Representation Failure*

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Abstract

Democratic representation is limited by the alternatives available to voters. We develop a methodology to gauge the extent to which the "supply side" of politics hinders voter welfare. Using rich data on thousands of candidates in three Brazilian legislative elections, we quantify the relative value voters place on candidates' policy positions and valence attributes, and evaluate voters' welfare given the set of candidates they face. We uncover substantial welfare losses: in half the country, average voter welfare is at least 80% lower than in an ideal representation benchmark. A large fraction of these losses are due to ideological incongruence between voters and politicians. To explain why candidates choose policy positions that diverge from voters' preferences, we develop and estimate a model of equilibrium policy determination. 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 democracies around the world have expressed discontent with the entire political system. From public demonstrations to overwhelming disapproval in opinion polls, large fractions of voters seem dissatisfied with the alternatives available to them. Such a systemic representation failure could severely undermine democracy. Freedom of choice, in effect, is only as good as the alternatives available to voters. How much does the "supply side" of politics undermine effective representation? Does this vary with the characteristics of voters in each constituency? Is voter dissatisfaction due primarily to ideological incongruence with politicians or to shortages in non-ideological attributes of the pool of candidates?

In this paper, we develop a methodology to quantify representation failures in a given democratic system, and apply it to legislative elections for Brazil's *Câmara dos Deputados*. Our approach is twofold. First, we use rich data on thousands of candidates running for office, voters' socioeconomic characteristics, and election results to estimate voters' preferences over candidates. In particular, we quantify the relative value voters place on policy positions versus non-ideological candidate attributes (valence).[1] We then use our estimates to evaluate the welfare loss to voters that can be attributed to limitations in the pool of candidates they face.

Brazil's electoral system makes the country particularly well suited for our analysis. First, in Brazil's open-list proportional-representation (PR) system, voters cast their ballots overwhelmingly for individual candidates rather than political parties. This

[1] We are aware of only a few papers that provide a measure of the relative importance of ideology and valence with field data. These papers use a range of methodological approaches: Kendall, Nannicini, and Trebbi (2015) combine structural estimation with a field experiment concerning a mayoral election in Italy; Beath, Christia, Egorov, and Enikolopov (2016) conduct a field experiment in Afghanistan; and Buttice and Stone (2012) use regression analysis in the context of the U.S. House of Representatives.

allows us to link voters' choices with individual candidates' characteristics rather than those of an entire list, as would be the case in a closed-list PR system. Second, voters typically choose from among a large menu of candidates in each constituency. Such richness of choice gives us great purchasing power to identify voters' preferences over candidate attributes. Third, differently from majoritarian elections, open-list PR elections mitigate wasted-vote considerations, enabling us to sidestep complications associated with strategic voting.

To estimate voters' preferences, we follow the methodological approach of Berry, Levinsohn, and Pakes (1995) (BLP), originally developed to estimate demand for differentiated products. 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.[2] The BLP approach provides two key advantages. First, by allowing preferences to depend on both observable and unobservable voter characteristics, it overcomes the independence of irrelevant alternatives (IIA) property inherent in standard multinomial logit models, enabling feasible estimation of rich substitution patterns across candidates.[3] Second, the approach explicitly accounts for unobserved heterogeneity in candidate valence (e.g., charisma), allowing us to disentangle voters' preferences for policy relative to non-ideological attributes.

Our estimates uncover a rich heterogeneity in preferences. Voters' preferred policies vary in systematic ways with observable characteristics of electoral districts, and they are heterogeneous within-district, after controlling for observables. For the typical

[2] Other applications of BLP in electoral contexts include Rekkas (2007) and Gordon and Hartmann (2013), who estimate the effect of campaign spending on electoral outcomes in Canadian (legislative) and U.S. (presidential) elections, respectively; Montero (2016), who estimates the electoral impact of coalition formation in Mexican legislative elections; and Ujhelyi, Chatterjee, and Szabó (2018), who study protest votes in India.

[3] This is particularly relevant in an electoral setting, 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.

candidate, though, policy considerations are eclipsed by voter demand for valence attributes: we estimate that a 1% change in policy position would require only a compensating change of about 0.08% in valence for vote shares to remain unaltered. Nevertheless, there is considerable heterogeneity both across and within districts in the importance that voters give to valence relative to ideology: for 25% of candidates in the sample, a 1% change in policy would require a compensating variation of at least 1.6% in valence for vote shares to remain unchanged.

With preference estimates in hand, we turn to our main objective of quantifying the loss in voter welfare attributable to deficiencies in the pool of candidates. To do this, we (i) evaluate voters' welfare given the actual set of candidates they face in the data and (ii) compare this measure of welfare with that coming from an ideal representation benchmark in which each voter is able to select her preferred candidate in all attributes.

Our results uncover a considerable failure of the Brazilian political system: across Brazil's 5,507 municipalities, we estimate a median welfare loss of 80% relative to the benchmark. In fact, even if we limit the number of "ideal" benchmark candidates per district to that observed in the data, or compare welfare with what voters would obtain if they could choose from among all candidates running in *any* district (with valence and policy positions as observed in the data), median welfare losses decrease only to 75% or 62%, respectively.

In many municipalities across Brazil, a significant fraction of the total welfare loss is due to ideological incongruence between voters and politicians.[4] To understand why politicians diverge from the policy preferences of their constituents, we develop and

[4]We find that ideological incongruence between politicians and voters is systematically larger in rural municipalities, while voters in urban municipalities tend to be systematically underserved in valence characteristics.

estimate a model of the "supply side" of politics in which candidates' policy positions emerge explicitly as equilibrium choices, taking valence differentials as given.[5] We model candidates' policies as resulting from a balance—carried out at the party level—between candidates' own policy preferences and electability of the party list.[6]

Our estimates reveal 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. We also find that variation in candidates' power vis-à-vis parties explains a significant fraction of the welfare loss to voters that is due to ideological mismatch with politicians. Specifically, districts in which parties are weak relative to their candidates tend to experience larger policy welfare losses.

As this discussion illustrates, candidate valence affects voter welfare both directly and through its influence on equilibrium policy choices. Thus, reforms aimed at improving the quality of representation (e.g., education requirements) could have unintended consequences leading to lower, or even negative, welfare changes. To evaluate whether these indirect equilibrium effects could be quantitatively meaningful, we consider a counterfactual scenario wherein candidates in the bottom three quartiles of the overall valence distribution draw a new valence value from the top quartile. We show that equilibrium policy adjustments would indeed offset the positive direct effect of higher valence on voters' welfare, leading to welfare losses for some voters. Our results caution that indirect equilibrium effects should not be glossed over when evaluating

[5]Methodologically, our approach is similar to that of recent studies in political science that estimate parameters of interest from the equilibrium conditions of a formal model—see, e.g., Ascencio and Rueda (2019).

[6]For formal models of electoral competition with valence differentiation in winner-takes-all elections, see Groseclose (2001), Aragones and Palfrey (2002), Hummel (2010), Ashworth and De Mesquita (2009), Bernhardt, Câmara, and Squintani (2011), and Krasa and Polborn (2012). For formal models of electoral competition with valence differentiation in proportional-representation systems, see Iaryczower and Mattozzi (2012), Iaryczower and Mattozzi (2013), and Galasso and Nannicini (2017).

potential reforms.

2 Brazilian Legislative Elections

We focus our analysis on elections of representatives for 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 8 or more than 70 seats.[7]

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 (Bormann and Golder 2013). Within each list, seats are assigned to candidates in descending order of votes received. Representatives are elected for four-year terms, with no constraints on reelection.[8]

The open-list PR system fosters a fragmented multiparty system (Mainwaring, Scully, et al. 1995). In the 2014 election, 28 parties placed candidates in the lower chamber.[9] The dispersion of votes across multiple parties results partly from regional vote concentration, but vote fragmentation arises even at the local level. This can be seen in

[7]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.

[8]Reelection rates are high: in 2014, over 74% of incumbents secured reelection.

[9]Table A.2 in the Appendix lists all parties gaining seats in the Câmara dos Deputados in 2014 with their respective vote and seat shares.

the left panel of Figure A.4 in the Appendix, which plots the empirical distribution of the effective number of parties in 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 rural population shares, median wages, and literacy rates across municipalities. 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. As shown in Figures A.2 and A.3 in the Appendix, poorer municipalities tend to vote overwhelmingly for the leftist PT, while wealthier municipalities tend to support the right-leaning PSDB.

2.1 Legislative Candidates

Brazil's electoral system puts individual candidates at the center of political choice. Indeed, the literature notes that (i) parties are weak, under-resourced, and often unable to constrain opportunistic behavior by individual legislators (Samuels 2003, Desposato 2006, Klašnja and Titiunik 2017); (ii) open-list PR and a lack of formal mechanisms channeling resources to congressional party leaders promote candidate-centric legislative careers (Mainwaring, Scully, et al. 1995, Samuels 2003); and (iii) 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, 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 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 and political experience, level of education, and gender.[10] For over 10,000 candidates, we are also able to obtain a measure of their policy positions using individual campaign contributions and the methodology outlined in Bonica (2014). We describe this in detail below.

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. Similarly, while only about half of the candidates have higher education, this figure increases 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.

While the education, professional experience, gender, and other valence attributes of candidates seem clearly important to voters, the policy positions candidates adopt may also be relevant. This has been shown in the U.S. and elsewhere.[11] Whether it

[10]This information is available from the *Tribunal Superior Eleitoral* (TSE).

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

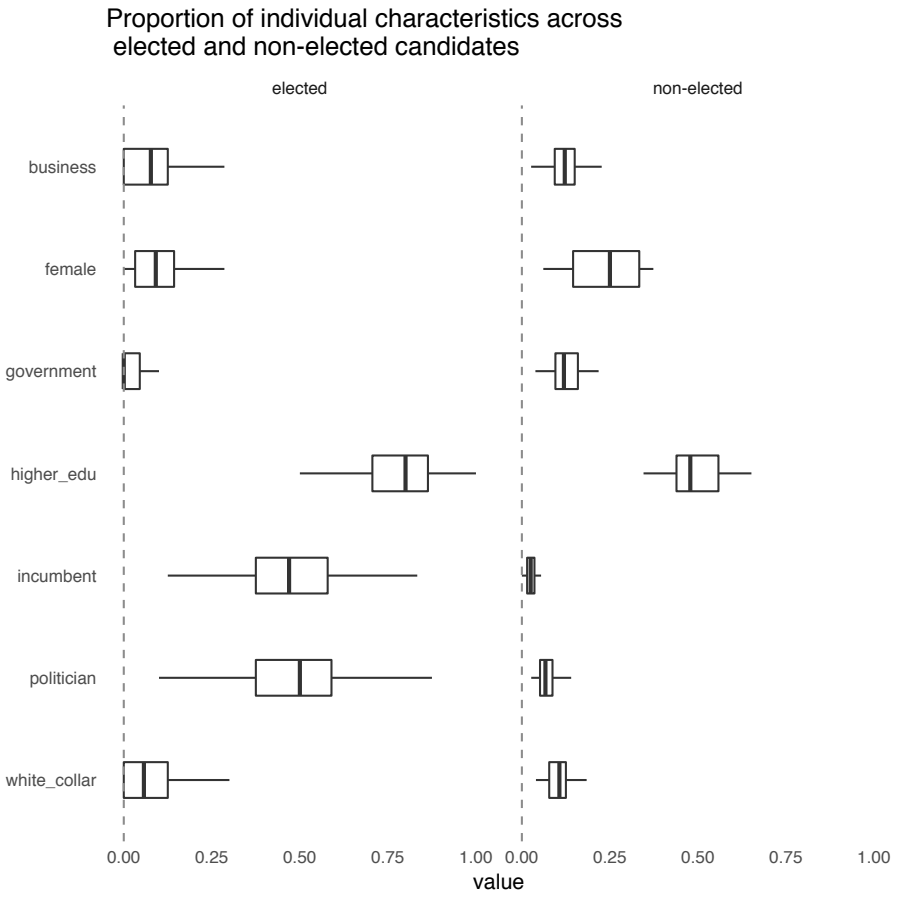


Figure 1: Candidates Observable Non-Policy (Valence) Characteristics.

is also true in Brazil, and how much weight voters put on ideology relative to valence, is an empirical question.

Estimating 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, there are no currently available measures of both incumbents' and challengers' policy positions for Brazilian legislative elections.[12] To address

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

this problem, we follow the approach of Bonica (2014) and produce our own estimates of candidates' policy choices, using micro-level data on campaign contributions for 2004-2014.[13] We also use this approach to estimate the policy positions of mayoral candidates, which prove useful in the estimation of our main model, as discussed later. While Bonica interprets these estimates as politicians' preferred policies, we only make the assumption that these are the candidates' policy choices, which could or not correspond to their true preferences.

To implement this approach, we use data on micro-level dyadic contributions, which include both individual and corporate donations.[14] Since corporations may donate to candidates strategically to secure access, 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.[15] 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.[16]

We perform a battery of sanity checks of the external and internal validity of our

[13] In U.S. data, Bonica's estimates closely match ideal point estimates obtained using roll-call data. The key assumption behind Bonica's approach is that a 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) more money to candidates that are closer to their ideal point, which in turn allows us to rank candidates' positions in the policy space.

[14] 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.

[15] Under-the-table donations—*caixa dois*—are common, but previous research using the same data shows that officially-declared donations capture the majority of campaign contributions (Boas, Hidalgo, and Richardson 2014).

[16] 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 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.

candidate policy estimates. The left panel of figure A.6 in the Appendix shows that 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) 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.

In the next section, we use this information on candidates' valence characteristics and policy choices, along with election results, 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 someone with 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 2 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.

3 Voter Preferences

To estimate voters' preferences over both candidates' policy positions and valence characteristics, we follow the approach of Berry, Levinsohn, and Pakes (1995) (BLP). Our data are particularly well suited for this technique as we have rich variability from over 10,000 candidates across multiple constituencies and electoral cycles. Combined with suitable instruments, this provides identification and allows us to obtain precise estimates.

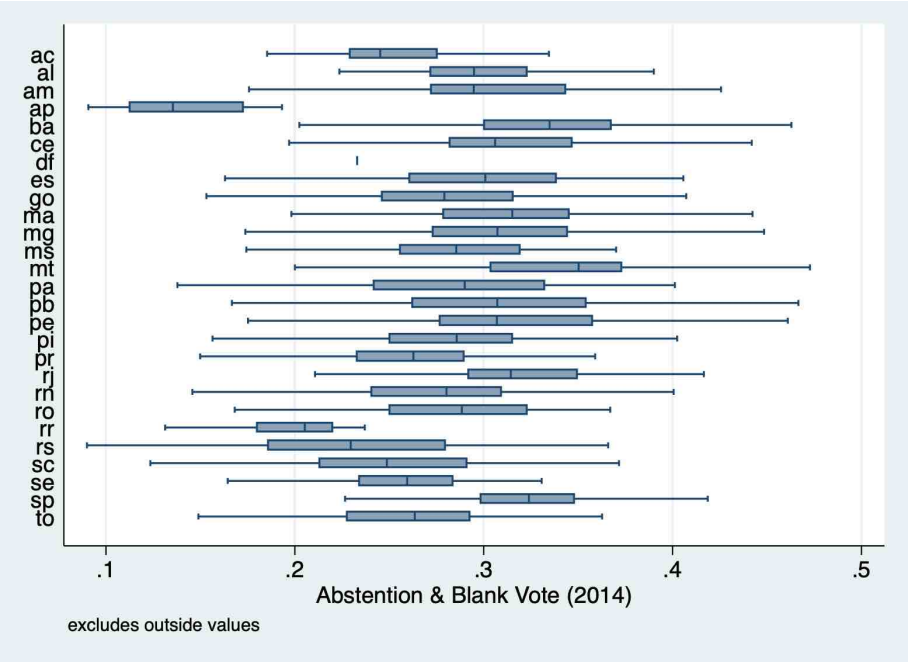


Figure 2: Distribution of Abstention and Blank Vote Shares (among registered voters) in Each Municipality, by State.

3.1 Voter Preferences: Empirical Model

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

$$u_{ijn} = \alpha_{1i} p_{jn} + \alpha_{2i} p_{jn}^2 + X_{jn}'\beta + \xi_{jn} + \epsilon_{ijn}, \tag{3.1}$$

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. This formulation has two noteworthy features.

First, despite our access to detailed information about candidates collected in X_{jn}, there remain electorally significant attributes—such as charisma or trustworthiness—that may affect voters' preferences but are unobserved by the analyst. 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}.

Second, the coefficients on the effect of j's policy position are voter-specific, and voter i's ideal policy can be recovered as $y_i = -\alpha_{1i}/(2\alpha_{2i})$.[17] Specifically, we assume that the coefficients $(\alpha_{1i}, \alpha_{2i})$ for voter i can be written as

$$\alpha_{ki} = \alpha_k + D'_{n(i)}\gamma_k + \sigma_k \nu_{ki} \quad \text{for } k = 1, 2, \tag{3.2}$$

where D_n is a vector of demographic characteristics of state n, $n(i)$ denotes the state in which voter i resides, and $(\nu_{1i}, \nu_{2i})' \sim N(0, I_2)$ are (unobserved) i.i.d. idiosyncratic policy preference shocks. As explained below, this enables estimation of rich preferences in a computationally feasible manner while relaxing the independence of irrelevant alternatives (IIA) property of standard multinomial logit models.

Because random utility shocks are distributed TIEV, the probability that voter i in district n selects candidate j given shocks (ν_{1i}, ν_{2i}) takes the familiar form

$$P^i_{jn}(\nu_{1i}, \nu_{2i}) = \frac{\exp(\delta_{jn} + \sum_{k=1}^{2} \sigma_k \nu_{ki} p^k_{jn})}{1 + \sum_{j' \in J_n} \exp(\delta_{j'n} + \sum_{k=1}^{2} \sigma_k \nu_{ki} p^k_{j'n})},$$

where J_n denotes the set of candidates running in state n and

$$\delta_{jn} \equiv \sum_{k=1}^{2} (\alpha_k + D'_n \gamma_k) p^k_{jn} + X'_{jn}\beta + \xi_{jn} \tag{3.3}$$

is the average voter utility from choosing candidate j. Notice that, as is standard, we

[17] In rare cases (fewer than 2.5% of voters), voters have convex policy preferences, i.e., $\alpha_{2i} \geq 0$. These voters prefer extreme policies and have ideal point $y_i = \overline{p}$ ($y_i = -\overline{p}$) if $\alpha_{1i} \geq 0$ ($\alpha_{1i} < 0$). We set $\overline{p} = \max\{|q_{0.5}(y)|, q_{99.5}(y)\}$, where $q_r(y)$ denotes the rth quantile of the (interior) y_is.

normalize the average "outside option" utility from abstaining or casting a void vote to $\delta_{0n} = 0$. Integrating over voters, candidate j's predicted vote share in district n can be written as

$$s_{jn} = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{\exp(\delta_{jn} + \sum_{k=1}^{2} \sigma_k \nu_{ki} p_{jn}^k)}{1 + \sum_{j' \in J_n} \exp(\delta_{j'n} + \sum_{k=1}^{2} \sigma_k \nu_{ki} p_{j'n}^k)} d\Phi(\nu_{1i}) d\Phi(\nu_{2i}), \tag{3.4}$$

where Φ denotes the standard normal cumulative distribution function.

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. Next, 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. Given $\sigma_1 = \sigma_2 = 0$, we can "invert" predicted vote shares to express them in terms of average voter utilities by taking logs of (3.4): $\log(s_{jn}) - \log(s_{0n}) = \delta_{jn}$. Then, replacing predicted vote shares with their observed counterparts in the data, $\hat{s}_{jn}$, and using (3.3), we obtain

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

which is just a linear regression of the log-ratio of candidate j's vote share to that of the "outside option" 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 parameters

α, γ, and β from this linear regression via two-stage least squares.

The multinomial logit model is computationally straightforward but imposes strong assumptions on voter preferences. In particular, since $\log(s_{jn}/s_{j'n}) = \delta_{jn} - \delta_{j'n}$, the log-ratio of the vote shares of any two candidates j and j' does not depend on the characteristics of other candidates (IIA). An important implication is that, if one candidate changes her policy position, 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.

When voters are heterogeneous, however, the previous estimation approach is no longer feasible. But an approach that builds on the same principles is. Given (3.4), predicted vote shares in each state n, $s_n = (s_{1n}, \ldots, s_{J_n n})$, depend not only on the average utilities $\delta_n = (\delta_{1n}, \ldots, \delta_{J_n n})$ (which subsume parameters α, γ, and β) but also on the policy-preference variance parameters $\sigma = (\sigma_1, \sigma_2)$. As a result, we can no longer explicitly "invert" predicted vote shares. Nevertheless, BLP show that, for any given value of σ, 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 (3.3) and given a candidate value of the parameters $\theta = (\alpha, \gamma, \beta, \sigma)$, we can compute the unobserved candidate valence consistent with $\delta_{jn}(\sigma)$:

$$\xi_{jn}(\theta) = \delta_{jn}(\sigma) - \sum_{k=1}^{2} (\alpha_k + D_n' \gamma_k) p_{jn}^k - X_{jn}' \beta. \tag{3.5}$$

This allows us to construct a Generalized Method of Moments (GMM) estimator around the instrumental-variables moment condition used in the logit case, noting that

$$E[Z_{jn}\xi_{jn}(\theta)] = 0 \quad \text{if and only if} \quad \theta = \theta_0, \tag{3.6}$$

where θ_0 denotes the true value of the model parameters.

To do this, 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 $\xi_{jn}(\theta)$ according to (3.5). Letting Z and $\xi(\theta)$ denote vertical stackings of Z'_{jn} and $\xi_{jn}(\theta)$ across candidates and elections in the data, a sample analog of (3.6) can be computed as $\frac{1}{J^*}Z'\xi(\theta)$, where J^* denotes the total number of observations. Under standard technical regularity conditions, the sample moments converge to the population moments as $J^* \to \infty$, and thus the (positive-definite) quadratic form $Q_{J^*}(\theta) = \left[\frac{1}{J^*}Z'\xi(\theta)\right]' W_{J^*} \left[\frac{1}{J^*}Z'\xi(\theta)\right]$ goes to zero only at the true value of the parameters θ_0. Accordingly, the "outer loop" searches over θ to minimize $Q_{J^*}(\theta)$. Inference follows standard GMM theory, including the choice of an optimal weighting matrix.[18]

The BLP algorithm can be computationally inefficient, as the inner loop relies on costly fixed-point calculations, and 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 provide technical details in Appendix B.

[18]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.

Instruments. A necessary order condition for identification is that Z_{jn} must include at least as many variables as there are parameters to be estimated. Moreover, in addition to satisfying the orthogonality restriction (3.6), 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 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 likewise uncorrelated with candidate j's unobserved valence but correlated with her policy choice in equilibrium given their influence on voter preferences.

Second, we exploit the policy positions of 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 given that 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.[19]

[19]Specifically, weights are proportional to $\exp\{-(X_{jn} - X_{j'n})'\text{Cov}(X)^{-1}(X_{jn} - X_{j'n})\}$, where $\text{Cov}(X)$ denotes the sample covariance matrix of candidate characteristics.

Finally, while the choice of instruments for (α, γ, β) follows standard intuition from linear regressions given (3.5), the policy-preference variance parameters $\sigma = (\sigma_1, \sigma_2)$ determine the nonlinear features of the model. Accordingly, we follow common practice and employ a nonlinear transformation (second-degree polynomial) of the other instruments.

3.2 Voter Preferences: Estimates

We report our parameter estimates of voters' preferences in Tables A.4 (ideology), A.6 (valence), and A.5 (party brands) in the Appendix. The first column of each table presents estimates from a multinomial logit model that does not control for voter demographics. The second column presents estimates from a multinomial logit model including voter demographics. The third column presents estimates from the BLP model, which allows for 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. Indeed, 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 A.4 shows that both restrictions are rejected by the data.

Table A.4 presents 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. Voters in more rural districts tend to be more left-leaning (see Figure A.9 in the Appendix), as do voters in districts that are older, less educated, and with lower employment

levels. Importantly, voters' policy preferences are heterogeneous even conditional on demographic characteristics.[20] This substantial heterogeneity both across and within districts suggests ideological considerations are vibrant in Brazilian politics, and it implies rich patterns of substitutability between candidates, which inform equilibrium policy choices.

Evaluating our preference estimates at municipality-level covariates D_m, we recover the average voter's ideal point in each municipality. This is depicted in Figure 3 (see also Figure A.8 in the Appendix for the distribution of ideology per state). The municipal estimates show a country broadly leaning left ideologically,[21] yet they also reveal substantial heterogeneity across regions and within states. The northeast and south are more uniformly left-wing, whereas the southeast and central-west regions (São Paulo, Goias) tend to be more conservative but highly polarized.

Tables A.5 and A.6 display estimates of the value of party brands (β^{brands}) and preferences for observed candidate characteristics ($\beta^{valence}$). The results in Table A.5 suggest that, with a few exceptions (DEM, MDB), party brands do not have a significant first-order impact on voters' choices. This corroborates the prevailing view in the Brazilian politics literature that elections are fundamentally candidate-centric rather than party-centric.

Voters, however, do care about the non-ideological characteristics of candidates. Consistent with the results of Besley and Reynal-Querol (2011), Brazilian voters prefer candidates that are more educated. They also have a preference for candidates that are younger and male, and they tend to dislike candidates with business experience

[20] While our point estimate of σ_1 is essentially zero, our estimate of σ_2 is positive (2.42) and statistically significant.

[21] 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.

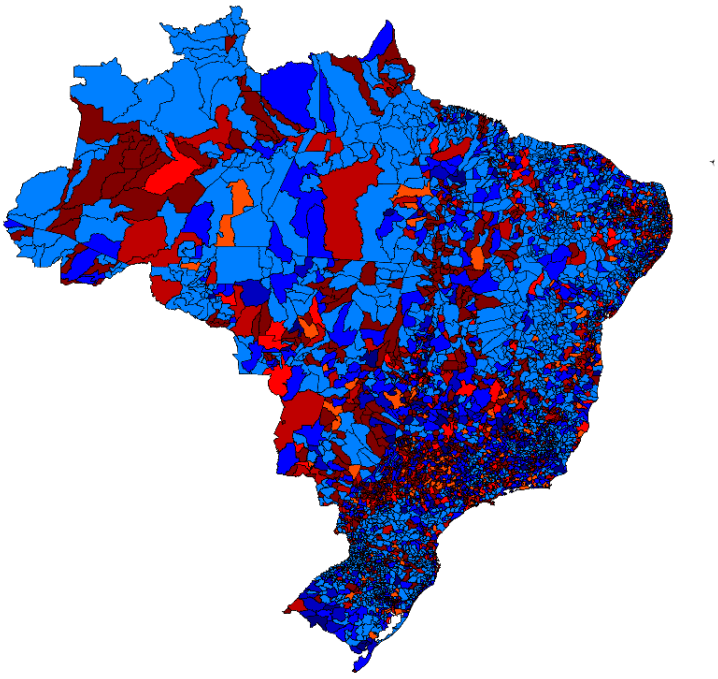


Figure 3: Voters' Ideological Preferences by Municipality (in 2014): darker blue (red) denotes more left-leaning (right) policy preference.

or government bureaucrats. The largest effect, however, is that associated with incumbency, which is about four times as large as the gender preference.[22]

A key question is how much voters care about ideology relative to candidates' valence attributes. To answer this, we compute the elasticities of candidates' vote shares with respect to their own policy position η^p_{jj} and valence η^v_{jj}. Note that the ideology (valence) elasticity measures the percentage change in vote share resulting from a 1% increase in the policy position (valence) of the candidate. Thus, the ratio $r_\eta \equiv |\eta^p_{jj}/\eta^v_{jj}|$ measures the percentage change in valence that would keep candidate j's vote share

[22]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 disentangled these (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.

unaffected after a 1% change in her policy position (in the appropriate direction). In Table 1, we report the first three quartiles of the distribution of r_η by state.

State	p25	p50	p75	State	p25	p50	p75
Santa Catarina (sc)	0.010	1.934	3.085	Ceará (ce)	0.001	0.135	1.953
Espírito Santo (es)	0.001	1.397	2.065	Roraima (rr)	0.021	0.134	1.133
Amapá (ap)	0.261	1.195	1.943	Piauí (pi)	0.025	0.130	0.749
Rondônia (ro)	0.020	0.840	2.629	Mato Grosso (mt)	0.001	0.122	1.469
Pernambuco (pe)	0.003	0.716	1.667	Mato Grosso do Sul (ms)	0.005	0.096	1.974
Sergipe (se)	0.002	0.369	1.564	Maranhão (ma)	0.005	0.045	1.275
Tocantins (to)	0.010	0.348	0.462	Acre (ac)	0.007	0.040	0.757
Rio Grande do Sul (rs)	0.002	0.250	2.190	Pará (pa)	0.003	0.030	1.227
Goiás (go)	0.013	0.220	1.487	Bahia (ba)	0.002	0.026	1.407
Paraná (pr)	0.001	0.202	1.359	Rio de Janeiro (rj)	0.001	0.017	1.611
Alagoas (al)	0.007	0.190	1.447	Amazonas (am)	0.005	0.014	1.435
Distrito Federal (df)	0.008	0.183	1.119	São Paulo (sp)	0.003	0.005	1.036
Rio Grande do Norte (rn)	0.001	0.140	1.734	Paraíba (pb)	0.002	0.004	1.698
Minas Gerais (mg)	0.000	0.139	2.123	**Total**	**0.003**	**0.084**	**1.611**

Table 1: Ideology/Valence Candidate Vote Share Elasticity Ratio (weighted by candidate vote share, by state).

As the table shows, the (weighted) median of r_η is well below one in all but five states, indicating that, at the valence and policies observed in the data, voters tend to be considerably more sensitive to valence than policy. In fact, for the median candidate across the country, a 1% change in *valence* would require a compensating change of about 12% in policy for vote shares to remain unaltered. This suggests that valence differentials in any given election weigh heavily on candidates' equilibrium policy choices, potentially leading to asymmetric policy outcomes. However, there is considerable heterogeneity, both across and within states. In a number of states (notably, Santa Catarina, Espírito Santo, Amapá, Rondônia, and Pernambuco), the median value of r_η is an order of magnitude higher than the national median, and, in all but one state, the 75th percentile is above one.

3.3 Welfare Gap

With preference estimates in hand, we turn to our main objective of quantifying the welfare loss that can be attributed to limitations in the pool of candidates. To do this, we (i) evaluate voters' welfare given the actual set of candidates they face in the data and (ii) compare this measure of welfare with that coming from an ideal representation benchmark in which each voter is able to select her preferred candidate in all characteristics.[23]

To carry out this exercise, we begin by computing expected voter welfare in each municipality m given the set of candidates who participated in the 2014 election, $\overline{u}_m^{data}$. To that end, we first compute the average utility voters in municipality m obtain from voting for each candidate j, δ_{jm}, evaluating (3.3) at our estimates and municipality demographics D_m. We then simulate a sample of registered voters for each municipality, 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 (3.1) 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, $\overline{u}_m^{ideal}$, 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 wel-

[23] Below in this section, we complement these results with two alternative benchmarks that limit "ideal" candidates in different ways. In Benchmark II, we limit the number of ideal candidates in each state to be equal to that in the data, and we select these candidates to maximize average voter welfare in the state. In Benchmark III, we compare welfare in the data with the welfare voters would obtain if they could choose from among all (actual) candidates running in *any* state, as in a single national district.

fare,[24] we compute the total welfare loss in each municipality m as

$$WL_m = 1 - \overline{u}_m^{data} / \overline{u}_m^{ideal}.$$

Figure 4 depicts the resulting welfare gap by municipality for the 2014 election. The results illustrate a considerable failure of the Brazilian political system. The median welfare loss with respect to the ideal benchmark across the 5,507 municipalities is 80%. Moreover, more than 75% of municipalities suffer a welfare loss of at least 66%, while 25% of municipalities suffer a loss of at least 90% of the benchmark. Figure A.10 in the Appendix plots the distribution of welfare losses across municipalities by state.

Figure 4: Welfare Loss (2014 election): lighter shade indicates observed welfare is closer to benchmark.

[24]Recall that we have normalized the utility from abstaining (or casting a void vote) to zero. Thus, the welfare loss should be interpreted as $WL_m = 1 - (\overline{u}_m^{data} - \overline{u}_m^{abs})/(\overline{u}_m^{ideal} - \overline{u}_m^{abs})$, where $\overline{u}_m^{abs}$ is the utility from abstaining. This measure is unchanged by affine transformations of utility.

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

To gauge the significance of ideological incongruence, we decompose the welfare gap as follows. We compute an intermediate level of welfare from a hypothetical election in which all candidates have maximum valence, as in the ideal benchmark, but choose policies as in the 2014 election, $\overline{u}_m^{val}$. 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:

$$WL_m = \underbrace{\frac{\overline{u}_m^{ideal} - \overline{u}_m^{val}}{\overline{u}_m^{ideal}}}_{\text{Policy WL}} + \underbrace{\frac{\overline{u}_m^{val} - \overline{u}_m^{data}}{\overline{u}_m^{ideal}}}_{\text{Valence WL}}.$$

The left panel of Figure 5 plots the distribution of policy welfare losses across municipalities. The median policy welfare loss is 22%, with 75% of municipalities having a policy welfare loss above 7%, and 25% of municipalities having a policy welfare loss above 47%. This indicates that, in multiple states, electoral competition provides weak incentives for politicians to adopt policies compatible with their constituents' interests. As the right panel of Figure 5 shows, this is particularly the case in heavily rural municipalities, where policy welfare losses are consistently larger. In contrast, voters in urban municipalities tend to be systematically underserved in valence char-

acteristics.

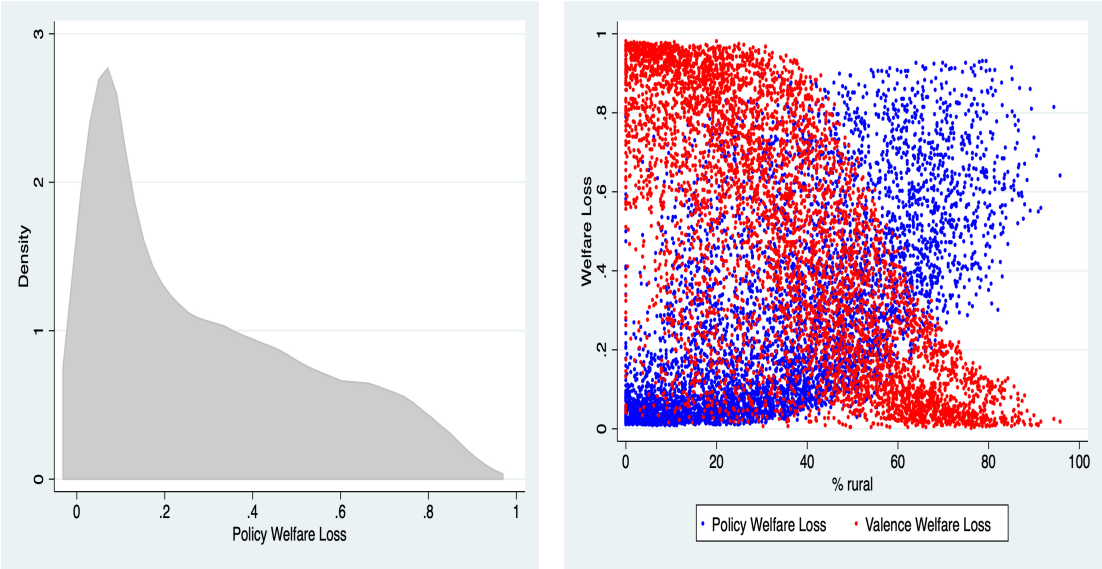


Figure 5: The left panel plots the distribution of policy welfare losses across municipalities. The right panel plots the policy welfare loss and valence welfare loss per municipality as a function of $\%rural$.

Alternative Benchmarks. In our ideal benchmark, we allow each voter to select her preferred candidate in all characteristics. We also consider two alternative benchmarks, which introduce additional constraints on voters' choice sets.

In Benchmark II, we restrict the number of candidates under consideration, ruling out the possibility of a personalized ideal candidate for each voter. In particular, we limit the number of "ideal" candidates in each state to be equal to that observed in the data, and we select these candidates to maximize average voter welfare in the state. In Benchmark III, we dispense altogether with the notion of ideal candidates, and we instead compare welfare in the data with what voters would obtain if they were able to choose from among all (actual) candidates running in *any* state, with

valence and policy positions as observed in the data.[25]

Figure 6 summarizes our results. We find that—independently of the measure—voter welfare losses due to deficiencies in their choice set are considerable. As described above, the median municipality welfare in the data is 80% lower than that in the ideal benchmark. But it is also 75% lower than the median municipality welfare in Benchmark II, where we limit the number of "ideal" candidates, and 62% lower than the median in Benchmark III, where we focus on real candidates, possibly running in other states. We conclude that the brunt of the representation failure uncovered in our main exercise is not due to inflation in the number of candidates. Large welfare losses persist even if we consider alternatives that are certainly feasible in Brazil's political system.

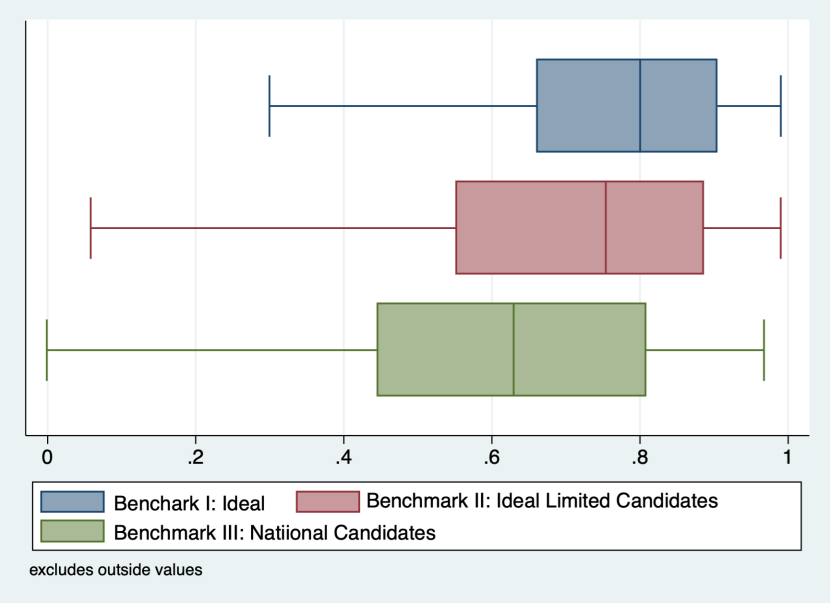


Figure 6: Welfare Loss Relative to Alternative Benchmarks.

[25]This benchmark should not be taken as a counterfactual of what would occur under a single national district. In that case, legislators would adjust their policy positions in response to the new competitive environment.

4 A Model of Equilibrium Policy Choice

In our estimation of voters' preferences (Section 3), the endogeneity of candidates' policy positions is addressed with an instrumental-variables approach. We now take preference estimates as given and turn to the task of estimating a model of the "supply side" of politics, where candidates' positions emerge explicitly as equilibrium choices. Having estimates of both the "demand" and "supply" sides of politics enables counterfactual analyses of how the system would work under different conditions from those observed in the data. We explore these in Section 4.3.

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 other candidates, limited by each candidate's strength within the party. Both electability and candidate strength are a function of candidates' valence attributes.

4.1 Endogenous Policy Choice: Model and Estimation

There are L parties and N states. We denote the set of candidates running for party ℓ in state n by J_n^ℓ. 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.[26] The party seeks to maximize its share of seats in the legislature and would like to choose the policies of each of its candidates accordingly. However, inducing a politician to adopt a position that differs from her own ideal policy θ_{jn} is costly for the party. We allow this cost μ_{jn}^{ℓ} to be a function of candidate-specific covariates, which we estimate.

Letting $\mathbf{p}_n^{\ell}$ denote the vector of policy positions of all candidates in J_n^{ℓ}, party ℓ's payoff is

$$\Pi^{\ell}(\mathbf{p}) = \sum_{n=1}^{N} \sum_{j \in J_n^{\ell}} \left[w_n s_{jn}(\mathbf{p}_n^{\ell}, \mathbf{p}_n^{-\ell}) - \mu_{jn}^{\ell} |p_{jn} - \theta_{jn}| \right], \tag{4.1}$$

where w_n denotes state n's seat share in the legislature, $\mathbf{p}^{\ell} \equiv (\mathbf{p}_1^{\ell}, \ldots, \mathbf{p}_N^{\ell})$ collects the policy positions of all party-ℓ candidates, and $\mathbf{p} \equiv (\mathbf{p}^1, \ldots, \mathbf{p}^L)$. We assume that the ideal policies of party ℓ's candidates in district n are distributed $\theta_{jn} \sim N(\theta_n^{\ell}, (\sigma_n^{\ell})^2)$, where both the mean θ_n^{ℓ} and standard deviation σ_n^{ℓ} depend on state covariates. The cost parameter μ_{jn}^{ℓ}, on the other hand, is given by

$$\mu_{jn}^{\ell} = \exp\left(A_{\ell} + W_{jn}'\chi + \zeta_{jn}^{\ell}\right), \tag{4.2}$$

where 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 (including j's unobserved valence ξ_{jn}), 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 party but not by the analyst.

A Nash equilibrium is a profile of policy choices $\tilde{\mathbf{p}}$ such that $\tilde{\mathbf{p}}^{\ell} \in \arg\max_{\mathbf{p}^{\ell}} \Pi^{\ell}(\mathbf{p}^{\ell}, \tilde{\mathbf{p}}^{-\ell})$ for all $\ell = 1, \ldots, L$. The equilibrium necessary first-order conditions for party ℓ in

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

state n imply the following for all of its candidates $j \in J_n^\ell$:

$$\frac{\partial \Pi^\ell(\tilde{\mathbf{p}})}{\partial p_{jn}} = 0 \implies \left| \frac{w_n}{\tilde{p}_{jn}} \left(\tilde{\eta}_{jn,j} \tilde{s}_{jn} + \sum_{j' \in J_n^\ell \setminus \{j\}} \tilde{\eta}_{j'n,j} \tilde{s}_{j'n} \right) \right| = \mu_{jn}^\ell, \tag{4.3}$$

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 of the vote share of candidate j' with respect to the policy position of candidate j in state n. In equilibrium, each party sets policies so that the marginal benefit of changing a candidate's policy—which accounts for the effect of j's policy change on her own vote share, $\tilde{\eta}_{jn,j}\tilde{s}_{jn}$, as well as on the vote shares of other party candidates, $\sum_{j' \in J_n^\ell \setminus \{j\}} \tilde{\eta}_{j'n,j}\tilde{s}_{j'n}$—equals the marginal cost, μ_{jn}^ℓ.

Taking logs and substituting expression (4.2), we can write (4.3) 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

$$r_{jn(j)} = A_{\ell(j)} + W_{jn(j)}'\chi + \zeta_{jn(j)}^{\ell(j)}, \tag{4.4}$$

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 obtained in Section 3.

4.2 Endogenous Policy Choice: Estimates

Tables 2 and A.7 present our estimates of the coefficients of the cost function μ. 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 3.2 that incumbency, education, youth, and lacking a business or bureaucratic background are valence characteristics that voters value. Notice that the coefficient estimates associated with *all* these attributes are positive and statistically significant. Hence, the first-order lesson from Table 2 is that being endowed with characteristics that voters value empowers individual candidates, prompting parties to choose policies for them that are more in line with the candidates' own preferences, to the detriment of party votes and voter welfare.[27] 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) 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 (4.3), equals this marginal cost. Thus, the

[27] 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. In the context of elections for the U.S. House of Representatives, however, Stone and Simas (2010) find that incumbents with a personal character advantage are closer ideologically to their district's preferences, while disadvantaged challengers take more extreme policy positions, in line with Groseclose (2001).

"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 2: Estimates of Coefficients χ (candidate characteristics) in Regression (4.4).

cost, together with vote-share elasticities in each state—which reflect the intensity of electoral competition—determines equilibrium policies. Figure A.11 (in the Appendix) 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 other words, policy welfare losses are greater when parties are weak vis-à-vis their candidates.

4.3 Counterfactual: A Shock to Candidate Quality

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 (Ferraz and Finan 2009, Galasso and Nannicini 2011). As noted, however, candidates' valence affects voter welfare both directly and indirectly, through its influence on equilibrium policy choices. Thus, 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

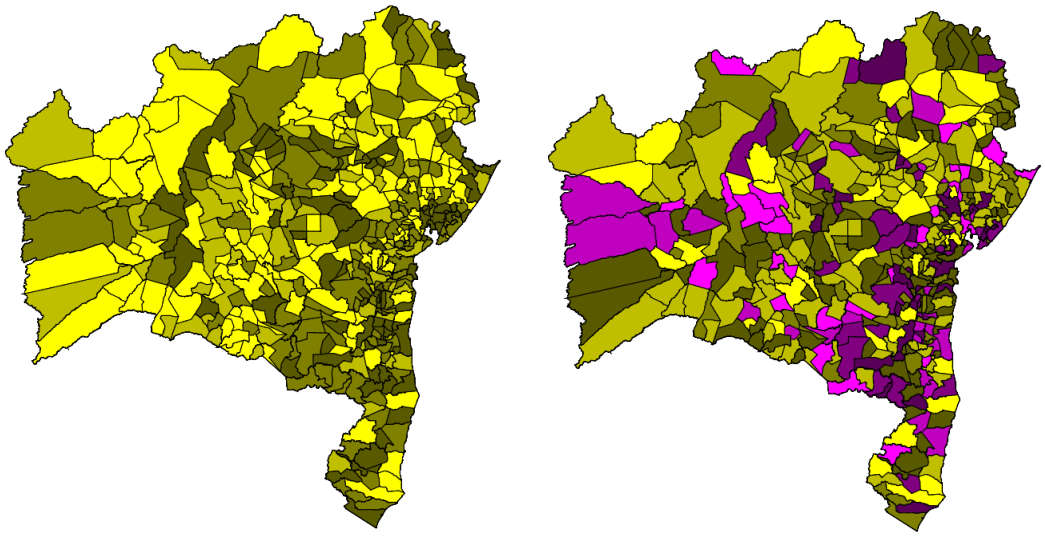
in welfare resulting from an upward shift in the distribution of candidates' overall valence. Specifically, we consider a counterfactual scenario wherein candidates in the bottom three quartiles of the overall valence distribution draw a new valence value from the top quartile. To reduce the computational burden, we focus our analysis on the state of Bahia, whose demographics are most representative of the nation as a whole.[28]

Figure 7 presents our 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 counterfactual equilibrium policies. Municipalities colored in lighter purple (yellow) experience a higher welfare loss (gain). As shown in the left panel, keeping policies fixed at the old equilibrium, the valence shock has an overwhelmingly positive direct effect on welfare. This direct effect increases average voter welfare—measured as a percentage of ideal welfare as in Section 3.3—across municipalities by 20 percentage points with respect to that in the data. Nine out of ten municipalities attain an increase in welfare of more than 9 percentage points, while the top quartile registers an increase of more than 28 percentage points.

When we consider the net equilibrium effect, average welfare still increases considerably but only by 11.5 percentage points. Moreover, more than 10 percent of municipalities experience a welfare loss. This is also illustrated in Figure A.12 in the Appendix, which shows the scatterplot by municipality of percentage changes in welfare relative to the data with fixed and equilibrium policies.

Our analysis shows that the indirect equilibrium effects of changes in valence can be both qualitatively and quantitatively significant. They should not be glossed over

[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 7: 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.

when evaluating reforms such as gender quotas, minimal education requirements, or reelection bans.

5 Conclusion

In any democratic system, the power of voters is limited by the set of candidates running for office. Freedom of choice, in effect, is only as good as the alternatives available to voters. In recent years, voters in democracies around the world have expressed discontent with the entire political system. If this perception of a failure of representation were warranted, transitory discontent could be a signal of more fundamental problems in a political system.

In this paper, we develop a methodology to gauge representation failures in a given democratic system, and we apply it to legislative elections in Brazil. We quantify

the relative value voters place on candidates' policy positions and valence attributes. We then evaluate voters' welfare given the set of candidates they face. Our results indicate 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 in an ideal representation benchmark.

In many municipalities, a large fraction of these losses are due to ideological mismatch between voters and politicians. To explain why candidates choose policy positions that diverge from voters' preferences, we develop and estimate a model of equilibrium policy determination. 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. We also find that districts in which parties are weak relative to their candidates tend to experience larger policy welfare losses.

Through counterfactual experiments, we explore the effects of potential institutional reforms aimed at improving the quality of representation. 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 analysis provide guidance in this respect.

We believe our approach can be fruitfully extended to other countries in and outside the region. Doing so would enable better understanding of how well different electoral institutions serve voters' interests. Another fruitful direction for future research is to integrate our 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 institutional choice. We hope our first step in this direction encourages others to pursue these exciting research opportunities.

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A Appendix: Additional Tables and Figures

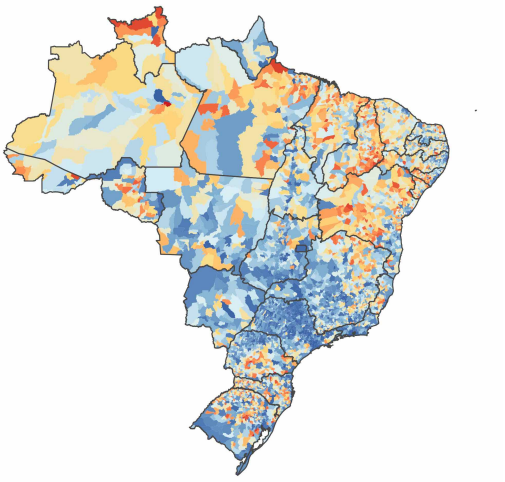
	Representatives		Population		District Mag.
State	Number	%	No.	%	Pop / Legs
São Paulo (sp)	70	13.6%	39,924,091	21.5%	570,344
Minas Gerais (mg)	53	10.3%	19,159,260	10.3%	361,495
Rio de Janeiro (rj)	46	9.0%	15,180,636	8.2%	330,014
Bahia (ba)	39	7.6%	13,633,969	7.3%	349,589
Rio Grande do Sul (rs)	31	6.0%	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.

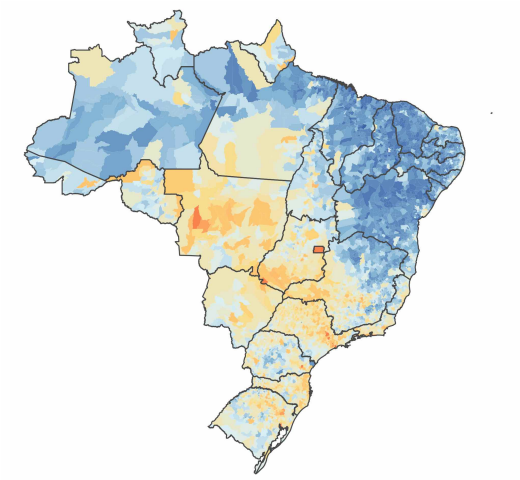
Coalition	Parties	Votes	% of votes	Seats	% of seats
Pro-government Coalition "Com a Força do Povo"	Workers' Party (Partido dos Trabalhadores, PT)	13,554,166	13.93%	68	13.26%
	Brazilian Democratic Movement Party (Partido do Movimento Democrático Brasileiro, PMDB)	10,791,949	11.09%	66	12.87%
	Progressive 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.

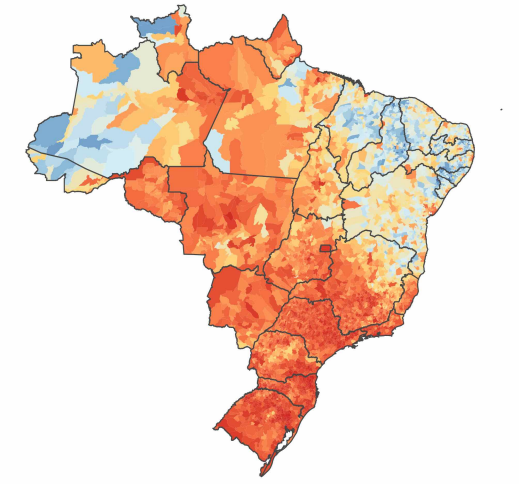
states



% rural

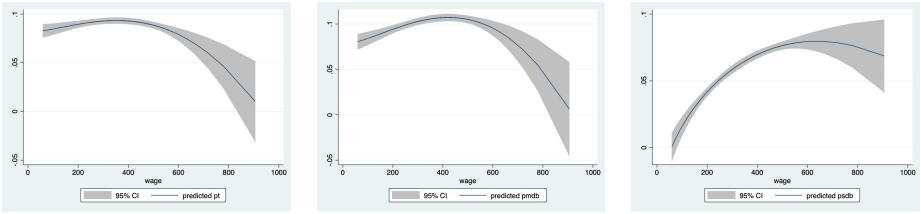


median wage



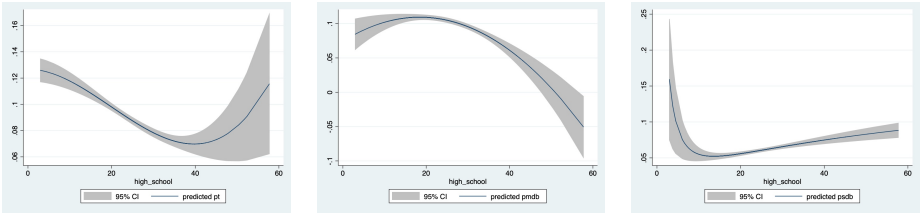
literacy rate

Figure A.1: Socioeconomic Indicators, by Municipality.



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.

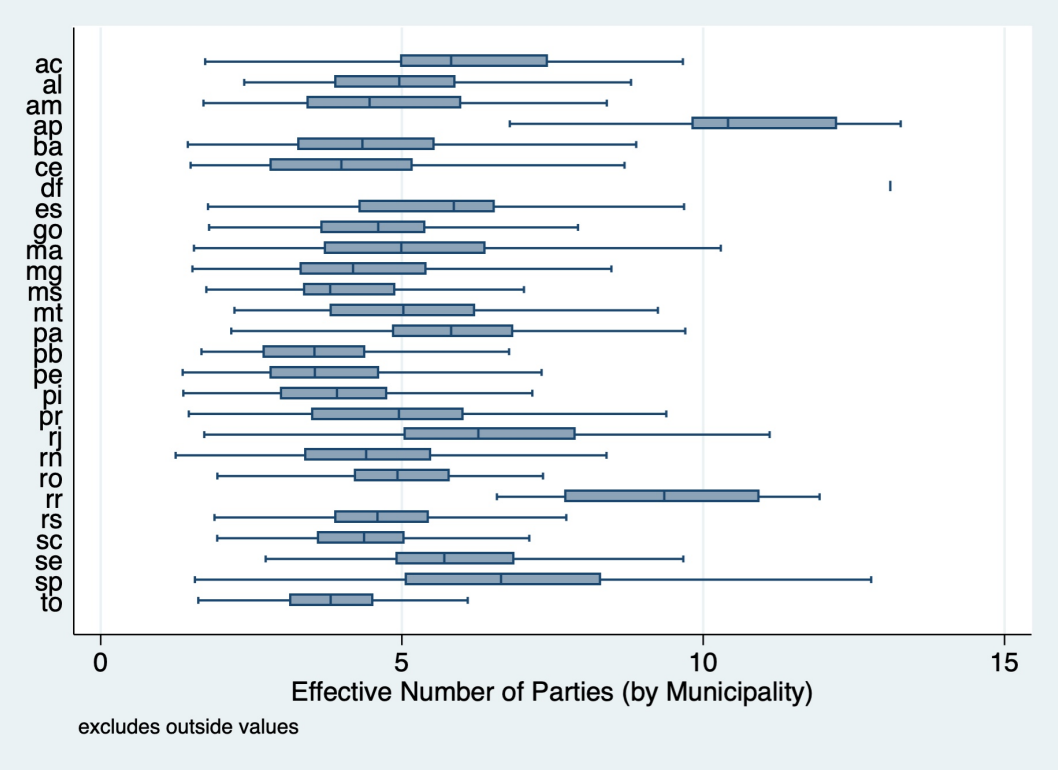


Figure A.4: Effective Number of Parties (municipality-level vote shares) in the 2014 Election, by State.

	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.

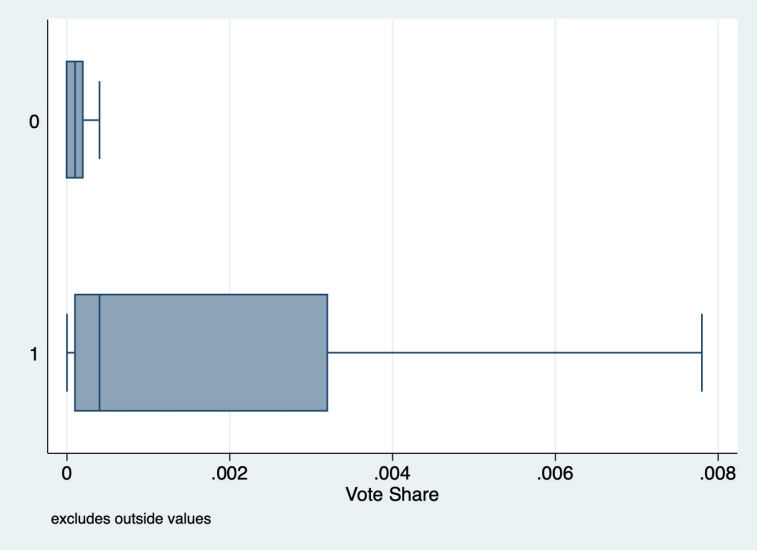


Figure A.5: Vote Share of Candidates With (1) and Without (0) Policy Data.

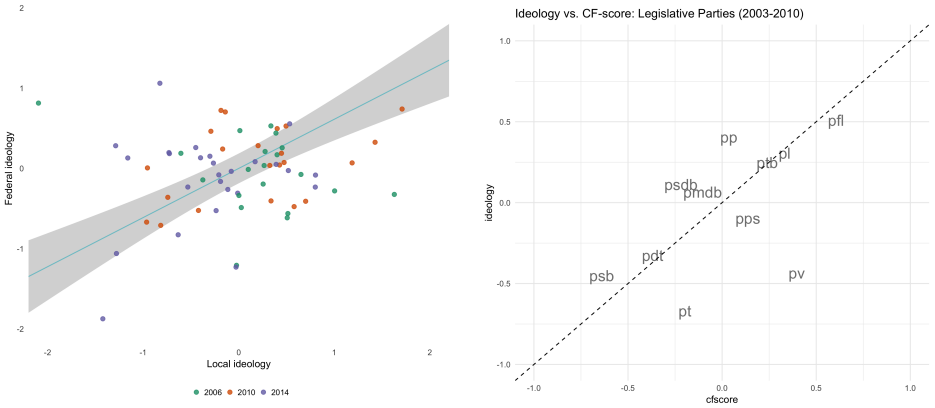


Figure A.6: Face Validity of Policy Measure.

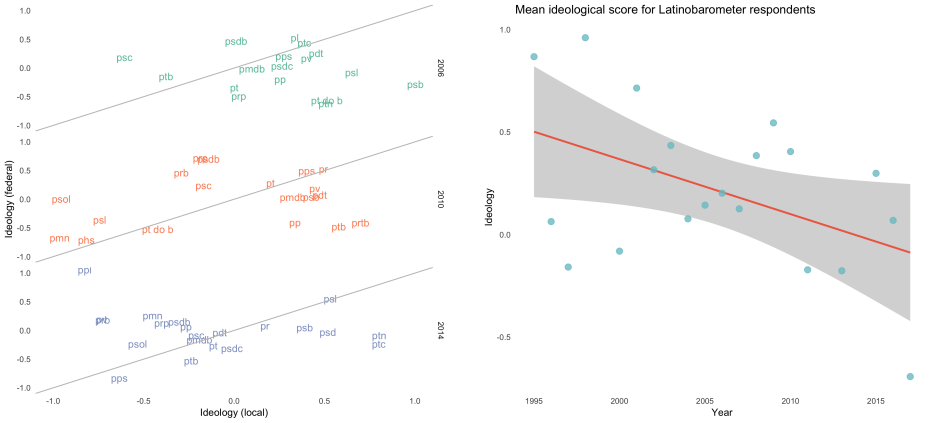


Figure A.7: Progressive Movement to the Left of the Ideological Spectrum: in our estimates (left) and in Latinborometer surveys (right).

	MNL	MNL (Covs)	BLP (Covs)
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.4: Parameter Estimates: Policy Preference.

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

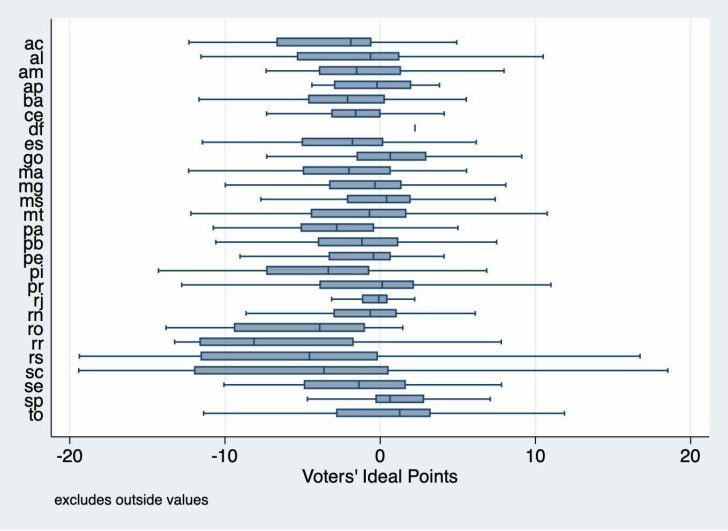


Figure A.8: Distribution of Average Municipality Ideological Preference, by State.

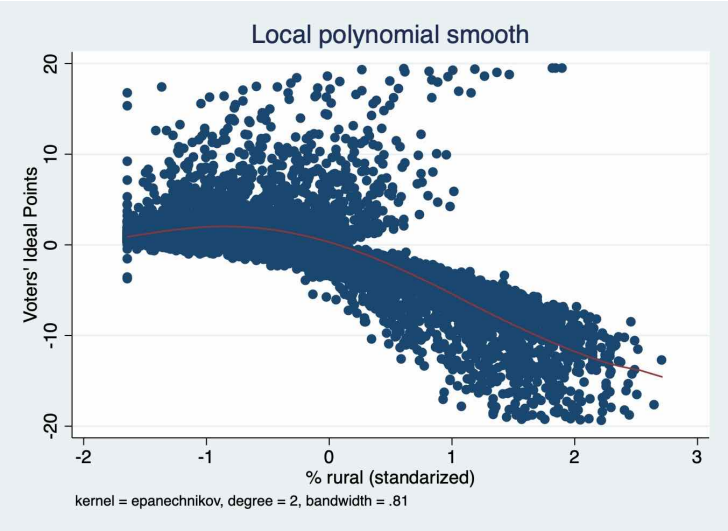


Figure A.9: Voters' Policy Preferences (as a function of $\%rural$ in each municipality).

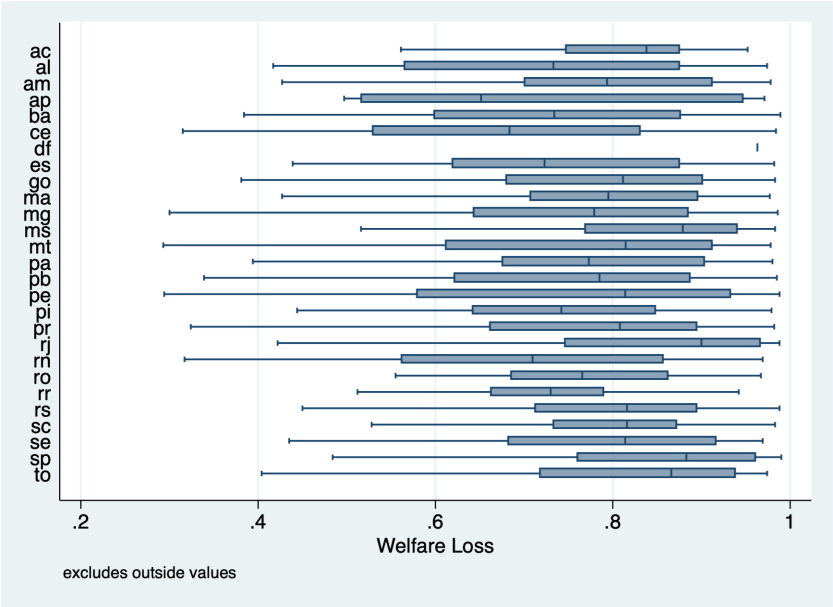


Figure A.10: Distribution of Welfare Loss across municipalities by state.

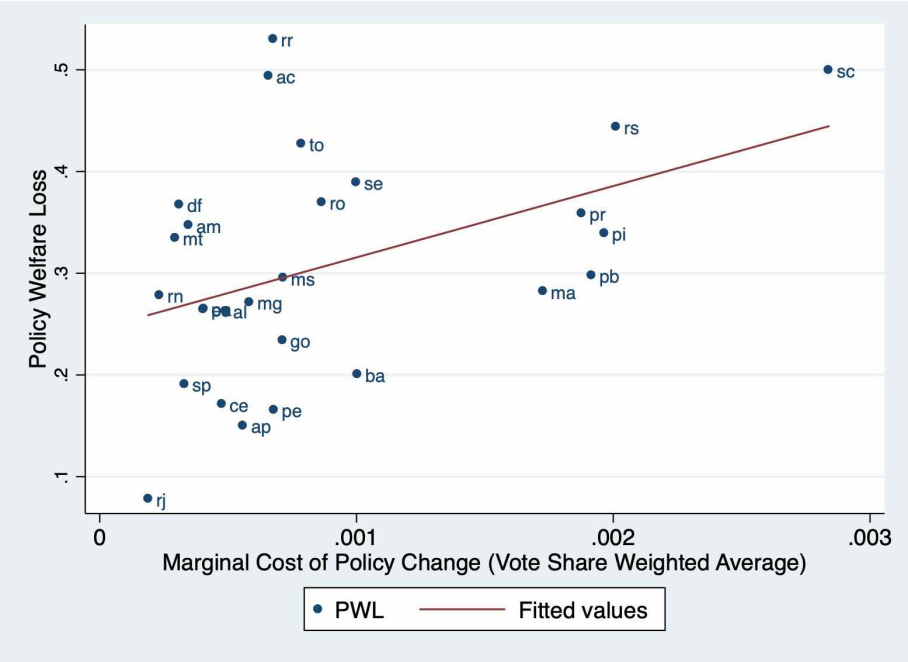


Figure A.11: Marginal Cost of Changes in Policy, and Policy Welfare Loss.

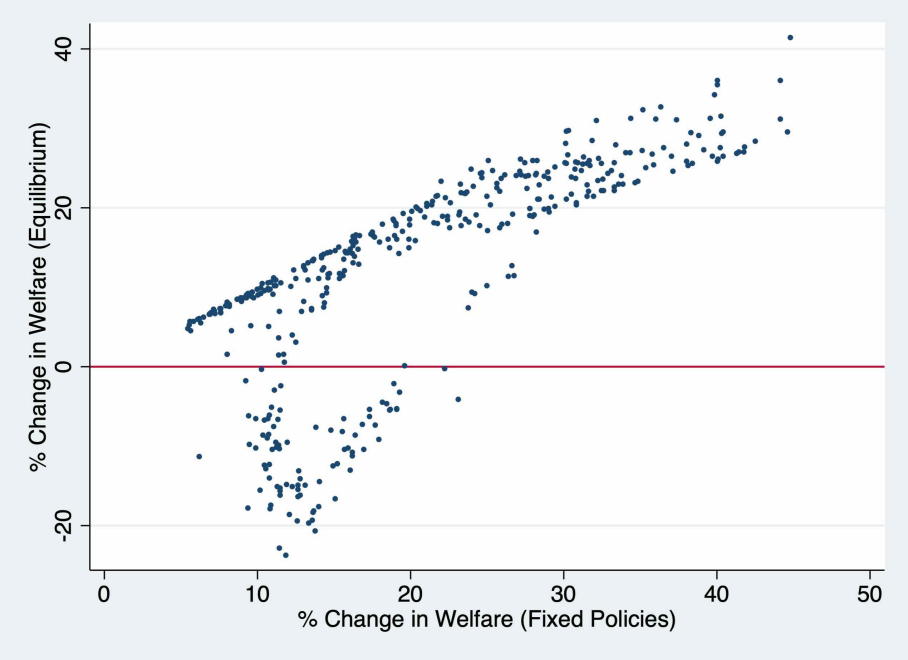


Figure A.12: Valence Improvement Counterfactual: % change in welfare with fixed (horizontal axis) and equilibrium policies (vertical axis)

"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 (4.4).

B Appendix: Estimation of Voters' Preferences

B.1 GMM Estimation and Inference

As discussed in Section 3.1, 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 (3.5). 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 (3.6). 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 $\tilde{W}$.[29] Then, allowing for potential correlation in unobserved valence across candidates in the same race, the optimal

[29] 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.

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 3.1, the traditional BLP "nested fixed point" (NFXP) algorithm for computing $\hat{\theta}$ can be inefficient and 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 state-of-the-art 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 equilibrium con-

straints:

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

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

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

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

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.[30] We employ Knitro's Interior-Point/Conjugate-Gradient algorithm, to which we provide exact first derivatives of the objective and constraints.

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