR system, however, individual policy choices can impose externalities on other candidates, both from outside and within the party. The party partially internalizes the externalities that each candidate imposes on its own candidates, limited by each candidate's strength within the party.[22]

We capture the strength of each candidate as the cost the party would face to change policy away from the candidate's ideal policy, and we allow this cost to be a function of candidate-specific covariates, which we estimate. Having estimates of both the "demand" and "supply" side of politics enables counterfactual analyses of how the system would work under different conditions from those observed in the data. We explore these in Sections 5.3 and 5.4.

[22]The degree of substitutability between candidates here is key and is thus part of the motivation for following the BLP estimation approach in Section 4.

5.1 Endogenous Policy Choice: Model and Estimation

There are L parties and N states. We think of the policy position of each candidate j in party ℓ as emerging from a compromise between the goals of the party and of the individual politician.[23] The party wants to maximize its share of seats in the legislature and would like to choose the policies of each of its candidates accordingly. However, each politician finds it costly to adopt a policy position that differs from her own ideal policy. We assume that the party internalizes its politicians' costs to varying degrees, depending on the power of each politician within the party.

Denoting by J_n^ℓ the set of candidates running for party ℓ in state n, by $\mathbf{p}_n^\ell$ the vector of policy positions of all candidates in J_n^ℓ, and by w_n state n's seat share in the legislature, party ℓ's payoff is

$$\Pi^\ell = \sum_{n=1}^{N} \sum_{j \in J_n^\ell} \left[w_n s_{jn}(\mathbf{p}_n^\ell, \mathbf{p}_n^{-\ell}) - \mu_{jn}^\ell |p_{jn} - \theta_{jn}| \right]. \tag{5.1}$$

Here, θ_{jn} denotes candidate j's ideal policy, and we assume $\theta_{jn} \sim N(\theta_n^\ell, (\sigma_n^\ell)^2)$, where both the mean θ_n^ℓ and standard deviation σ_n^ℓ are functions of state covariates. The parameter μ_{jn}^ℓ reflects the weight that party ℓ puts on j's policy preferences and is given by

$$\mu_{jn}^\ell = \exp\left(A_\ell + W_{jn}'\chi + \zeta_{jn}^\ell\right). \tag{5.2}$$

[23] Our empirical results are unchanged if we conduct this analysis at the coalition (or list) level rather than the party level, which suggests the key tradeoffs occur within parties.

Here, A_ℓ is a party fixed effect, W_{jn} is a vector of observed characteristics of the candidate and the state in which she runs, and ζ_{jn}^ℓ is a candidate-specific shock such that $E[\zeta_{jn}^\ell | W_{jn}] = 0$, which is observed by the candidate and the party but not by the analyst.[24]

Letting $\mathbf{p}^\ell \equiv (\mathbf{p}_1^\ell, \ldots, \mathbf{p}_N^\ell)$ and $\mathbf{p} \equiv (\mathbf{p}^1, \ldots, \mathbf{p}^L)$, a (Nash) equilibrium is a profile of policy choices $\tilde{\mathbf{p}} = (\tilde{\mathbf{p}}^1, \ldots, \tilde{\mathbf{p}}^L)$ such that all parties are jointly best responding, i.e., for all ℓ,

$$\tilde{\mathbf{p}}^\ell \in \arg\max_{\mathbf{p}^\ell} \sum_{n=1}^{N} \sum_{j \in J_n^\ell} \left[w_n s_{jn}(\mathbf{p}_n^\ell, \tilde{\mathbf{p}}_n^{-\ell}) - \mu_{jn}^\ell |p_{jn} - \theta_{jn}| \right].$$

The equilibrium necessary first-order conditions for party ℓ in state n imply the following for all of its candidates $j \in J_n^\ell$:

$$\frac{\partial \Pi^\ell(\tilde{\mathbf{p}})}{\partial p_{jn}} = 0 \implies \left| \frac{w_n}{\tilde{p}_{jn}} \left(\tilde{\eta}_{jn,j} \tilde{s}_{jn} + \sum_{j' \in J_n^\ell \setminus \{j\}} \tilde{\eta}_{j'n,j} \tilde{s}_{j'n} \right) \right| = \mu_{jn}^\ell, \tag{5.3}$$

where $\tilde{s}_{j'n} = s_{j'n}(\tilde{\mathbf{p}}_n)$ and $\tilde{\eta}_{j'n,j} = \left(\frac{\partial s_{j'n}(\tilde{\mathbf{p}}_n)}{\partial p_{jn}} \right) \left(\frac{\tilde{p}_{jn}}{\tilde{s}_{j'n}} \right)$ is the elasticity in state n of the vote share of candidate j' with respect to the policy position of candidate j. The parameter μ_{jn}^ℓ captures the marginal cost for the party of moving policy away from the candidate's ideal point. In equilibrium, each party sets policy so that this marginal cost equals the marginal benefit of changing the candidate's policy, which includes the effect of j's policy change on her own vote share, $\tilde{\eta}_{jn,j} \tilde{s}_{jn}$, and its effect on the vote shares of other party candidates, $\sum_{j' \in J_n^\ell \setminus \{j\}} \tilde{\eta}_{j'n,j} \tilde{s}_{j'n}$.

[24] In particular, W_{jn} includes j's unobserved valence ξ_{jn} estimated in Section 4.

Taking logs and substituting expression (5.2), we can write (5.3) as

$$r_{jn} \equiv \log\left(\left|\frac{w_n}{\tilde{p}_{jn}}\left(\tilde{\eta}_{jn,j}\tilde{s}_{jn} + \sum_{j' \in J_n^\ell \setminus \{j\}} \tilde{\eta}_{j'n,j}\tilde{s}_{j'n}\right)\right|\right) = A_\ell + W'_{jn}\chi + \zeta_{jn}^\ell.$$

Note that all the components of r_{jn}, including the equilibrium policy positions, vote shares, and elasticities, are known from the data or from "demand-side" estimates. We can then recover the coefficients A and χ by estimating the linear model

$$r_{jn(j)} = A_{\ell(j)} + W'_{jn(j)}\chi + \zeta_{jn(j)}^{\ell(j)} \quad \text{for all } j \in J^*, \tag{5.4}$$

where $n(j)$ and $\ell(j)$ denote, respectively, the state and party for which j runs. The key inputs that allow us to carry out this exercise and identify the supply-side parameters are the flexible elasticity estimates that we obtained in Section 4 using the BLP approach.

5.2 Endogenous Policy Choice: Estimates

Tables 1 and A.7 present our estimates of the coefficients of the μ function (5.2). For interpretation, note that a positive coefficient implies that a larger value of the associated variable increases the party's marginal cost of inducing the candidate to adopt a policy position different from her preferred policy.

Recall from our voter preference estimates in Section 4.3 that incumbency, education, youth, and lacking a business or bureaucratic background are va-

lence characteristics, which voters value. Notice that the coefficient estimates associated with *all* these attributes are positive and statistically significant. Hence, the first-order lesson from Table 1 is that being endowed with characteristics that voters value empowers individual candidates, prompting parties to choose policies that are more in line with the candidates' own preferences, to the detriment of party votes and voter welfare.[25]

"Supply Side" Estimates (μ function)

Age	0.036	Higher Education	0.313
	(0.028)		(0.125)
Age Sq.	-0.115	Business Exp.	-0.168
	(0.023)		(0.054)
Incumbent 2006	1.658	Gov. Experience	-0.740
	(0.173)		(0.098)
Incumbent 2010	2.295	Technician	-0.057
	(0.145)		(0.136)
Incumbent 2014	2.819	White Collar	-0.095
	(0.200)		(0.068)
Unobserved Valence	0.055	Gender	-0.004
	(0.002)		(0.197)

Table 1: Estimates of Coefficients χ (candidate characteristics) in Model (5.4).

In particular, incumbency has a large estimated effect, even when compared with that of the candidate's professional background or their education (all dichotomous variables). This implies that parties face a significantly larger cost of pushing incumbents to switch their policy positions away from their ideal points relative to new candidates. On the other hand, gender is not statistically significant.

Using these estimates, we can compute, for each party ℓ, the (expected)

[25]This result is in the spirit of Aragones and Palfrey (2002), who show – in the context of winner-takes-all elections with two candidates – that candidates with a valence advantage adopt less moderate positions.

marginal cost of changing the policy position of each of its candidates, μ_{jn}^{ℓ}. As discussed, in equilibrium parties choose candidates' policy positions so that the marginal benefit of changing policy, the left-hand side of (5.3), equals this marginal cost. Thus, the cost, together with vote-share elasticities in each state – which reflect the intensity of electoral competition – determine candidates' equilibrium policies.

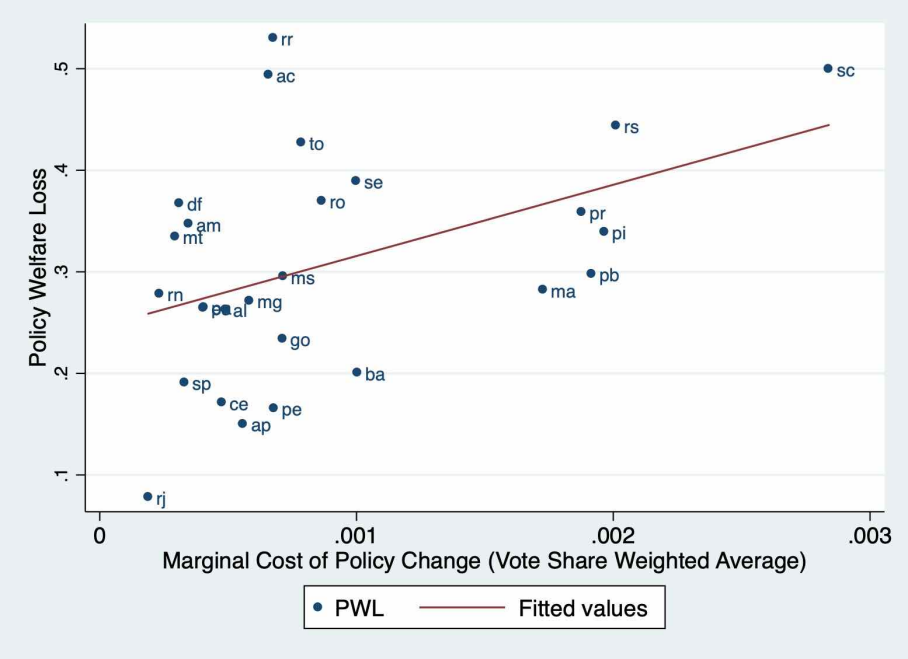


Figure 9: Marginal Cost of Changes in Policy, and Policy Welfare Loss.

Figure 9 plots the vote-share-weighted average of μ_{jn}^{ℓ} for each state, together with the state average policy welfare loss from Section 4.4. The figure shows that, on average, increases in the cost of adjusting policies lead to larger welfare losses due to ideological incongruence between candidates and voters.

In the next section, we use the full equilibrium model of policy choice and voter

demand for candidates to further explore how changes in the characteristics of the candidates running for office affect voter welfare.

5.3 Counterfactual: Better Candidates

A pressing concern for voters and scholars alike is the overall quality of democratic representation and whether institutional reforms aimed at recruiting better candidates can improve voter welfare (Galasso and Nannicini 2011, Ferraz and Finan 2009). As we saw in the previous sections, however, candidates' valence affects voter welfare both directly and indirectly, through its influence on equilibrium policy choices. Because of this, reforms that may seem obviously beneficial to voters (such as increasing candidates' education) might have unintended consequences leading to lower, or even negative, welfare changes.

To evaluate this possibility, in this section we compute direct and indirect changes in welfare resulting from an upward shift in the distribution of candidates' overall valence.[26] Specifically, we consider a counterfactual scenario in which candidates in the bottom three quartiles of the overall valence distribution draw a new valence value from the distribution of candidates in the top quartile.[27] To reduce the computational burden, we focus our analysis on the state of Bahia, whose demographics are most representative of the nation as

[26] Overall valence is computed as the net sum of its observed and unobserved components, i.e., $X'_{jn}\beta + \xi_{jn}$.

[27] In practice, when evaluating any particular policy change (gender quotas, minimal education requirements, no reelection), we need to consider how it might affect other characteristics of the pool of candidates. While any such exercise is feasible in this context, it requires taking a stance on such selection effects. Our proposed exercise allows us to bypass these considerations, focusing instead on the effect of a pure valence improvement.

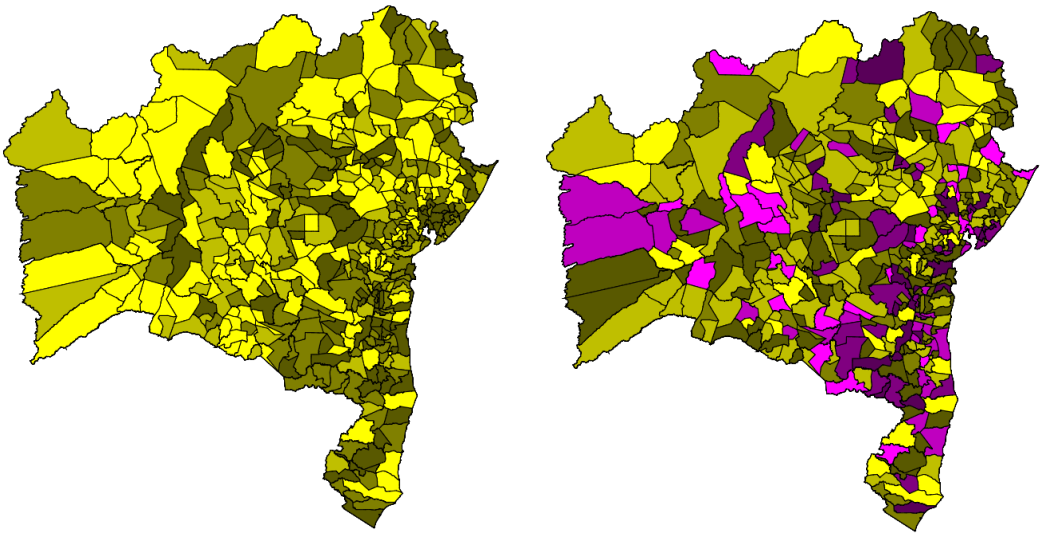
a whole.[28]

Figure 10 presents the results. The left panel plots welfare changes by municipality with fixed policy positions as in the data, while the right panel plots welfare changes with equilibrium policies. Municipalities colored in lighter purple (yellow) experience a higher welfare loss (gain). As we can see in the left panel, keeping policies fixed at the old equilibrium, the valence shock has an overwhelmingly positive effect on welfare. The direct effect of the valence shock increases average voter welfare – measured as a percentage of ideal welfare as in Section 4.4 – across municipalities by 20 percentage points with respect to that in the data. Ninety percent of all municipalities attain an increase in welfare of more than 9 percentage points, while the top quartile registers an increase of average welfare of more than 28 percentage points.

When we consider the full equilibrium effect, however, the picture that emerges is more nuanced. Average welfare still increases considerably, but now only by 11.5 percentage points. Moreover, more than 10 percent of all municipalities experience a welfare loss. This is also illustrated in Figure A.11 in the Appendix, which shows the scatterplot by municipality of percentage changes in welfare with respect to the data with fixed and equilibrium policies.

The analysis shows that the indirect equilibrium effects of changes in valence can be both qualitatively and quantitatively significant, and should not be glossed over when implementing reforms such as female quotas, minimal education requirements, or reelection bans.

[28] We compute equilibrium policies in the counterfactual by best-response iteration starting from the policy positions observed in the data.



Fixed Policies Equilibrium

Figure 10: Welfare Change Following Counterfactual Valence Improvement, Bahia: lighter purple (yellow) indicates higher welfare loss (gain). The left panel plots welfare changes by municipality with fixed policy positions. The right panel plots welfare changes with equilibrium policies.

5.4 Counterfactual: Party Consolidation

A striking feature of the Brazilian political system is the large number of parties and candidates participating in elections, which has led scholars to question the quality of governance in such a fragmented system (Figueiredo and Limongi (2000)). Up to this point, we focused on how the characteristics and number of electoral alternatives affect voter welfare. In this section, we consider their effect on electoral *outcomes*. In particular, we examine the effect of restricting political competition to the top eight parties.[29]

As in the previous counterfactual exercise, the constraint on the number of

[29]We also rule out coalitions in this counterfactual. See the discussion in Footnote 31.

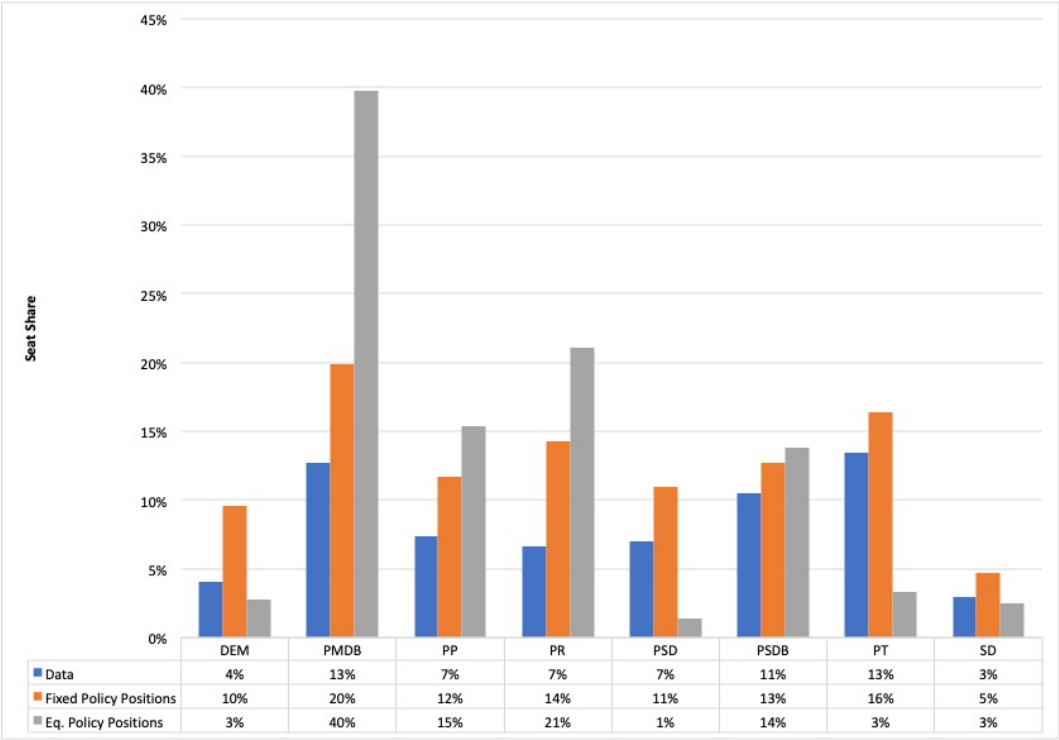
parties fielding candidates for office has both a direct and an indirect effect. A naive analysis would maintain the characteristics of the trimmed set of candidates running for office fixed, and would simply compute how the votes of the excluded candidates get distributed among the surviving candidates. This, however, ignores equilibrium effects, i.e., that the "empty spaces" in the ideological spectrum will prompt candidates to optimally relocate, leading to further changes in vote shares. Thus, the full answer requires that we compute a new equilibrium for the counterfactual set of candidates running for office.[30]

Figure 11 presents the main results of this exercise. With fixed policies, all major parties gain representation in the chamber. The big winners here are the DEM, going from 4% to 10% of the seats, the PMDB, going from 13% to 20%, and PR, going from 7% to 14%. On the other hand, the PSDB, PT, and SD parties see relatively small gains. When we consider full equilibrium effects, however, results change considerably. The PMDB emerges as the clear winner, obtaining 40% of the seats. PP and PR also register significant gains, capturing 15% and 21% of the seats respectively. On the other hand, DEM, PSD, and particularly the PT suffer considerable losses, even with respect to the seat distribution observed in the data.[31]

This counterfactual experiment reaffirms not only the importance of indirect

[30] Once again, the flexibility of the BLP approach (in particular, dispensing with IIA) allows us to do this in a plausible way, without imposing overly restrictive or unrealistic substitution patterns on candidates' policy choices.

[31] While a full analysis of the role of electoral coalitions is beyond the scope of this paper, it is notable that party consolidation effects seem to occur within coalitions. For instance, PMDB emerges as the clear standard-bearer of the "Com a Força do Povo" coalition (see Table A.2), capturing most of the seats lost by coalition partners PSD and PT. Similarly, DEM and SD seats transfer to PSDB, their larger partner in the "Muda Brasil" coalition.



	DEM	PMDB	PP	PR	PSD	PSDB	PT	SD
Data	4%	13%	7%	7%	7%	11%	13%	3%
Fixed Policy Positions	10%	20%	12%	14%	11%	13%	16%	5%
Eq. Policy Positions	3%	40%	15%	21%	1%	14%	3%	3%

Figure 11: Counterfactual: Party Consolidation. The figure plots seat shares in the data (blue), in the immediate response to a trimming of competing parties without policy adjustment (orange), and with policies resulting from a new equilibrium (grey).

equilibrium effects, but also the richness of ideological competition in Brazil, contrary to some views in the literature.[32] Candidates' strategic policy choices have crucial consequences for voter welfare and election outcomes.

[32]Our findings align with more recent scholarship highlighting the growing relevance of programmatic appeals in legislative elections (Hagopian, Gervasoni, and Moraes (2009)).

6 Conclusion

In this paper, we set out to evaluate how well the Brazilian political system serves its voters. To that end, we estimate voters' preferences over candidates, viewing candidates as a collection of both pre-determined valence attributes and endogenous policy positions. This allows us to quantify – for the first time, to our knowledge – how much Brazilian voters value ideological representation relative to valence, and how much weight voters give to individual candidate characteristics relative to party labels.

Using these estimates, we evaluate voters' welfare given the actual set of candidates they face in the data. We compare this welfare with an ideal (but attainable) benchmark in which voters are well served in terms of both valence and ideological representation. The results uncover a large failure of the Brazilian political system that leads to an average welfare loss of 77% relative to the benchmark across the 5,507 Brazilian municipalities.

We further examine the roots of this representation failure. Our estimates imply that, in many states, a significant fraction of the welfare loss is due to ideological incongruence between voters and politicians. To understand why politicians make policy choices that diverge from the preferences of their constituencies, we estimate a model of the "supply side" of politics, in which candidates' positions emerge explicitly as equilibrium choices. A key lesson from this exercise is that candidates with valence advantages are able to put forth policies that are more in line with their own preferences, to the detriment of party votes and voter welfare. Relatedly, we also find that candidates'

power vis-a-vis the parties they represent explains a significant fraction of the welfare loss to voters that is due to ideological incongruence. This complements previous results in the literature on the consequences of weak parties in Brazil.

Through a series of counterfactual experiments, we explore the consequences of potential institutional reforms aimed at improving the quality of representation and governance. By estimating a full model of candidate policy choice and voter demand for candidate characteristics, we are able to gauge not only the direct effects of such reforms, but also indirect effects through equilibrium policy adjustments. Our results caution that what might at first glance seem unambiguously beneficial to voters can have unintended equilibrium consequences, which should not be glossed over when evaluating potential reforms. We hope our analytical approach may provide guidance in this respect.

We also believe our approach can be fruitfully extended to other countries in and outside the region. Doing so would allow us to better understand how well different electoral institutions serve voters' interests. Another fruitful direction for future research is to integrate this approach with a model of selection into politics. This would constitute, without a doubt, a considerable undertaking. However, such an exercise would shed light on the long-term consequences of electoral institutions. We hope that our first step in this direction encourages others to explore these exciting research directions.

References

Ansolabehere, S., and P. E. Jones (2010): "Constituents' Responses to Congressional Roll-Call Voting," *American Journal of Political Science*, 54(3), 583–597.

Aragones, E., and T. R. Palfrey (2002): "Mixed Equilibrium in a Downsian Model with a Favored Candidate," *Journal of Economic Theory*, 103, 131–161.

Berry, S., J. Levinsohn, and A. Pakes (1995): "Automobile prices in market equilibrium," *Econometrica: Journal of the Econometric Society*, pp. 841–890.

Berry, S. T., and P. A. Haile (2014): "Identification in differentiated products markets using market level data," *Econometrica*, 82(5), 1749–1797.

Bohn, S. R. (2011): "Social policy and vote in Brazil: Bolsa Família and the shifts in Lula's electoral base," *Latin American Research Review*, pp. 54–79.

Bonica, A. (2014): "Mapping the ideological marketplace," *American Journal of Political Science*, 58(2), 367–386.

Canes-Wrone, B., D. W. Brady, and J. F. Cogan (2002): "Out of step, out of office: Electoral accountability and House members' voting," *American Political Science Review*, 96(1), 127–140.

Carey, J. M., and M. S. Shugart (1995): "Incentives to cultivate a personal vote: A rank ordering of electoral formulas," *Electoral studies*, 14(4), 417–439.

Desposato, S. W. (2006): "Parties for rent? Ambition, ideology, and party switching in Brazil's chamber of deputies," *American Journal of Political Science*, 50(1), 62–80.

Dubé, J.-P., J. T. Fox, and C.-L. Su (2012): "Improving the Numerical Performance of Static and Dynamic Aggregate Discrete Choice Random Coefficients Demand Estimation," *Econometrica*, 80(5), 2231–2267.

Ferraz, C., and F. Finan (2008): "Exposing corrupt politicians: the effects of Brazil's publicly released audits on electoral outcomes," *The Quarterly journal of economics*, 123(2), 703–745.

——— (2009): "Motivating politicians: The impacts of monetary incentives on quality and performance," Discussion paper, National Bureau of Economic Research.

Figueiredo, A. C., and F. Limongi (2000): "Presidential power, legislative organization, and party behavior in Brazil," *Comparative Politics*, pp. 151–170.

Galasso, V., and T. Nannicini (2011): "Competing on good politicians," *American political science review*, 105(1), 79–99.

Gordon, B. R., and W. R. Hartmann (2013): "Advertising effects in presidential elections," *Marketing Science*, 32(1), 19–35.

Hagopian, F., C. Gervasoni, and J. A. Moraes (2009): "From patronage to program: The emergence of party-oriented legislators in Brazil," *Comparative Political Studies*, 42(3), 360–391.

Hansen, L. P. (1982): "Large Sample Properties of Generalized Method of Moments Estimators," *Econometrica*, 50(4), 1029–1054.

Iaryczower, M., G. L. Moctezuma, and A. Meirowitz (2018): "Career Concerns and the Dynamics of Electoral Accountability," .

Klašnja, M., and R. Titiunik (2017): "The incumbency curse: Weak parties, term limits, and unfulfilled accountability," *American Political Science Review*, 111(1), 129–148.

Linz, J. J. (1990): "The perils of presidentialism," *Journal of democracy*, 1(1), 51–69.

Mainwaring, S. (1999): *Rethinking party systems in the third wave of democratization: the case of Brazil*. Stanford University Press.

Mainwaring, S., T. Scully, et al. (1995): *Building democratic institutions: Party systems in Latin America*. Stanford University Press Stanford.

McFadden, D. (1973): "Conditional Logit Analysis of Qualitative Choice Behavior," in *Frontiers of Econometrics*, ed. by P. Zarembka, pp. 105–142. Academic Press, New York.

Montero, S. (2016): "Going it alone? an empirical study of coalition formation in elections," Typeset, Univeristy of Rochester.

Neto, O. A. (2006): "The presidential calculus: Executive policy making and cabinet formation in the Americas," *Comparative Political Studies*, 39(4), 415–440.

Neto, O. A., and R. da Matriz (1998): "Cabinet formation in presidential regimes: an analysis of 10 Latin American Countries," in *Ponencia presentada en el Meeting of the Latin American Studies Association: The Palmer House Hilton Hotel*.

O'Donnell, G. A. (1998): "Horizontal accountability in new democracies," *Journal of democracy*, 9(3), 112–126.

Power, T. J. (2010): *Political right in postauthoritarian Brazil: elites, institutions, and democratization*. Penn State Press.

Power, T. J., and R. Rodrigues-Silveira (2019): "Mapping Ideological Preferences in Brazilian Elections, 1994-2018: A Municipal-Level Study," *Brazilian Political Science Review*, 13(1).

Power, T. J., and C. Zucco (2012): "Elite preferences in a consolidating democracy: the Brazilian legislative surveys, 1990–2009," *Latin American Politics and Society*, 54(4), 1–27.

Rekkas, M. (2007): "The impact of campaign spending on votes in multiparty elections," *The Review of Economics and Statistics*, 89(3), 573–585.

Samuels, D. (2003): *Ambition, federalism, and legislative politics in Brazil*. Cambridge University Press.

——— (2004): "From socialism to social democracy: Party organization and the transformation of the workers' party in Brazil," *Comparative Political Studies*, 37(9), 999–1024.

Su, C.-L., and K. L. Judd (2012): "Constrained optimization approaches to estimation of structural models," *Econometrica*, 80(5), 2213–2230.

Ujhelyi, G., S. Chatterjee, and A. Szabó (2018): "None of the above," Working paper, University of Houston.

Zucco, C. (2009): "Ideology or what? Legislative behavior in multiparty presidential settings," *The Journal of Politics*, 71(3), 1076–1092.

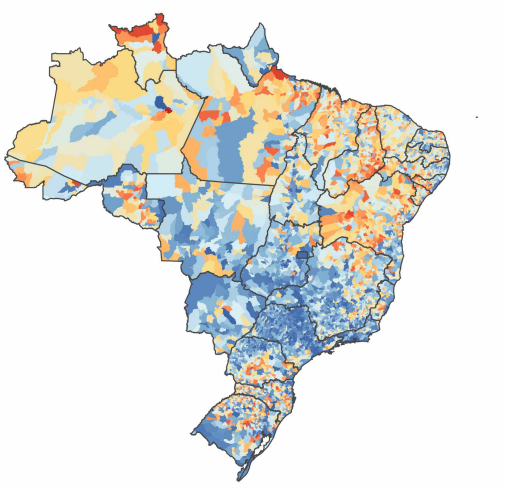
Zucco, C., and B. E. Lauderdale (2011): "Distinguishing between influences on Brazilian legislative behavior," *Legislative Studies Quarterly*, 36(3), 363–396.

A Appendix: Additional Tables and Figures

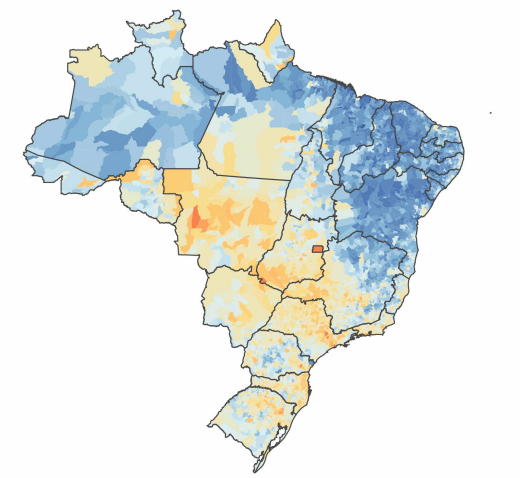
	Representatives		Population		District Mag.
State	Number	%	No.	%	Pop / Legs
São Paulo (sp)	70	13.6%	39,924,091	21.5%	570,344
Minas Gerais (mg)	53	10.3%	19,159,260	10.3%	361,495
Rio de Janeiro (rj)	46	9.0%	15,180,636	8.2%	330,014
Bahia (ba)	39	7.6%	13,633,969	7.3%	349,589
Rio Grande do Sul (rs)	31	6.0%	10,576,758	5.7%	341,186
Paraná (pr)	30	5.8%	10,226,737	5.5%	340,891
Pernambuco (pe)	25	4.9%	8,541,250	4.6%	341,650
Ceará (ce)	22	4.3%	8,450,527	4.4%	371,822
Maranhão (ma)	18	3.5%	6,424,340	3.5%	356,908
Goiás (go)	17	3.3%	5,849,105	3.1%	344,065
Pará (pa)	17	3.3%	7,443,904	4.0%	437,877
Santa Catarina (sc)	16	3.1%	6,178,603	3.3%	386,163
Paraíba (pb)	12	2.3%	3,753,633	2.0%	312,803
Espírito Santo (es)	10	1.9%	3,392,775	1.8%	339,278
Piauí (pi)	10	1.9%	3,086,448	1.7%	308,645
Alagoas (al)	9	1.7%	3,093,994	1.7%	343,777
Amazonas (am)	8	1.6%	3,350,773	1.8%	418,847
Rio Grande do Norte (rn)	8	1.6%	3,121,451	1.7%	390,181
Mato Grosso (mt)	8	1.6%	2,954,625	1.6%	369,328
Distrito Federal (df)	8	1.6%	2,469,489	1.3%	308,686
Mato Grosso do Sul (ms)	8	1.6%	2,404,256	1.3%	300,532
Sergipe (se)	8	1.6%	2,036,227	1.1%	254,528
Rondônia (ro)	8	1.6%	1,535,625	0.8%	191,953
Tocantins (to)	8	1.6%	1,373,551	0.7%	171,694
Acre (ac)	8	1.6%	707,125	0.4%	88,391
Amapá (ap)	8	1.6%	648,553	0.3%	81,069
Roraima (rr)	8	1.6%	425,398	0.2%	53,175
Total	513	100.0%	185,712,713	100.0%	313,514

Table A.1: Number of Representatives per State, and District Magnitude.

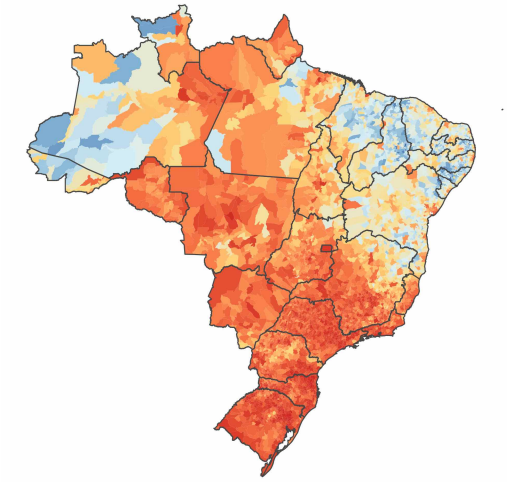
states



% rural



median wage

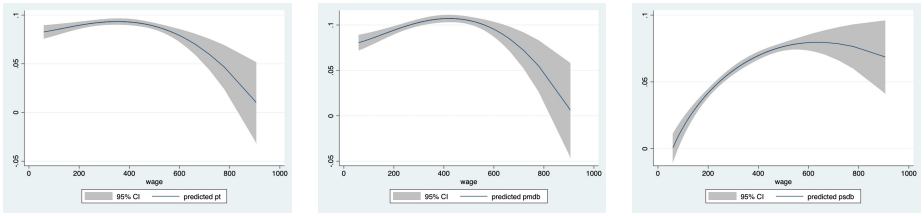


literacy rate

Figure A.1: Socioeconomic Indicators, by Municipality.

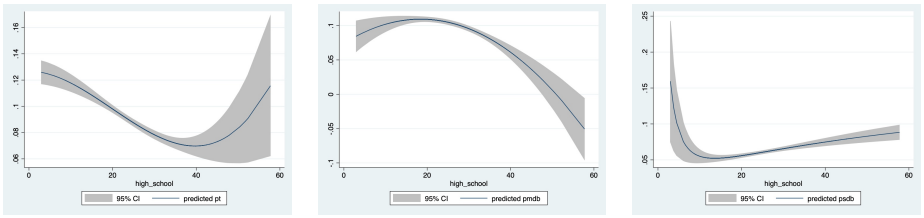
Coalition	Parties	Votes	% of votes	Seats	% of seats
Pro-government Coalition "Com a Força do Povo"	Workers' Party (Partido dos Trabalhadores, PT)	13,554,166	13.93%	68	13.26%
	Brazilian Democratic Movement Party (Partido do Movimento Democrático Brasileiro, PMDB)	10,791,949	11.09%	66	12.87%
	Progressive Party (Partido Progressista, PP)	6,429,791	6.61%	38	7.41%
	Social Democratic Party (Partido Social Democrático, PSD)	5,967,953	6.13%	36	7.02%
	Republic Party (Partido da República, PR)	5,635,519	5.79%	34	6.63%
	Brazilian Republican Party (Partido Republicano Brasileiro, PRB)	4,424,824	4.55%	21	4.09%
	Democratic Labour Party (Partido Democrático Trabalhista, PDT)	3,472,175	3.57%	19	3.70%
	Republican Party of the Social Order (Partido Republicano da Ordem Social, PROS)	1,977,117	2.03%	11	2.14%
	Communist Party of Brazil (Partido Comunista do Brasil, PC do B)	1,913,015	1.97%	10	1,95%
	Total	**54,166,509**	**55,67%**	**303**	**59,07%**
Opposition Coalition "Muda Brasil"	Brazilian Social Democracy Party (Partido da Social Democracia Brasileira, PSDB)	11,073,631	11.38%	54	10.53%
	Democrats (Democratas, DEM)	4,085,487	4.20%	21	4.09%
	Brazilian Labour Party (Partido Trabalhista Brasileiro, PTB)	3,914,193	4.02%	25	4.88%
	Solidarity (Solidariedade, SD)	2,689,701	2.76%	15	2.92%
	Labour Party of Brazil (Partido Trabalhista do Brasil, PT do B)	828,876	0.85%	2	0,39%
	National Labor Party (Partido Trabalhista Nacional, PTN)	723,182	0.74%	4	0.78%
	National Ecologic Party (Partido Ecológico Nacional, PEN)	667,983	0.69%	2	0.39%
	Party of National Mobilization (Partido da Mobilização Nacional, PMN)	468,473	0.48%	3	0.58%
	Christian Labour Party (Partido Trabalhista Cristão, PTC)	338,117	0,35%	2	0.39%
	Total	**24,789,643**	**25,47%**	**128**	**24,95%**
Opposition Coalition "Unidos pelo Brasil"	Brazilian Socialist Party (Partido Socialista Brasileiro, PSB)	6,267,878	6.44%	34	6.63%
	Popular Socialist Party (Partido Popular Socialista, PPS)	1,955,689	2.01%	10	1.95%
	Humanist Party of Solidarity (Partido Humanista da Solidariedade, PHS)	943,068	0,97%	5	0.97%
	Social Liberal Party (Partido Social Liberal, PSL)	808,710	0.83%	1	0.20%
	Progressive Republican Party (Partido Republicano Progressista, PRP)	724,825	0.75%	3	0.58%
	Free Homeland Party (Partido Pátria Livre, PPL)	141,254	0.15%	0	0.00%
	Total	**10,841,424**	**11,15%**	**53**	**10,33%**
Out of coalition *(Fora de coligação)*	Social Christian Party (Partido Social Cristão, PSC)	2,520,421	2.59%	13	2.53%
	Green Party (Partido Verde, PV)	2,004,464	2.06%	8	1,56%
	Socialism and Liberty Party (Partido Socialismo e Liberdade, PSOL)	1,745,470	1,79%	5	0.97%
	Christian Social Democratic Party (Partido Social Democrata Cristão, PSDC)	509,936	0.52%	2	0.39%
	Brazilian Labour Renewal Party (Partido Renovador Trabalhista Brasileiro, PRTB)	454,190	0.47%	1	0.20%
	United Socialist Workers' Party (Partido Socialista dos Trabalhadores Unificado, PSTU)	188,473	0.19%	0	0.00%
	Brazilian Communist Party (Partido Comunista Brasileiro, PCB)	66,979	0.07%	0	0.00%
	Workers' Cause Party (Partido da Causa Operária, PCO)	12,969	0.01%	0	0,00%
	Total valid votes	**97,300,478**	**100,00%**	**513**	**100,00%**

Table A.2: Brazilian Chamber of Deputies Electoral Results 2014.



PT $PMDB$ $PSDB$

Figure A.2: Party Vote Shares and Median Wage, by Municipality.



PT $PMDB$ $PSDB$

Figure A.3: Party Vote Shares and High School Att., by Municipality.

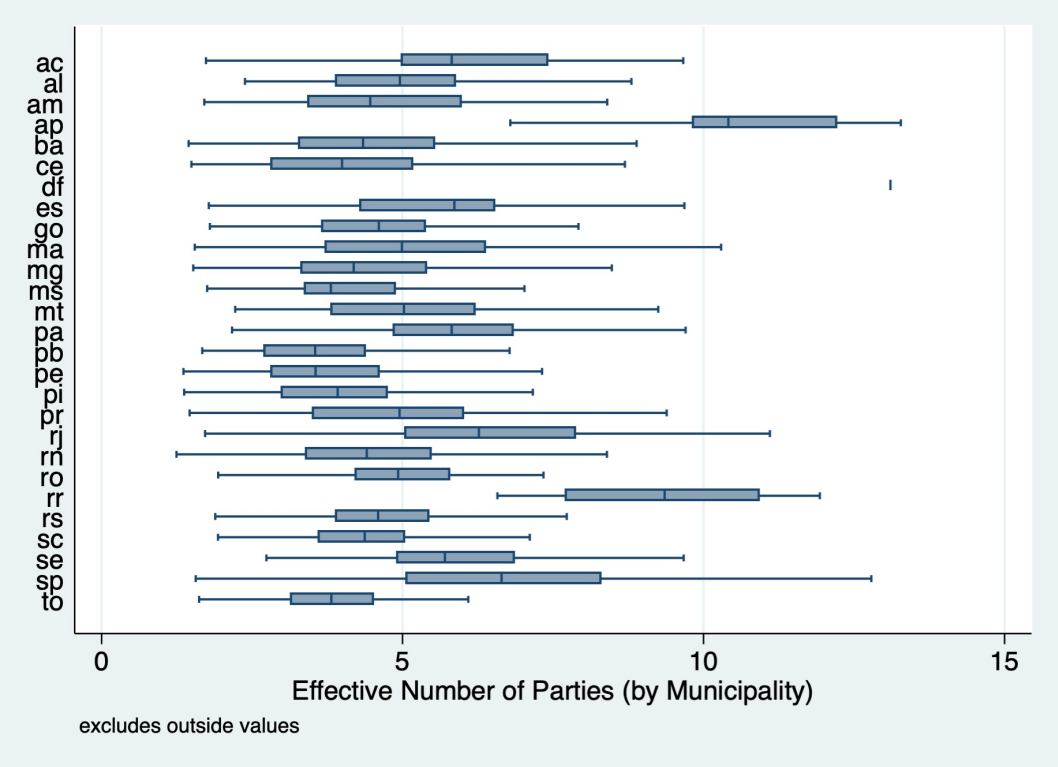


Figure A.4: Effective Number of Parties (municipality-level vote shares) in the 2014 Election, by State.

	2006			2010			2014		
State	Full	Sample	Percent	Full	Sample	Percent	Full	Sample	Percent
Acre	50	34	68.00	37	29	78.38	62	50	80.65
Alagoas	82	55	67.07	63	40	63.49	99	64	64.65
Amazonas	78	41	52.56	51	31	60.78	76	46	60.53
Amapa	63	49	77.78	62	57	91.94	102	85	83.33
Bahia	216	134	62.04	243	145	59.67	287	186	64.81
Ceara	145	83	57.24	114	73	64.04	190	124	65.26
Distrito Federal	106	76	71.70	94	67	71.28	125	109	87.20
Espirito Santo	83	62	74.70	72	62	86.11	147	107	72.79
Goias	109	73	66.97	116	78	67.24	93	63	67.74
Maranhao	153	97	63.40	151	103	68.21	222	136	61.26
Minas Gerais	528	355	67.23	523	357	68.26	595	406	68.24
Mato Grosso Do Sul	70	53	75.71	67	46	68.66	114	80	70.18
Mato Grosso	92	64	69.57	68	42	61.76	86	66	76.74
Para	137	85	62.04	118	77	65.25	170	124	72.94
Paraiba	87	58	66.67	77	64	83.12	90	66	73.33
Pernambuco	198	98	49.49	176	90	51.14	152	100	65.79
Piaui	83	53	63.86	87	63	72.41	85	69	81.18
Parana	258	178	68.99	265	167	63.02	287	203	70.73
Rio De Janeiro	707	416	58.84	751	452	60.19	862	596	69.14
Rio Grande Do Norte	68	37	54.41	60	37	61.67	80	60	75.00
Rondonia	69	58	84.06	71	59	83.10	81	67	82.72
Roraima	81	56	69.14	61	48	78.69	77	71	92.21
Rio Grande Do Sul	279	206	73.84	271	184	67.90	305	236	77.38
Santa Catarina	131	108	82.44	147	109	74.15	124	80	64.52
Sergipe	48	33	68.75	54	39	72.22	72	58	80.56
Sao Paulo	952	671	70.48	1030	755	73.30	1239	871	70.30
Tocantins	70	49	70.00	40	34	85.00	46	39	84.78
Total	4943	3282	66.40	4869	3308	67.94	5868	4162	70.93

Table A.3: Proportion of Candidates with No Missing Data on Covariates (in sample), by State and Electoral Cycle.

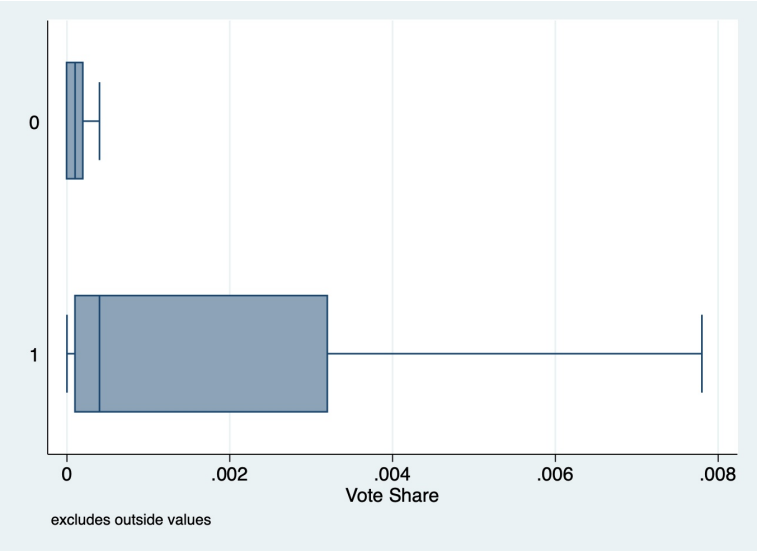


Figure A.5: Vote Share of Candidates With (1) and Without (0) Policy Data.

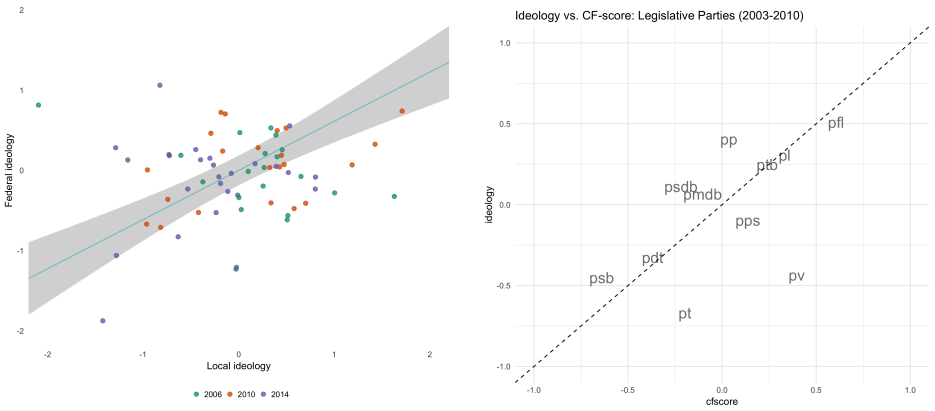


Figure A.6: Face Validity of Policy Measure.

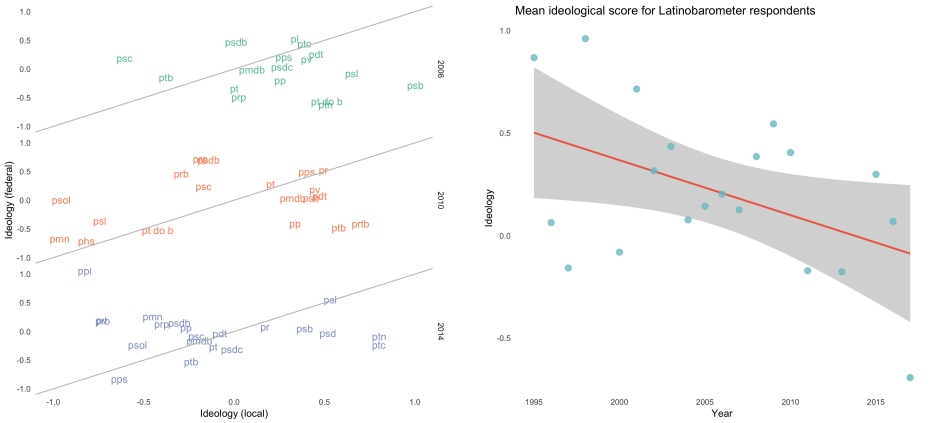


Figure A.7: Progressive Movement to the Left of the Ideological Spectrum: in our estimates (left) and in Latinborometer surveys (right).

	MNL	MNL (Covs)	BLP (Covs)
Age	-0.341	-0.065	-0.309
	(0.123)	(0.128)	(0.093)
Age Sq.	0.091	0.032	0.102
	(0.078)	(0.060)	(0.046)
Gender (male)	0.271	0.325	0.585
	(0.267)	(0.276)	(0.221)
Incumbent 2006	1.316	1.222	0.829
	(0.550)	(0.648)	(0.634)
Incumbent 2010	2.227	2.134	2.368
	(0.611)	(0.634)	(0.519)
Incumbent 2014	2.018	2.108	2.470
	(0.576)	(0.699)	(0.524)
Higher Education	0.216	0.513	0.410
	(0.266)	(0.217)	(0.204)
Business Exp.	-0.847	-0.500	-0.727
	(0.270)	(0.283)	(0.215)
Government Exp.	-0.733	-1.154	-0.527
	(0.364)	(0.338)	(0.295)
Technician	0.282	0.568	0.464
	(0.527)	(0.582)	(0.469)
White Collar	0.470	0.372	0.329
	(0.396)	(0.375)	(0.267)

Table A.4: Parameter Estimates ($\beta^{valence}$): Observed Candidate Characteristics.

	MNL	MNL (Covs)	BLP (Covs)
DEM	0.472	1.404	2.429
	(1.589)	(1.361)	(1.285)
PDT	-0.552	-1.061	-0.157
	(0.639)	(0.458)	(0.413)
MDB	0.576	-0.112	1.043
	(0.787)	(0.614)	(0.505)
PP	-1.583	-1.902	-0.651
	(0.498)	(0.552)	(0.394)
PR	0.008	-0.185	0.070
	(0.723)	(0.507)	(0.384)
PRB	-1.098	-0.542	0.572
	(0.823)	(0.913)	(0.814)
PSB	-0.822	-1.511	-0.245
	(0.613)	(0.496)	(0.455)
PSD	1.379	0.356	0.842
	(1.136)	(0.973)	(1.050)
PSDB	-1.324	-1.934	-0.911
	(0.507)	(0.502)	(0.418)
PT	-0.587	-1.209	0.425
	(0.723)	(0.547)	(0.486)
PTB	-0.315	-0.827	-0.084
	(0.526)	(0.555)	(0.406)

Table A.5: Parameter Estimates: Party Brands (β^{brands}). We display only estimates for parties with at least three million votes.

	MNL	MNL (Covs)	BLP (Covs)
Policy (α_1)	3.527	-4.869	-4.915
	(1.416)	(4.262)	(3.886)
Policy × Median Wage (γ_1^{wage})		-10.949	-7.556
		(5.279)	(4.613)
Policy × % Rural (γ_1^{rural})		-22.329	-17.426
		(7.569)	(6.658)
Policy × % Higher Education (γ_1^{edu})		2.751	2.418
		(3.301)	(3.187)
Policy × % Employed (γ_1^{emp})		13.280	12.957
		(7.451)	(6.753)
Policy × Average Age (γ_1^{age})		-6.273	-7.930
		(3.629)	(3.027)
Policy × % Female (γ_1^{female})		-0.827	2.054
		(4.611)	(4.452)
Policy Sq. (α_2)	-1.968	-1.047	-4.461
	(0.607)	(0.445)	(1.123)
Policy Sq. × Median Wage (γ_2^{wage})		0.316	-0.255
		(0.568)	(0.439)
Policy Sq. × % Rural (γ_2^{rural})		1.036	1.642
		(0.642)	(0.710)
Policy Sq. × % Higher Education (γ_2^{edu})		0.163	0.944
		(0.330)	(0.364)
Policy Sq. × % Employed (γ_2^{emp})		0.976	2.143
		(0.693)	(0.677)
Policy Sq. × Average Age (γ_2^{age})		-0.779	-0.964
		(0.310)	(0.324)
Policy Sq. × % Female (γ_2^{female})		0.317	0.378
		(0.447)	(0.450)
Policy × Individual Ideology (σ_1)			0.0002
			(1127.6)
Policy Sq. × Individual Ideology (σ_2)			2.423
			(0.727)

Table A.6: Parameter Estimates: Policy Preference.

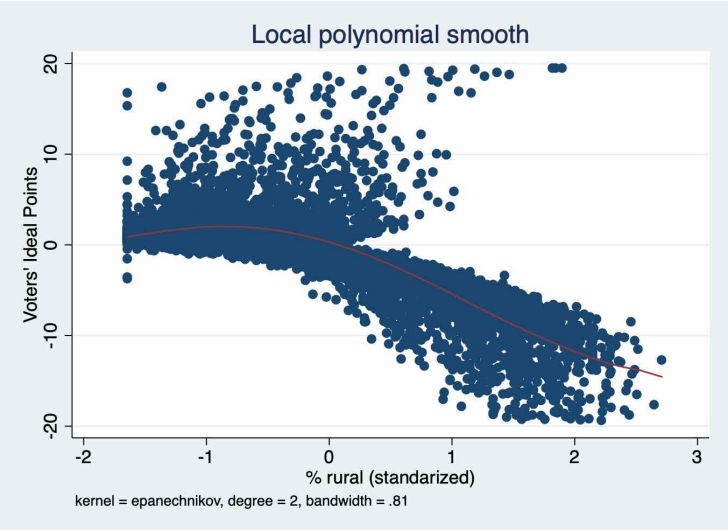


Figure A.8: Voters' Policy Preferences (as a function of $\%rural$ in each municipality).

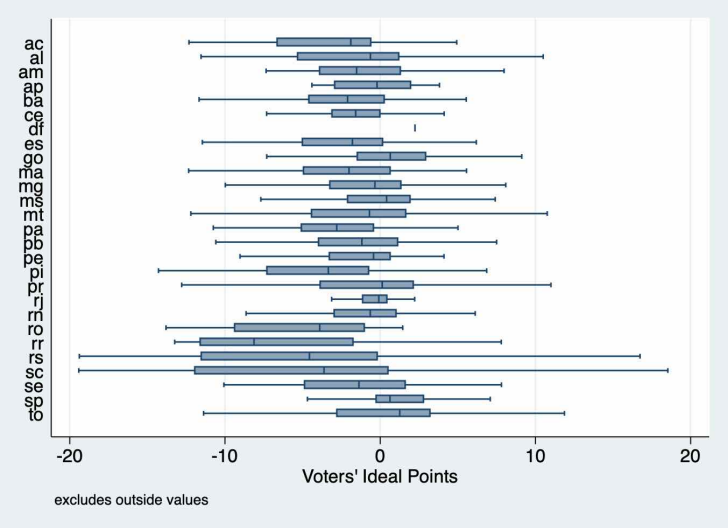


Figure A.9: Distribution of Average Municipality Ideological Preference, by State.

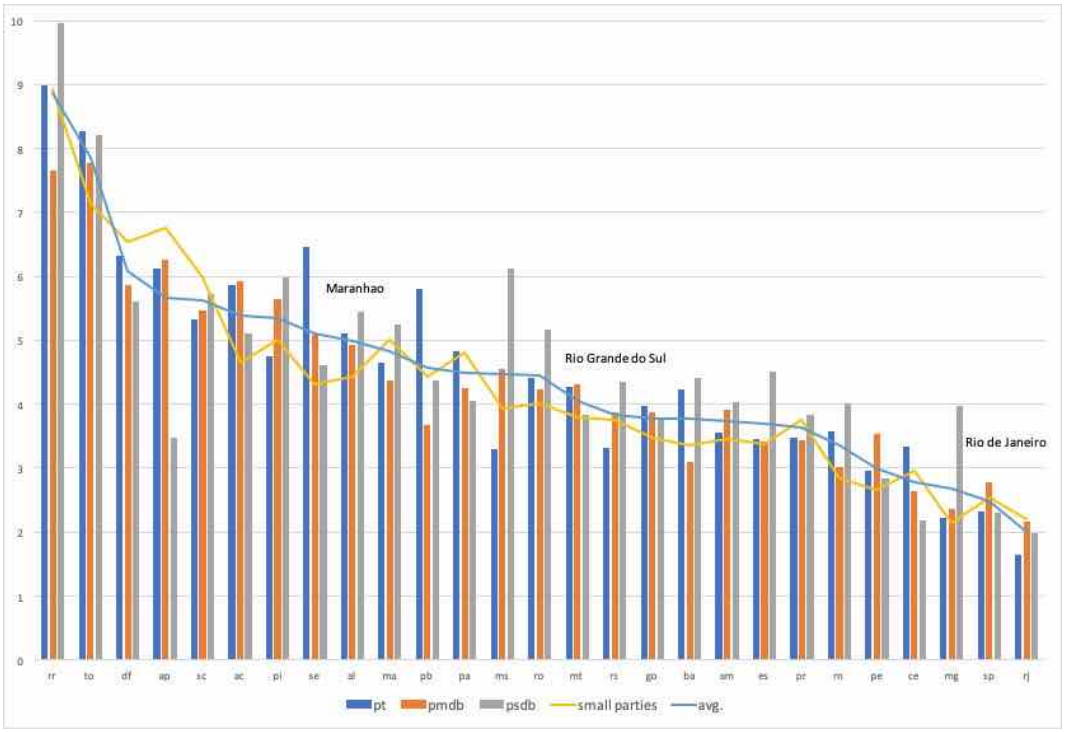


Figure A.10: Average point-by-point distance between distribution of voters' ideal points and distribution of candidates' positions for selected parties.

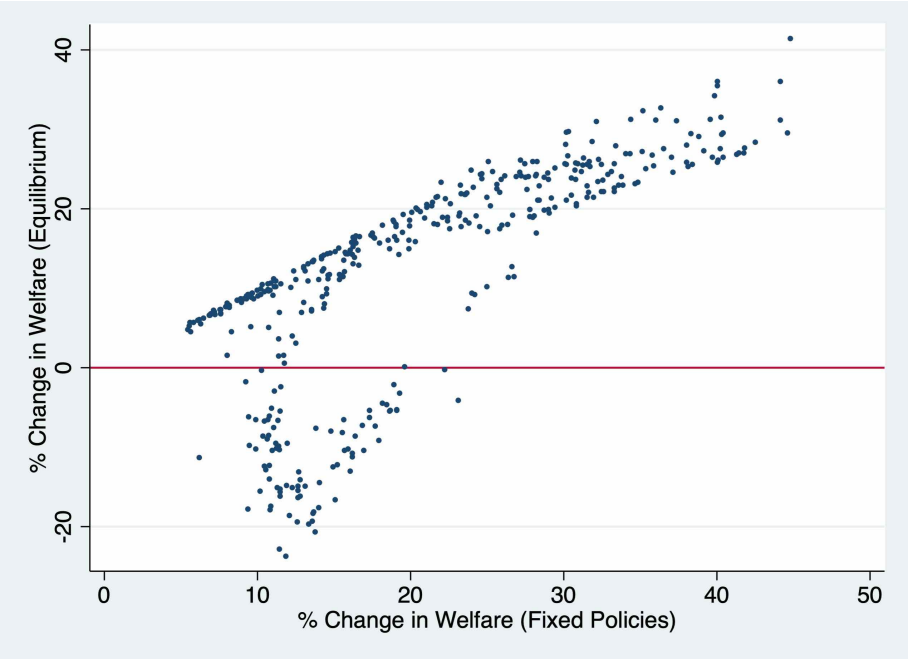


Figure A.11: Valence Improvement Counterfactual: % change in welfare with fixed (horizontal axis) and equilibrium policies (vertical axis)

"Supply Side" Estimates (μ function)			
State Characteristics			
Median Wage	-0.190	% Higher Education	0.435
	(0.290)		(0.165)
% Rural	1.337	% Employed	4.546
	(0.359)		(0.384)
Average Age	-1.219	% Female	1.182
	(0.097)		(0.228)
Party Fixed Effects			
DEM	-1.801	PDT	-2.507
	(0.266)		(0.318)
MDB	-2.165	PP	-2.173
	(0.352)		(0.288)
PR	-1.001	PRB	-3.147
	(0.474)		(0.538)
PSB	-2.605	PSD	-1.382
	(0.387)		(0.452)
PSDB	-2.176	PT	-2.185
	(0.260)		(0.287)
PTB	-2.208		
	(0.592)		

Table A.7: Estimates of Coefficients χ (state characteristics) and Party Fixed Effects A in Model (5.4).

B Appendix: Estimation of Voters' Preferences

B.1 GMM Estimation and Inference

As discussed in Section 4.2, a GMM estimator of the parameters of our model can be obtained by minimizing the quadratic form

$$Q_{J^*}(\theta) = \xi(\theta)' Z W Z' \xi(\theta),$$

where $\xi_{jn}(\theta)$ is defined by (4.7). Under standard GMM regularity conditions (see Hansen (1982) and Berry, Levinsohn, and Pakes (1995)), this estimator, $\hat{\theta}$, satisfies

$$\sqrt{J^*}(\hat{\theta} - \theta_0) \xrightarrow{d} N(0, (G'WG)^{-1} G'W\Omega W'G(G'W'G)^{-1})$$

as the sample size $J^* \to \infty$. Here,

$$G = E[Z_{jn} \nabla_\theta \xi_{jn}(\theta_0)] \quad \text{and} \quad \Omega = E[Z'_{jn} \xi_{jn}(\theta_0) \xi_{jn}(\theta_0)' Z'_{jn}]$$

are the gradient and variance, respectively, of the moment conditions (4.8). Notice that the optimal weighting matrix $W^* = \Omega^{-1}$ minimizes the asymptotic variance of the estimator, which then simplifies to $(G'\Omega^{-1}G)^{-1}$. This suggests a two-step estimation approach, which we follow.

In a first step, a consistent but inefficient estimate $\tilde{\theta}$ of θ_0 can be obtained

by minimizing $Q_{J^*}(\theta)$ using any positive-definite matrix $\tilde{W}$.[33] Then, allowing for potential correlation in unobserved valence across candidates in the same race, the optimal weighting matrix can be consistently estimated as $\tilde{W}^* = \tilde{\Omega}^{-1} = \left(Z' V_\xi(\tilde{\theta})' Z\right)^{-1}$, where $(V_\xi(\tilde{\theta}))_{jj'} = \xi_j(\tilde{\theta})\xi_{j'}(\tilde{\theta})$ if j and j' compete in the same race and $(V_\xi(\tilde{\theta}))_{jj'} = 0$ otherwise. In a second step, reestimating the model using $\tilde{W}^*$ delivers a consistent and efficient estimate $\hat{\theta}$ of θ_0. For robust inference, again allowing for potential correlation in unobserved valence across candidates in the same race, a consistent estimate of the asymptotic variance of $\hat{\theta}$ can be obtained as $(\hat{G}'\hat{\Omega}^{-1}\hat{G})^{-1}$, where $\hat{G} = Z'\nabla_\theta \xi(\hat{\theta})$ and $\hat{\Omega} = Z' V_\xi(\hat{\theta}) Z$.

B.2 MPEC Approach

As noted in Section 4.2, the traditional BLP "nested fixed point" (NFXP) algorithm for computing $\hat{\theta}$ can be inefficient and very sensitive to convergence criteria. We rely instead on the MPEC approach of Su and Judd (2012). The key idea is that, rather than "inverting" vote shares at each step of the optimization search, which involves costly fixed point calculations, we can simply impose $\tilde{s}_{jn}(\delta_n, \sigma) = \hat{s}_{jn}$ as explicit constraints on the optimization program. Since modern optimization algorithms only enforce constraints at convergence, this can considerably reduce the computational burden.

Further computational gains can be obtained by exploiting sparsity. Specifically, we estimate $\hat{\theta}$ by solving the following mathematical program with equi-

[33] We employ an approximation of Ω^{-1} using the residuals of the homogeneous version of our model with $\sigma = 0$. Recall that estimation in this case boils down to a linear regression via two-stage least squares.

librium constraints:

$$\min_{\theta,\xi,\psi} \psi' W \psi \text{ subject to}$$

$$\psi = Z'\xi \text{ and} \tag{B.1}$$

$$\tilde{s}_{jn}(\delta_n, \sigma) = \hat{s}_{jn} \text{ for all } j, n, \text{ where} \tag{B.2}$$

$$\delta_{jn} = \sum_{k=1}^{2} (\alpha_k + D_n' \gamma_k) p_{jn}^k + X_{jn}' \beta + \xi_{jn}. \tag{B.3}$$

Dubé, Fox, and Su (2012) show that this MPEC and the traditional BLP NFXP algorithm yield theoretically identical estimates of θ_0, but the MPEC approach delivers superior numerical performance. While the computational cost of estimation may seem to increase by treating ξ and the moment conditions ψ as auxiliary variables – and thus expanding the size of the optimization problem – note that (B.1) and (B.3) are linear constraints and (θ, ξ) no longer enter the objective function directly. This, together with the sparsity that results from ξ_{jn} having no effect on vote shares outside of j's district and electoral cycle, adds to the computational advantages over NFXP from avoiding repeated fixed point calculations.

Realizing these gains, however, requires state-of-the-art optimization software, capable of handling problems with thousands of variables and nonlinear constraints. We implement our MPEC estimator using the industry-leading Knitro.[34] We employ Knitro's Interior-Point/Conjugate-Gradient algorithm, to which we provide exact first derivatives of the objective and constraints.

[34] https://www.artelys.com/en/optimization-tools/knitro