

Career Concerns and the Dynamics of Electoral Accountability*

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Abstract

Quantifying the value that legislators give to reelection relative to policy is crucial to understanding electoral accountability. We estimate the preferences for office and policy of members of the US Senate, using a structural approach that exploits variation in polls, position-taking and advertising throughout the electoral cycle. We then combine these preference estimates with estimates of the electoral effectiveness of policy moderation and political advertising to quantify electoral accountability in competitive and uncompetitive elections. We find that senators differ markedly in the value they give to securing office relative to policy gains: while over a fourth of senators are highly ideological, a sizable number of senators are willing to make relatively large policy concessions to attain electoral gains. Nevertheless, electoral accountability is only moderate on average, due to the relatively low impact of changes in senators' policy stance on voter support.

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1 Introduction

A core principle of representative democracy is that elections serve to discipline politicians in government. The basic idea is that if a politician were to deviate too much from the preferences of her constituency, voters would remove her from office (Barro (1973), Mayhew (1974), Ferejohn (1986)). Thus, politicians who value reelection will not stray far from voters' preferred policies.

In practice, however, the power of elections to make politicians accountable to voters rests on multiple preconditions, which vary across candidates and characteristics of each electoral race. In this paper, we propose an empirical approach that decomposes the determinants of electoral accountability into two components: politicians' *preferences* for office versus policy, and the effectiveness of position-taking and advertising on reelection prospects.

Disentangling preferences from electoral conditions is crucial to understanding electoral accountability because voters only affect politicians indirectly, through elections. Indeed, while incumbents who put a large value on reelection would not mind compromising their policy ideas to gain *any* electoral edge, those who put a larger weight on policy will be less willing to exchange policy concessions for electoral gains (see, e.g. Alesina and Cukierman (1990)). Since marginal expected electoral gains depend on the perceived competitiveness of the election, incumbents with different preferences for office and policy will have different degrees of responsiveness to voters in safe and competitive elections.

The second component of the electoral accountability mechanism consists of factors external to the politician. Independently of the tradeoffs that the politician might be *willing* to make, for this mechanism to have any chance to work voters must be at least somewhat responsive to the choices politicians make while in office. If voters were to blindly follow partisan lines, for instance, politicians would not have incentives to cater their policy choices to voters' policy preferences. Similarly, if voters were easily persuadable through advertising, ideologically motivated politicians can be tempted to substitute policy concessions for TV ads. High powered incentives for electoral accountability require then, that voters are highly sensitive to politicians' policy choices, and relatively insensitive to non-policy means of persuasion, such as political advertising.

To capture the different components of electoral accountability in a unified framework, we model explicitly the dynamic problem of a legislator running for reelection. We estimate the model using data for over a hundred US senators who ran for reelection between 2000 and 2014 (132 electoral cycles).

The model captures the dynamic tradeoffs of the politician, as she responds to changing electoral conditions throughout the electoral cycle. In each period, the senator chooses a policy position and TV-ad buys after observing her standing in the polls. Both advertising and adopting policies that are in line with her constituency’s interests affect polls in the next period, but are costly to the politician. In particular, a senator who is more heavily ideological has a higher cost of deviating from her ideal policy. Improving her standing in the polls within cycle doesn’t contribute to the senator’s payoffs directly, but puts her in a better electoral position as the election approaches. At election time, the senator gets an office payoff if she attains reelection and an additional payoff (possibly zero) from a large margin of victory.¹

Identification of the model parameters relies on the *within-cycle dynamics* of position-taking and advertising in response to changing electoral conditions. There are two key ideas here. First, the level of “effort” exerted in various degrees of competitiveness of the election pins down the relative value of reelection versus lopsided wins: more ads, or larger policy moderation towards the voter in “safe” relative to “competitive” electoral states are consistent with larger values of lopsided wins relative to simply being reelected. Second, for any total level of effort, senators who care more about policy will tend to substitute policy responsiveness with political advertising. Thus, the relative responsiveness of policy and ads in competitive and safe electoral conditions pins down the relative weight of policy vs reelection concerns.

Our results provide various novel insights. First, we are able to quantify how each senator would trade policy concessions for electoral gains, if these were available to them. Here we measure senators’ preferences – the marginal rate of substitution between policy concessions and electoral gains – separately from the tradeoffs that are actually available to them. We find that most senators are willing to make significant policy concessions for a higher probability of retaining office. In particular, the senator

¹ Previous research (see eg. Griffin (2006), Mian, Sufi, and Trebbi (2010)) shows that *on average*, representatives are more responsive to voters in close elections. Whether and to what extent senators are responsive to voters in safe elections is an empirical question. Our model nests the model with no payoffs for lopsided wins, and allows us to capture heterogeneity in responsiveness across senators.

at the median of the distribution is willing to give up 2.1% of the distance between party medians for a 1% increase in the probability of a close win, and 4.5% of the distance between party medians for a 1% increase in the probability of a safe win. We also document a substantial heterogeneity in the importance that senators give to reelection versus policy. More than a fourth of all senators in our sample are heavily ideological, and are not willing to give up large policy concessions for electoral gains.

Second, we consider what tradeoffs are actually available to the politicians, by estimating the electoral return of position-taking and advertising. In doing this, we also rely on within-cycle variation, by exploiting the panel structure of our data. We find that increasing the incumbent's TV ads, or reducing her challenger's advertising, improves her advantage in the polls in the short-run, with an additional, albeit smaller, long-run effect that decays over time.² In particular, we find that policy *moderation towards the voters* increases senators' advantage in the polls. Thus, extreme positions are penalized in moderate states, but rewarded in more heavily liberal or conservative ones.³ From a quantitative standpoint, however, gains and losses from changes in position-taking are only moderate in magnitude, weakening incentives for electoral accountability.

Third, by combining the estimates on senators' preferences with the electoral effectiveness of position-taking and advertising, we are able to assess to what extent senators would accommodate the preferences of their voters, for varying degrees of competitiveness of the election.

To obtain a comparable measure across senators, we construct an *electoral accountability index* (EAI), which measures senators' predicted policy positions as a percentage of the distance between their ideal policy and the vote-maximizing position in their state. We find that for the average senator, electoral accountability is only moderate, reaching a maximum of 26% in competitive elections, and a minimum of 14% in the presence of a large electoral advantage. Nevertheless, consistent with the heterogeneity in senators' preferences for office and policy, there is significant varia-

² Our short-run estimate of the effectiveness of political advertising is comparable in magnitude with previous findings in the literature. See Huber and Arceneaux (2007), Stratmann (2009), Gerber, Gimpel, Green, and Shaw (2011), Gordon and Hartmann (2013), Spenkuch and Toniatti (2018).

³ These results complement the previous findings of Canes-Wrone, Brady, and Cogan (2002), who show that incumbents are penalized for ideological extremity. Our results show that senators are punished for ideological extremity relative to their district, but that this doesn't always mean that senators are punished for taking extreme liberal or conservative positions.

tion in how politicians respond to voters. In fact, in competitive elections, the EAI is around 73% for senators in the top quartile of career concerns, and lower than 5% for those in the bottom quartile. We also find that female senators are on average more responsive to voters than their male counterparts, that Democrats are on average more responsive than Republicans, and that more ideologically extreme senators – who observe a larger benefit of adjusting their policy position – are more responsive than moderate members.

Our results reconcile the general perception that senators typically do give a large value to being reelected, with the relatively low average levels of responsiveness to voters we observe in the data. We find that the moderate level of electoral accountability on average is due to three factors. First, over a fourth of senators in our sample are heavily ideological, and would only be willing to deviate from their policy preferences in exchange for a large electoral gain. Second, the electoral return of policy moderation is low, both in absolute terms and relative to the electoral return of political advertising. Third, the modal senator enjoys a significant advantage in the polls, making them less willing to respond to voters' preferences.

To further clarify the relative role of preferences and the electoral returns of policy moderation we evaluate two counterfactual exercises: we consider (i) an increase in the electoral effectiveness of position-taking relative to what we observe in the data, and (ii) a ban of political advertisement. We find that even quadrupling the return of policy moderation from the levels observed in the data only increases the average EAI to about 50% in close elections. Similarly, eliminating political advertising leads to a moderate increase (less than 10 p.p.) in the level of electoral accountability for the typical senator. These results indicate that the weight most senators give to their own ideology is considerable, and emphasize the importance of adverse selection for voter welfare.

2 Related Literature

Our paper contributes to three distinct research lines. First, a prominent literature in political science focuses on understanding whether legislators are responsive to constituency preferences. The traditional approach in the empirical literature has been

to model legislator voting behavior as a direct function of constituency preferences (Kalt and Zupan (1984), Peltzman (1984), Kalt and Zupan (1990), Bender (1991), Levitt (1996), Mian, Sufi, and Trebbi (2010)).⁴ In our model, instead, voters' preferences enter indirectly, through their effect on electoral outcomes. Our estimates allow us to disentangle how the preferences of voters and politicians, the competitiveness of the race, and the effectiveness of policy and advertising to change voter support, affect legislators' behavior.

A key ingredient in this account (often implicit in the literature) is a degree of *voter* responsiveness to legislators' policy positions. The presence of this relationship is not at all guaranteed. In fact, a robust literature follows Campbell, Converse, Miller, and Stokes (1980) in arguing that voters are driven by partisanship, and are largely unresponsive to legislators' policy stances. Contrary to this view, Canes-Wrone, Brady, and Cogan (2002), Ansolabehere and Jones (2010) and Fowler et al. (2020) among others provide evidence that legislators' records affect voting behavior. Our results provide additional evidence supporting this view, but indicate that voters' relatively low sensitivity to senators' policy positions provides weak incentives for electoral accountability.⁵

At a broader level, our paper connects with a series of recent papers which have adopted a structural estimation approach to study how elected politicians respond to electoral incentives. In particular, Lim (2013) and Sieg and Yoon (2017) estimate the value of office vs. policy for trial court judges in Kansas and US governors respectively, assuming it is homogeneous across agents. A key innovation of our paper is to exploit within-cycle variation in polls, position-taking and advertising to estimate senators' preferences for office and policy. This allows us to obtain rich heterogeneity in our preference estimates, using the differential responsiveness of ads and position-taking to variation in the perceived level of voter support across the electoral cycle. In contrast, the estimation approach in Diermeier, Keane, and Merlo (2005) and Lim (2013) require observing dynamic tradeoffs over the long run, as induced by politicians' career decisions, to quantify electoral accountability. Likewise,

⁴ Lee, Moretti, and Butler (2004) argue that selection, and not responsiveness to voters, explains voting outcomes in the US House of Representatives (see also Kau and Rubin (1979)).

⁵ Differently than previous literature, we estimate the effect of ads and position-taking on a panel, using monthly variation in polls, position-taking and advertising. This allows us to account for senators' fixed characteristics, as well as for potential confounders that vary over the electoral cycle.

Sieg and Yoon (2017), Avis, Ferraz, and Finan (2018) and Aruoba, Drazen, and Vlaicu (2018) exploit the dynamics across electoral cycles induced by term limits in models of electoral competition.⁶

3 Data

Our main data consist of monthly observations of voting support, roll-call votes, and TV advertising expenditures for 102 incumbent senators who ran for reelection at least once in the period 2000-2014, for a total of 132 (senator-congress) electoral cycles.⁷ We supplement these data with individual characteristics of the senators, as well as demographic and economic indicators at the state level.

Polls. To measure senators' advantage in the polls, we use public opinion data for each senate race, collected from *Polling Report*, *Real Clear Politics* and *Pollster*. The `pointlead` of each senator t months away from the election measures the average difference between the share of respondents in favor of the incumbent and the challenger in that month. We compute a weighted average of this measure over all available polls in each period, where the weights are inversely proportional to the number of survey respondents. Whenever possible, we fill gaps in senate races' opinion data with the predicted `pointlead` obtained from incumbent senators' approval rates, prediction market data, and national polls that contain individual voters' congressional approval (see Appendix A for details).

Figure 1 illustrates three key facts about the evolution of voter support. First, polls are informative throughout the electoral cycle. In fact, late realizations of `pointlead` are highly predictive of the observed incumbent advantage on election day (upper panel), and throughout the cycle, current values of `pointlead` are a good predictor of `pointlead` in the next period (lower right panel). Second, while on average incumbents enjoy an advantage of close to 20 p.p., there is significant heterogene-

⁶ Sieg and Yoon (2017) and Aruoba, Drazen, and Vlaicu (2018) study US governors, Avis, Ferraz, and Finan (2018) focuses on municipalities in Brazil, and Lim (2013) studies elected and appointed judges in Kansas. Diermeier, Keane, and Merlo (2005) quantify the monetary value of a seat in Congress.

⁷ We exclude the electoral cycle 2005/06 since advertising data is not available.

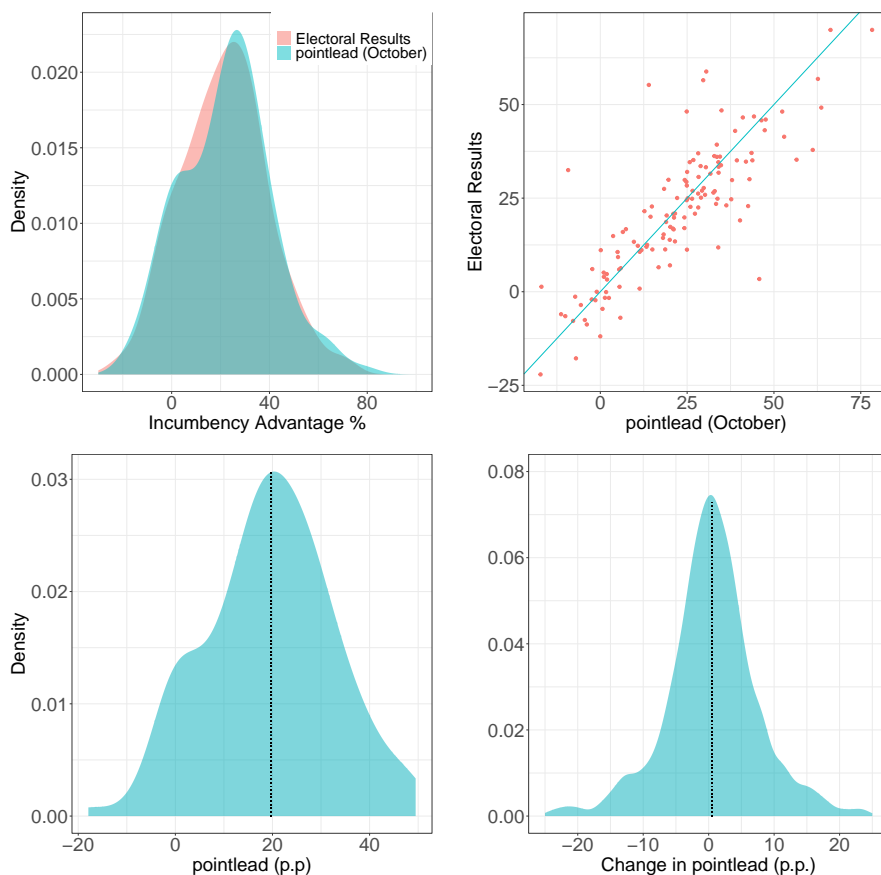


Figure 1: The Dynamics of Polls and Electoral Returns. The upper left panel plots the distribution of realized electoral returns and `pointlead` a month before the election. The upper right panel plots the corresponding crossplot. The lower left panel plots the distribution of the average `pointlead` per senator over the electoral cycle. The lower right panel plots the distribution of the monthly change in `pointlead` for each senator and time period.

ity in electoral security both across senators (lower left panel) and within senators throughout the electoral cycle (lower right panel).

Policy Positions. To quantify senators’ policy positions at each point in time, we use two alternative measures. In our benchmark specification, we use scaling techniques to obtain a one-dimensional measure capturing variability in senators’ voting records. Specifically, we define senator i ’s `position` in month t as her “ideal point” estimate from a Bayesian Quadratic Normal model (Clinton, Jackman, and Rivers (2004b)). We use `position` only as a summary of senators’ position-taking,

and do not interpret it as a measure of policy preferences, which we then estimate as parameters of the model. Due to data limitations, scaling roll calls in a single month results in highly variable and imprecisely estimated positions. To overcome this problem, we estimate policy positions using a rolling window of roll call votes taken within the previous 12 months.⁸ Figure 2 plots the policy positions observed in the data, for Democrat and Republican Senators, vis-à-vis their advantage in the polls.

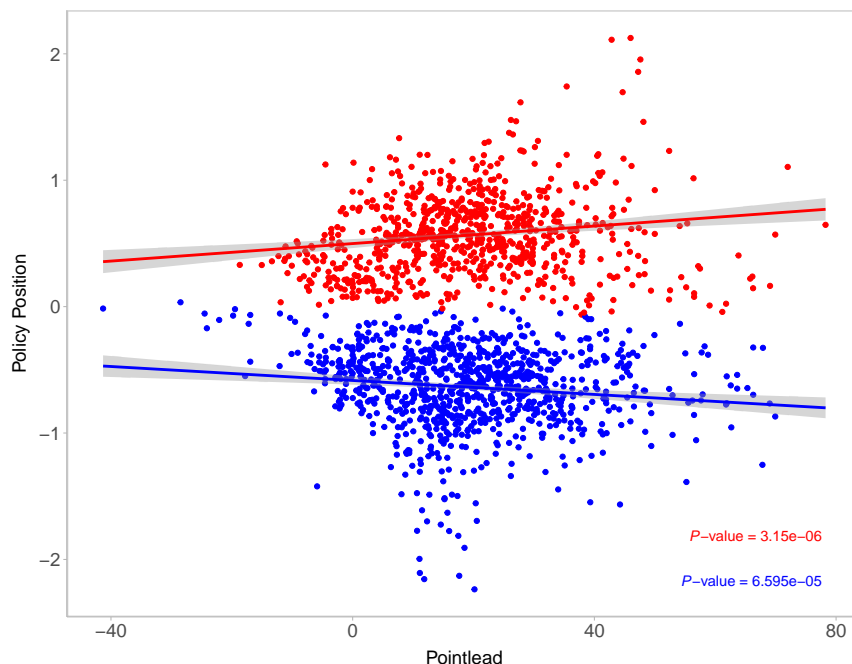


Figure 2: Senators’ Policy Positions and Advantage in the Polls. Red indicates Republicans, Blue denotes Democrats.

Advertising. Advertising data allows us to measure the *quantity* of TV ad buys directed to voters in each period, `tv-ads`. To construct this measure, we first compute the monthly TV ad spending for each incumbent senator by adding the costs of all ads

⁸ In Appendix D.6, we show that (i) restricting to periods in which positions can be reliably estimated at a monthly level, the month-to-month and smoothed measures are highly correlated, and that (ii) our main results are robust when using a shorter (6 month) scaling window size. We also compute an alternative measure of senators’ policy positions in each period, `partyvote`, defined as the percentage of party votes (votes for which a majority of Republicans opposes a majority of Democrats) in which the senator takes the Republican position.

aired during each month on her behalf. We then measure the number of impressions, or gross rating points (GRPs), dividing TV ad expenditures by prices.⁹ We also use challengers' TV ad buys, sponsored by the challenger and third parties on her behalf.¹⁰

The left panel of Figure 3 plots the cumulative proportion of TV ad expenditures disbursed up to each month before the election. As the figure shows, senators tend to concentrate TV ad expenditures in the last 6 months before the election. The right panel of Figure 3 shows that senators tend to spend more in TV ads as elections become more competitive (no causal emphasis intended).

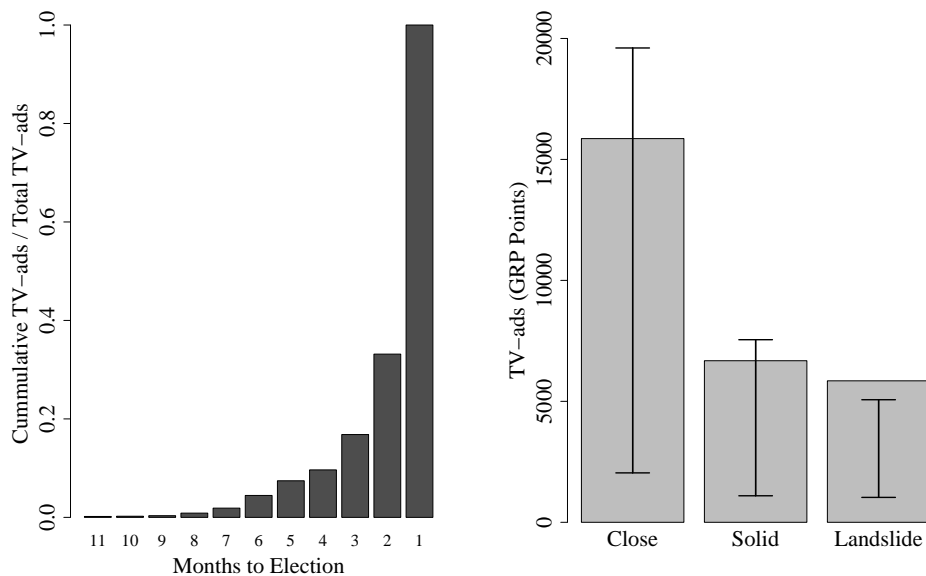


Figure 3: Average TV ad buys by Time to Election and `pointlead`. Line segments represent the interquartile range of values in the data.

⁹ We use SQUAD data on ad prices for the third quarter of each election year during the period 2002-2010, from Martin and Peskowitz (2015). Prices are weighted by the fraction of the population in each congressional district residing in a given media market. In Appendix D.7 we assess the impact on our estimates of potential measurement error, which could be caused by high-frequency variation in prices, or price discrimination by TV stations.

¹⁰ In Appendix D.8, we reproduce the analysis using total campaign expenditures. Using campaign expenditures has the benefit of including other electioneering activities, but fails to disentangle quantities from prices, and incorporates a significant fraction of indirect costs, which do not affect voters directly.

Additional Variables. We incorporate various senator and race-specific characteristics, including party, gender, seniority, committee service, leadership positions, and state-level presidential vote share. We also control for contested and uncontested primary elections for incumbents and challengers, demographic characteristics at the state level (median household income, education, % older population, % black population, % hispanic population), and economic indicators that vary both across states and within electoral cycles (unemployment, economic activity). To inform our measure of state ideology, we follow Canes-Wrone, Brady, and Cogan (2002) and compute the average vote spread for the period 2000-2012 between the Republican and Democrat presidential candidates in each state, `presrep.margin`, using data from Dave Leip’s *Atlas of U.S. Presidential Elections*. We refer the reader to Appendix A for a description of these data, and descriptive statistics of all variables.

4 The Model

We consider the decision-making problem of an incumbent politician t months away from the election, $t = T, \dots, 1$. At the beginning of period t , the incumbent observes her advantage in the polls, $p_t \in \mathcal{P}$. After observing p_t , the incumbent decides (i) a policy position $x_t \in \Pi_x$ and (ii) the quantity of TV ads, $e_t \in \Pi_e$. Consistent with our estimation strategy, we let Π_x , Π_e and \mathcal{P} be finite sets. We let $y_t \equiv (x_t, e_t)$ denote the endogenous variables in period t , and $z_t \equiv (p_t, y_t)$.

Both position taking and TV ads affect next period polls. The incumbent’s advantage in the polls evolves stochastically, with conditional mean

$$E[p_{t-1}|z_t] = \pi_1 p_t + \pi_2 (x_t - \varepsilon)^2 + \pi_3 \sqrt{e_t} + C_t,$$

where ε denote voters’ preferred policy position, and C_t denotes senator and race-specific controls, including the challenger’s advertisement expenditures.

Deploying an amount e_t of TV ads in period t has an opportunity cost $C(e_t) = \gamma e_t^2$. Pandering to voters, in turn, is costly to the politician who cares about ideology. In particular, we assume that when the politician takes a position x_t in period t she gets a flow payoff $u(x_t, \theta) = -\lambda(x_t - \theta)^2$, where $\theta \in \mathbb{R}$ is the politician’s ideal point and λ is the importance of ideology vis-à-vis office. As is customary in the literature, to

capture other factors that affect the decision of the politician but are unobserved by the researcher, we assume that a choice $y^j \equiv (x^j, e^j)$ also generates flow payoffs μ^j , where μ^j is known to the politician, but from the perspective of the researcher is an i.i.d. random variable with pdf $g(\cdot)$.

Voter support at election time, $t = 0$, determines the result of the election. We assume that the politician gets an office payoff $\omega \geq 0$ if she wins the election, and an additional benefit $\alpha \geq 0$ from a large margin of victory; i.e., $p_0 > \bar{p}$ for $\bar{p} \in [1/2, 1]$.¹¹ ¹² The payoff of losing the election is normalized to zero. Note that since the politician’s beliefs are stochastically increasing in current polls p_t , this specification induces a continuous increasing continuation value. The Bellman equation for the incumbent is

$$W_t(p_t, \mu_t) = \max_{y_t} \left\{ \lambda(x_t - \theta)^2 - \gamma(e_t)^2 + E \left[\bar{W}_{t-1}(p_{t-1}) \mid z_t \right] + \mu(y_t) \right\}, \quad (4.1)$$

where $\bar{W}_t(p_t) \equiv E_\mu [W_t(p_t, \mu_t)]$, and

$$E \left[\bar{W}_0(p_0) \mid z_1 \right] \equiv \Pr(1/2 < p_0 < \bar{p} \mid z_1) \omega + \Pr(p_0 > \bar{p} \mid z_1) (\omega + \alpha).$$

The solution to the politician’s problem is a policy function $\{\chi_{T-r}^*(\cdot)\}_{r=0}^{T-1}$, where in each t , $\chi_t^*(p_t, \mu_t)$ solves (4.1) in state (p_t, μ_t) .

Identification: From Data to Model Parameters. Equation (4.1) makes clear the dynamic tradeoff of the politician in our model. At each t , the politician balances the additional cost of ads and position-taking with their marginal return in terms of increasing the probability of being in a more favorable state next period, and ultimately winning the election. Since senators with different preference parameters will resolve these tradeoffs differently, leading to different choices in each state, observing senators’ choices over the electoral cycle allows us to recover these preference parameters. We illustrate this variation in Figure 4, for a liberal politician ($\theta = -0.6$) facing

¹¹ Our baseline specification nests the model with $\alpha = 0$. As we show in Section 6, the constrained model is rejected by the data for a large majority of senators in the sample. In Appendix D.2 we present the estimates for the constrained model.

¹² In our main specification, we define a safe win as a margin of victory of at least 15 p.p.. For robustness, we recompute our estimates with alternative thresholds (Appendix D.3). We show that our parameter estimates and policy functions are qualitatively unchanged (see Figures D5 and D6).

a relatively moderate electorate (with a poll-maximizing position at $\xi = -0.36$). In the figure, we plot the predicted position-taking and TV-ad buys as a function of the advantage in the polls, $t = 1, \dots, 5$ periods before the election.

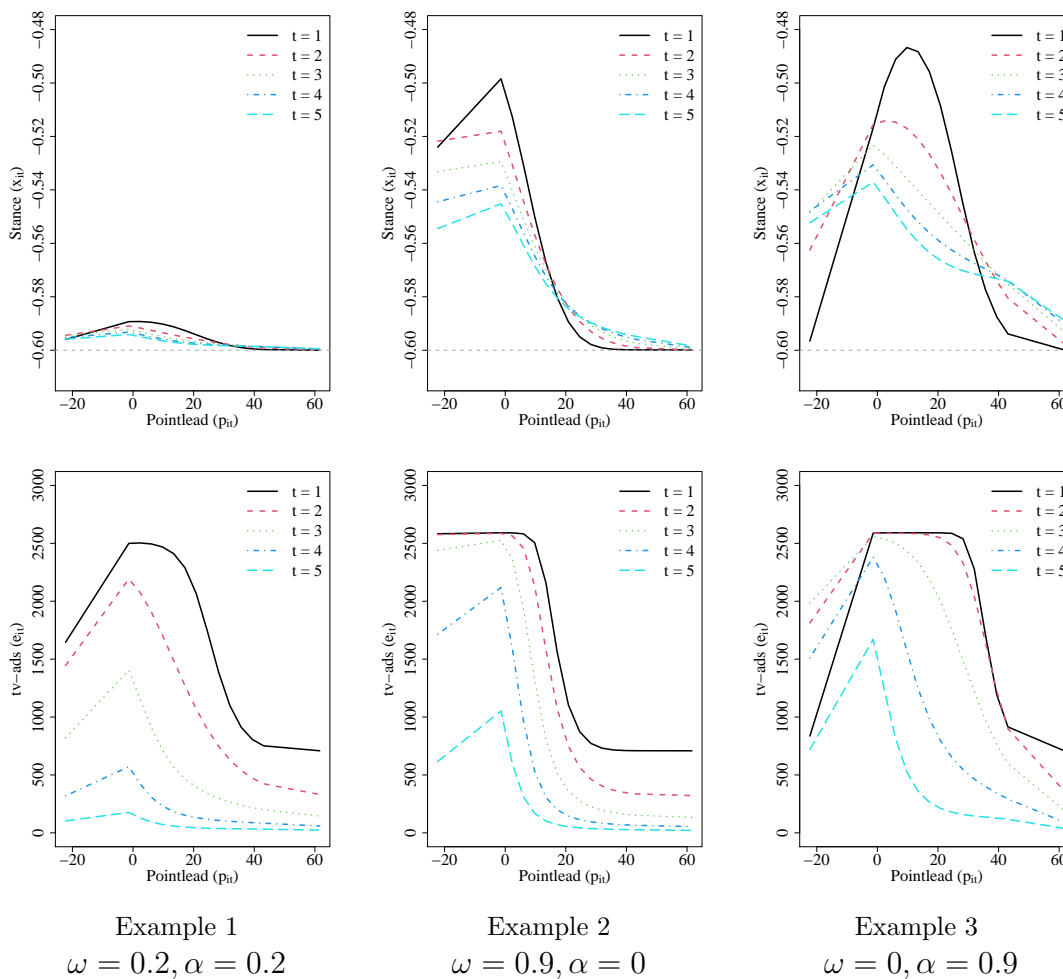


Figure 4: Predicted Position-Taking and TV-ad buys. Dashed gray lines depict senator ideal policy ($\theta = -0.6$).

In the example illustrated in the left panel, we set $\omega = \alpha = 0.2$. Given the low willingness to compromise her policy position for electoral gains, the politician optimally maintains a policy position close to her ideal point regardless of her advantage in the polls, with the brunt of her reelection effort falling on TV ads. In the center panel, we fix $\omega = 0.9, \alpha = 0$. In this case, the politician is much more willing to concede policy to attain reelection, but gives no value to safe wins. As a result, the politician

holds a policy position close to her ideal point when she enjoys a large advantage in the polls, but significantly moderates her policy position towards the voters’ preferred policy and increases TV ad expenditures as the election gets more competitive. In the right-hand panel, we consider the case where the politician gives a large value to office vis-à-vis policy, but puts significant value only on winning by a large margin ($\omega = 0, \alpha = 0.9$). In this example, the politician is responsive to voters even in safe races. Because the senator cares about winning by a large margin more than simply winning reelection, the degree of responsiveness towards the voters is not monotonic in electoral support.

The figure illustrates that larger changes in position-taking towards the voter and increased advertising expenditures in “safe” electoral states relative to “competitive” electoral states are consistent with lower values of ω/α , as in the left and right-hand panels. Similarly, larger changes in position-taking towards the voter and increased advertising expenditures in “competitive” electoral states relative to “safe” electoral states are consistent with larger values of ω/α , as in the center panel. Moreover, for any total level of effort, senators who care more about policy will tend to substitute policy responsiveness with political advertising. Thus, the relative responsiveness of policy and ads in competitive and safe electoral conditions pins down the relative weight of policy vs reelection concerns, ω/λ . The cost parameter γ/λ then rationalizes the overall level of ad expenditures.

Given ω, α, γ , we can compute the pattern of responsiveness to voters in each electoral condition. We then obtain the ideal policy θ as the policy chosen by the senator in electoral states in which she is not responsive to voters. In the next section, we describe more formally how this basic intuition translates into our estimation strategy.

5 Estimation

We are interested in estimating the structural parameters of the model presented in Section 4: ideal points, relative weights of ideology vis-à-vis office rents, and cost parameters. Let $\rho_i \equiv \{\theta_i, \lambda_i, \omega_i, \alpha_i, \gamma_i\}$ denote these individual-specific parameters, with $\rho \equiv \{\rho_i\}_{i=1}^N$, and let ψ denote the parameters of the transition function, governing the evolution of the state as a function of current state and endogenous variables,

$z_{i,t} \equiv (y_{i,t}, p_{i,t})$. Given panel data $\{z_{i,t}\}$ for senators $i = 1, \dots, N$, the likelihood of choices $y_{i,t}$ by senator i in period t can be written as the product of the transition probability $\Pr(p_{i,t}|z_{i,t+1}; \psi)$ and the conditional choice probability $\Pr(y_{i,t}|p_{i,t}; \rho_i, \psi)$:

$$L(\rho, \psi) = \prod_{i=1}^N \prod_{t=1}^T \Pr(y_{i,t}|p_{i,t}; \rho_i, \psi) \times \Pr(p_{i,t}|z_{i,t+1}; \psi), \quad (5.1)$$

Since the transition function of polls does not depend on either individual-specific parameters (ρ) or individual unobservable state variables μ_t^j , a consistent estimate of the transition function can be obtained by estimating it separately. Because this significantly reduces the computational burden, we estimate the parameters of the model in two steps. In the first step, we estimate the transition parameters ψ , pooling information across senators.¹³ In the second step, we estimate the individual-specific parameters ρ given the estimated transition probabilities, using a version of the nested fixed point algorithm (NFXP) originally developed by Rust (1994) (see also Aguirregabiria and Mira (2010)).¹⁴

The challenge in estimating ρ directly from the likelihood in (5.1) is that the conditional choice probability $\Pr(y_{i,t}|p_{i,t}; \rho_i, \psi)$ is not a known function of ρ_i . Instead, it is given by the optimal response of the politician with characteristics ρ_i in each state $(p_{i,t}, \mu_{i,t})$. To tackle this problem, the NFXP algorithm iterates along two steps. In an inner loop, we obtain the conditional choice probability $\Pr(y_{i,t}|p_{i,t}; \rho_i, \psi)$ for each given trial parameter ρ_i , by solving the dynamic problem of the senator with preferences ρ_i . In the outer loop, we search over the parameter space to maximize the likelihood, with the conditional choice probabilities associated with each trial parameter given by the inner loop.¹⁵

¹³ Given estimates of ψ , we specify the transition function using a discretized normal distribution, letting $p_{i,t}$ take values in a finite set (see Tauchen (1986)).

¹⁴ Alternatively, one could use the approach of Hotz and Miller (1993) and Bajari, Benkard, and Levin (2007), in which structural parameters are recovered from conditional choice probabilities (CCPs) without explicitly solving the optimization problem for each trial value of the parameters. In the absence of rich data, however, direct estimation of CCPs would require that we impose parametric assumptions to “pool” legislator data. This would impose arbitrary constraints on the mapping between structural parameters and equilibrium choices, which would carry over to structural parameter estimates, potentially introducing bias.

¹⁵ To implement this approach, we discretize the state and choice variables. We use a grid of 15 categories for our measure of polls (**pointlead**), 30 categories for our measure of policy position (**position**), and three categories for our measure of TV advertisement (**tv-ads**). We find that this binning captures the main features of the data well. For details, see Appendix B.2.

To relate senator’s preference parameters to relevant observable attributes, while still allowing heterogeneity *conditional* on covariates, we model structural parameters as latent random variables drawn from distributions with parameters that are functions of senator characteristics. This allows the preference estimates to be informed by both their effect on conditional choice probabilities and observable characteristics (see Appendix B.1 for more details).

To estimate the parameters of the transition function, we estimate the linear model

$$\begin{aligned}
 p_{i,t-1} = & \pi_0 + \pi_1 p_{i,t} + \pi_2 (x_{i,t} - \varepsilon_i)^2 \\
 & + \pi_3 \sqrt{e_{i,t}} + \pi_4 \sqrt{e_{i,t}^{ch}} + Q'_{it} \beta + \zeta_c + \epsilon_{i,t}.
 \end{aligned}
 \tag{5.2}$$

Here $\psi = \{\pi, \beta, \phi, \zeta_c\}$ is the vector of first-stage parameters of interest, Q_{it} is a vector of senator and state specific characteristics that include senator characteristics and state socio-economic indicators, and ζ_c are party-Congress fixed effects, which capture all session-specific shocks to polls for each party. The specification in equation (5.2) allows the effect of **position** (x_{it}) on voter support to differ based on the incumbent’s state electoral preferences through the term $\varepsilon_i \equiv a + b \times (\text{presrep.margin})$, where a and b are coefficients to be estimated.¹⁶ In addition, it directly allows for decreasing returns to **tv-ads** via the squared root transformation.¹⁷ The individual-specific covariates capture the effect of race characteristics on voter support, both fixed and time-variant within cycle. We cluster errors at the senator-congress level to account for heteroskedasticity and serial correlation at the electoral race level.

Differently than in a static model with observations at the electoral cycle level, equation (5.2) relies on within-cycle variation. The panel structure of the data allows us to control for the effect of potential time-varying confounders by controlling for past polls via a lagged dependent variable (LDV). We find similar estimated parameters

¹⁶ In eq. (5.2), we assume that the senators’ policy positions affect voter support through deviations from mean voter preference, as measured by the republican presidential margin in each state. This is of course a simplified model, that might not fully capture the richness of the electoral environment. In Appendix D.5 we show that our conclusions are robust when using the survey-based estimates of the mean and standard deviation of state ideology obtained by Tausanovitch and Warsaw (2013).

¹⁷In Table C3 in the Appendix, we consider alternative specifications that yield similar estimated transitions: we directly allow for nonlinear effects of **position** and its interaction with **presrep.margin**, as well as with **tv-ads**. We also consider a log transformation to capture the nonlinear effect of **tv-ads**.

when we estimate a version of equation 5.2 that also accounts for potential unobserved heterogeneity via “grouped fixed-effects” (Bonhomme and Manresa (2015)). This estimator controls for time-varying fixed effects within groups of senators, $\zeta_{g_i,t}$, where group membership, $g \in \{1, \dots, G\}$, is estimated from all possible clusters of legislators in the data based on an optimal grouping of legislators according to a least-squares criterion. Unlike legislator-specific fixed-effects, the “group-fixed effects” estimator is consistent in the presence of a lagged dependent variable (Nickell (1981)). In addition, it is more flexible, as it allows for changes over time in group heterogeneity. Table C2 in the Appendix shows the estimates for the “grouped fixed-effects” specification for $G \in \{1, 5, 10, 15, 20, 25\}$. As a robustness check, we re-estimate the model using an IV strategy to estimate the transition function. With the IV, we find a larger effect of changes in policy position on voter support. Our career concerns and ideal policy estimates, however, are largely unchanged (see Appendix D.4 for more details).

We estimate equation (5.2) on a balanced panel dataset. To do this, we impute missing `pointlead` observations via the EM algorithm, which is a commonly applied method to efficiently analyze unbalanced panels. The estimates of the first-stage with an unbalanced panel are almost identical to our main specification. This result, along with diagnostics for the multiple imputations, indicate that the bias induced by the presence of missing `pointlead` observations is negligible.¹⁸

Model Fit. To assess model fit, we compare the predictions of the model relative to the data, in and out of sample. To evaluate out of sample fit, we exploit the fact that our data contains multiple instances in which senators run two or even three times for office. We re-estimate the model parameters using only the first instance in which a senator runs for office in the sample, and use the resulting estimates to predict their behavior in the second or third run. The results (summarized in Figure C5 in the Appendix) indicate that the model provides a good approximation to the data, both in and out of sample.

¹⁸ Results available upon request.

6 Results

In this section, we present our main results. We begin by describing our estimates of senators’ *preferences* for office and policy; i.e., the policy concession senators would be *willing to give* to attain a gain in the probability of being reelected. To facilitate intuition, suppose that we maintain a fixed policy position x in the final T periods before reelection. Letting π and π^+ denote the probability of a close and a lopsided win respectively, we can write senator i ’s payoff (ignoring TV advertisement costs) as

$$U_i = -\lambda_i T(x - \theta_i)^2 + \omega_i \pi + (\omega_i + \alpha_i) \pi^+. \quad (6.1)$$

Expression (6.1) makes clear that the relevant parameters determining how each politician trades-off policy concessions for electoral gains are ω_i/λ_i and α_i/λ_i . Figure 8 presents our estimates of $(\omega_i + \alpha_i)/\lambda_i$ for each senator in our sample, along with bootstrap confidence intervals. As the figure shows, there is a large degree of heterogeneity in preferences for office vs. policy among US senators. Senators at the bottom of the figure (e.g., Sessions, Grassley, Collins, Specter, Gregg, or Voinovich) give a large value to ideological congruence, and are not willing to make large policy concessions for electoral gains. On the other hand, senators at the top of the figure (e.g., Roberts, Boxer, Reed, Hatch, Leahy) are – according to our estimates – largely willing to make policy concessions to achieve electoral gains (Figure C1 in Appendix C.1 presents the estimates of ω_i/λ_i (in logs), which is relevant to evaluate the “willingness to pay” for close wins.).

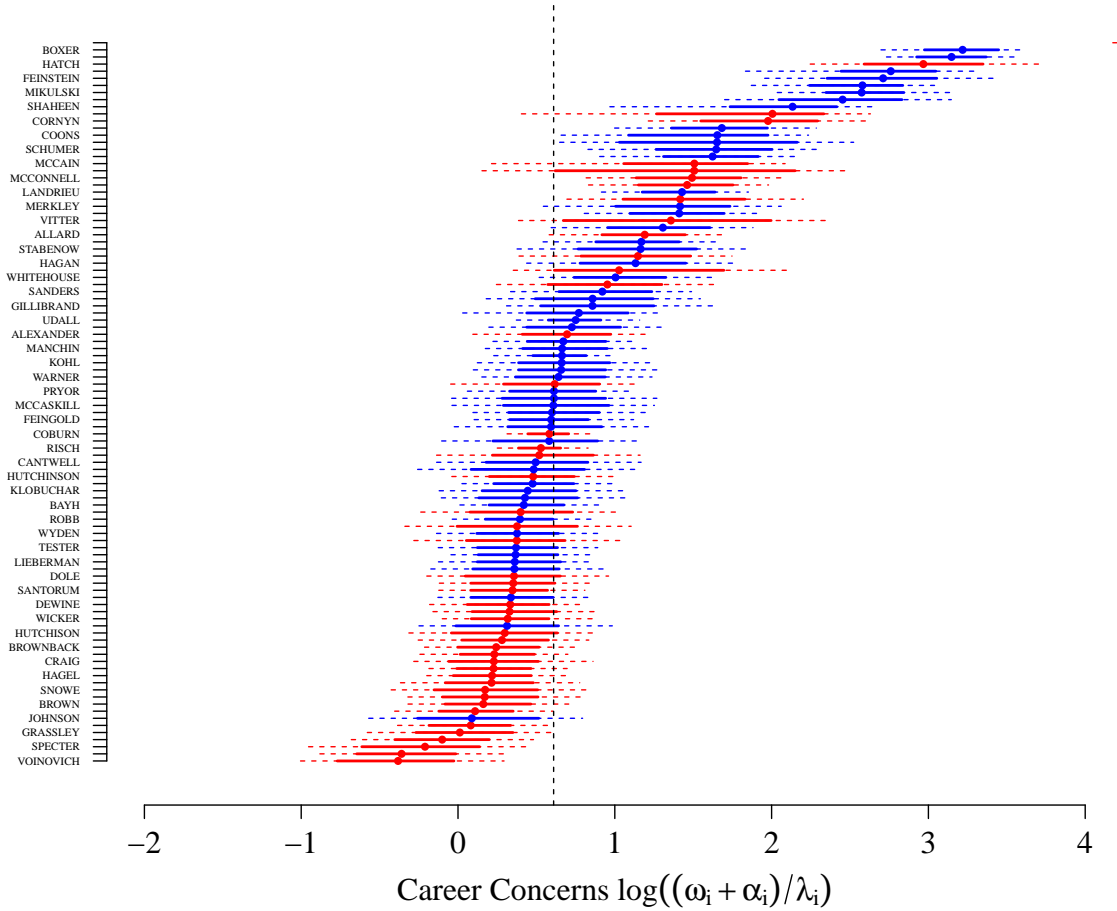


Figure 5: Estimates of $\log(\omega_i + \alpha_i)/\lambda_i$ for each senator in the sample. Solid (dashed) lines represent 80% (90%) bootstrap confidence intervals.

To provide a more readily interpretable magnitude of senators' preferences for office vs policy, we compute the change in policy each senator would be willing to concede for a 1 p.p. increase in the probability of a safe or a close win. We refer to this quantities as the *compensating variation* for safe and close wins, CV_i^{safe} and CV_i^{close} respectively. From (6.1), if we consider the change from an initial policy position $x^0 = \theta_i$,

$$CV_i^{safe} \equiv \left(\frac{1}{|\theta_{med}^D - \theta_{med}^R|} \right) \sqrt{\left(\frac{\omega_i + \alpha_i}{\lambda_i} \right) \frac{1}{T} \Delta\pi}, \quad (6.2)$$

where we have normalized the policy concession by the distance between party me-

dians $|\theta_{med}^D - \theta_{med}^R|$, since the underlying space of policies is only identified up to an affine transformation. Similarly, CV_i^{close} is obtained using ω_i/λ_i . Figure 6 plots the empirical distribution of our point estimates of the compensating variation for safe and close wins, fixing $T = 6$.

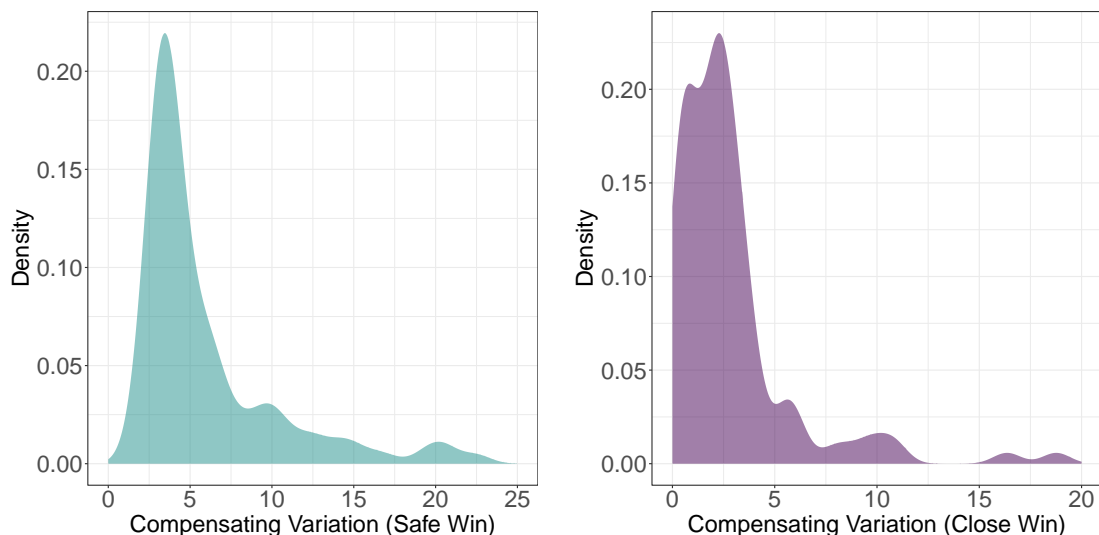


Figure 6: **Compensating Variation:** Policy sacrifice senators are willing to make in each of the last six months before the election for a 1 p.p. increase in the probability of a safe and a close win, as a proportion of the distance between party medians.

We find that a majority of senators are willing to give up substantial policy concessions for an increase in their electoral prospects. In particular, the senator at the median of the distribution is willing to give up a policy concession of 2.1% of the distance between party medians for a 1% increase in the probability of a close win, and of 4.5% of the distance between party medians for a 1% increase in the probability of a safe win.¹⁹ The difference in the two figures reflects our estimate of a non-negligible payoff for lopsided wins for a large fraction of senators in our sample. Indeed, the probability that $\alpha_i \geq 0.1$ is above 95% for 78% of the senators in our sample.²⁰

¹⁹ For an alternative reference, 2.1% of the distance between party medians corresponds to about 5% of the average policy distance between politicians' ideal points and the vote maximizing position in their state.

²⁰ Due to space considerations, we relegate the discussion of our ideal point estimates to Appendix C.1.1.

Efficacy of Advertising and Position-Taking. In our previous results, we discussed the policy concession senators would be willing to give to attain a gain in the probability of being reelected. In determining when to compromise in policy, or to what extent, however, senators must judge the effectiveness of the instruments at their disposal: how much would a TV ad or policy concession *actually* increase voter support. In this section, we describe our estimates of the effectiveness of ads and position-taking to change voter support.

Table 6 presents the key estimates (table C1 in Appendix C.2 presents the full set of estimates). Column (1) presents the OLS estimates for a specification without lagged polls, senator and state-specific factors. Column (2) adds the effect of past polls. Column (3) – our main specification – adds senator-state controls and fixed effects for each party in each electoral cycle. Column (4) reproduces (3) with “grouped fixed-effects”. Column (5) maintains the specification in column (3), with our alternative measure of position-taking (partyvote).

Table 1: First Stage Results (Compact)

	<i>Dependent variable: $p_{i,t-1}$</i>				
	OLS (1)	LDV (2)	LDV (3)	GFE (4)	LDV(partylvote) (5)
$p_{i,t}$		0.816*** (0.023)	0.763*** (0.025)	0.765*** (0.026)	0.763*** (0.028)
$(x_{i,t} - \xi)^2$	-6.497*** (2.311)	-1.533*** (0.507)	-2.199*** (0.829)	-2.272*** (0.517)	
$(x_{i,t}^p v - \xi)^2$					-8.291*** (2.707)
$\sqrt{\epsilon_{i,t}}$	0.027 (0.017)	0.017*** (0.007)	0.020*** (0.007)	0.013** (0.006)	0.023*** (0.008)
$\sqrt{\epsilon_{i,t}^{chall}}$	-0.137*** (0.022)	-0.047*** (0.009)	-0.049*** (0.010)	-0.049*** (0.007)	-0.046*** (0.010)
Observations	1,584	1,584	1,584	1,584	1,347
Senator-State Controls	No	No	Yes	No	Yes
Congress-Party FE	No	No	Yes	Yes	Yes
Group FE	No	No	No	Yes (20)	No
Adjusted R ²	0.128	0.676	0.683	0.834	0.689
F Statistic	78.629***	827.425***	110.940***	32.015***	97.376***

*Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors clustered at the senator-congress level in parentheses.*

We find that policy moderation towards the voters shifts the distribution of voter support, inducing different incentives for senators running for reelection in moderate,

conservative and liberal states. The effect of position-taking on voter support can be seen in Figure 7. In this figure, we group states as liberal and conservative according to the distribution of state ideology, with liberal (conservative) states below (above) the median of `presrep.margin`. We then plot the immediate estimated change in `pointlead` in each state given a change in the senator's `position` from the 25th to the 75th percentile of observed policy positions in the group of liberal and conservative states.

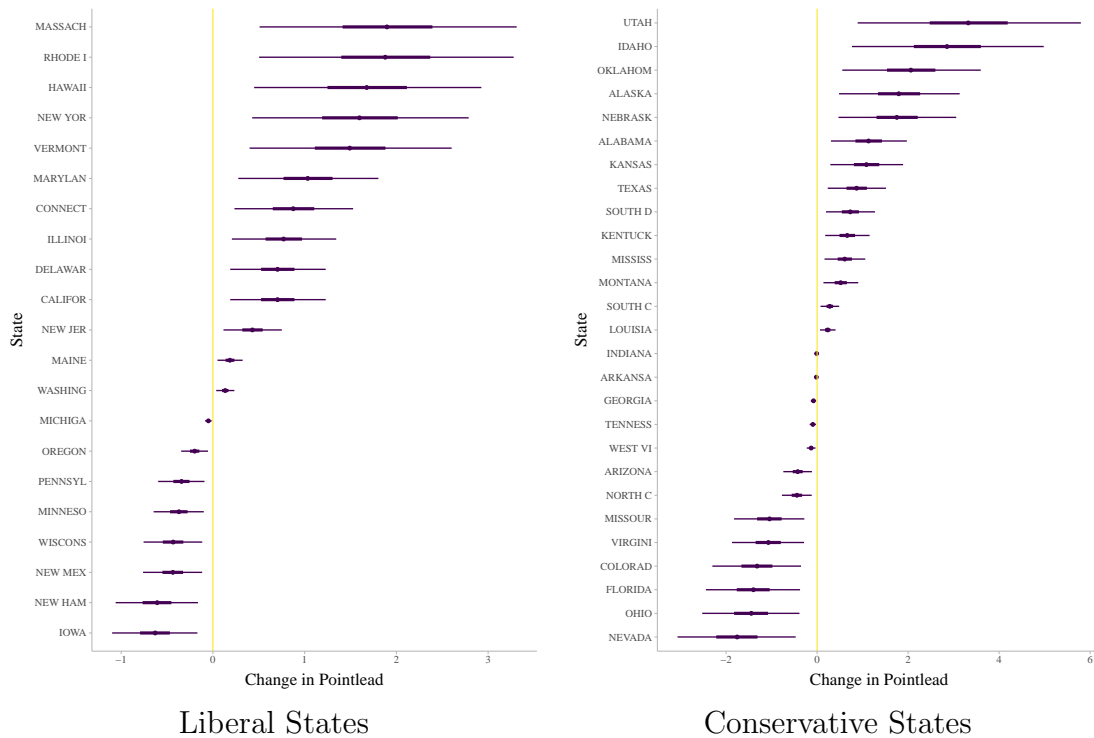


Figure 7: Effect of Position Taking on Voter Support. Change in `pointlead` given a change in `position` from its 25th to its 75th percentile in the group of liberal (left panel) and conservative states (right panel). Thick (thin) lines represent 80% and 90% confidence intervals.

There are two key takeaways from the figure. First, extreme policy positions do not muster electoral support in all states. Indeed, taking extreme policy positions increases voter support in the most liberal or conservative states (Massachusetts, Rhode Island, Hawaii, New York; Utah, Idaho, Oklahoma, Alaska), but reduces voter support in more moderate states (Iowa, New Hampshire, New Mexico; Nevada, Ohio, Florida, Colorado). These results differ somewhat from the findings of the literature

(see Canes-Wrone, Brady, and Cogan (2002) and references therein), where the general finding is that incumbents are penalized for ideological extremity.²¹ Second, the effect of changes in policy positions on voter support is moderate in magnitude. A change in position from the 25th to the 75th percentile of observed policy positions in each group leads to an increase of under 2 p.p. in the most liberal states, and under 4 p.p. in the most conservative states.

Political advertising also shifts the distribution of voter support, for both incumbent and challenger. For instance, increasing incumbent’s TV ads by 1,000 GRPs (or 200 ads in 5% rating shows) eight months before the election has an immediate impact of increasing next period pointlead by around 1.1 p.p. at the average ad buy. An increase of 1,000 GRP’s in the challenger’s TV ads decreases the incumbent’s next period pointlead by around 2.9 p.p.²² The long run effect of ads persists up to election day, but is considerably smaller, since past advantages in the polls depreciate by about 25 percent per month (see Table 1).²³ The partial erosion of previous gains induces a larger response in both ads and policy moderation as the election gets closer, as shown in Figure 4, and contributes to explain the “bunching” of ads in months closer to the election we observe in the data (see Figure 3).

²¹ This difference is due, in part, to the fact that in contrast to our model, specifications in extant work do not allow the effect of position-taking on voter support to vary with the partisan leaning of each state.

²² Our short-run estimates are in line with comparable estimates. In House races, Stratmann (2009) finds that increasing incumbent’s (challenger’s) advertising by 1000 GRP’s increases her pointlead by 2.4 p.p. (4.2 p.p.). For Presidential elections, Huber and Arceneaux (2007) estimate a comparable effect of 0.5 p.p. - 0.8 p.p. and Spenkuch and Toniatti (2018) find a comparable effect of 0.7 p.p., while Gordon and Hartmann (2013) estimate a larger effect, of about 3 p.p. for Republicans, and 3.4 p.p. for Democrats.

²³ In a field experiment on the 2006 Gubernatorial campaign in Texas, Gerber, Gimpel, Green, and Shaw (2011) find a large (5 p.p.) short run effect of ads on vote shares, but a pronounced decay, with advertisement effects vanishing after a couple of weeks.

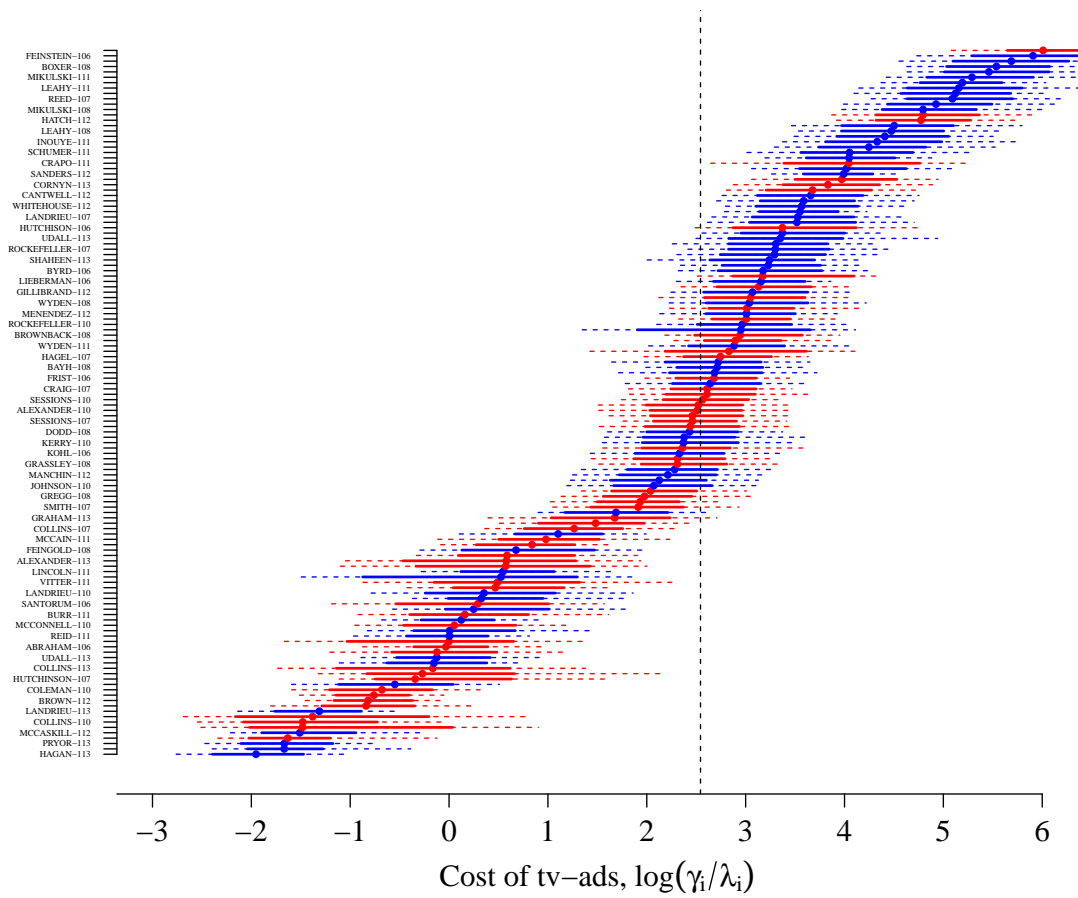


Figure 8: Estimates of the cost (γ) of TV ads. Solid (dashed) lines represent 80% (90%) bootstrap confidence intervals.

While the effect of ads on voter support is assumed to be equal across candidates, we allow cost parameters γ_i to vary at the individual level. This allow us to capture persistent unobserved heterogeneity across senators, which may arise due to differences in the cost of advertising across media markets, or senators' fundraising ability. Indeed, as figure 8 shows, our estimates imply a significant heterogeneity in costs, which contributes to explain the large differences in the level of advertising across senate races we observe in the data.

Electoral Accountability. We now turn to politicians' behavior in office, to address electoral accountability. To what extent do senators adjust their position away from their ideal points and towards the electorate they represent? How does this vary with their perceived electoral advantage? Answering these questions requires that we combine our estimates of senators' preferences for office and policy with the effectiveness of the instruments at their disposal. This is done through the policy function $\chi_t^{i*}(\cdot)$ estimated for each senator i , where in each t , $\chi_t^{i*}(p_t, \mu_t)$ gives the optimal response of senator i in state (p_t, μ_t) , given preferences ρ_i , and given the transition function parameter estimates ψ .

To summarize aggregate patterns of electoral accountability we compute an aggregate policy function. To do this, we construct an *electoral accountability index*, EAI_{it} , defined by the relative weight of voters' preferences in i 's optimal policy position at time t and poll advantage p , as given by i 's policy function,

$$\text{EAI}_{it} \equiv \frac{\chi_t^{i*}(p_t, \mu_t) - \theta_i}{(\xi_i - \theta_i)} \times 100, \quad (6.3)$$

where ξ_i denotes the policy position that maximizes i 's electoral support. An electoral accountability of 100 in state (p_t, t) means that the senator's predicted position is the one that maximizes voter support, $\chi_t^{i*}(p_t, \mu_t) = \xi_i$, while $\text{EAI} = 0$ means that the senator is predicted to take a policy position equal to his preferred ideal policy $\chi_t^{i*}(p_t, \mu_t) = \theta_i$. We then compute the average EAI across individual senators, as a function of their advantage in the polls. In the left panel of Figure 9 we plot the mean EAI across senators, as well as for each quartile of the career concern distribution, as ranked by λ .

There are three key takeaways from the figure. First, our results shed light on the mixed support in the literature for the *marginality* hypothesis, which asserts that legislators will tend to be more responsive to voters when their seat is in danger (see Bartels (1991), Ansolabehere, Snyder Jr, and Stewart III (2001), Griffin (2006), Mian, Sufi, and Trebbi (2010)). While individual senators *can* be equally or even more responsive when elections are not close, *on average* senators are more responsive to constituency interests in competitive elections than when they anticipate they will win by a large margin. Second, even at its maximum level (in close elections), the average electoral accountability index is below 30%, and goes down to about 14% for a large

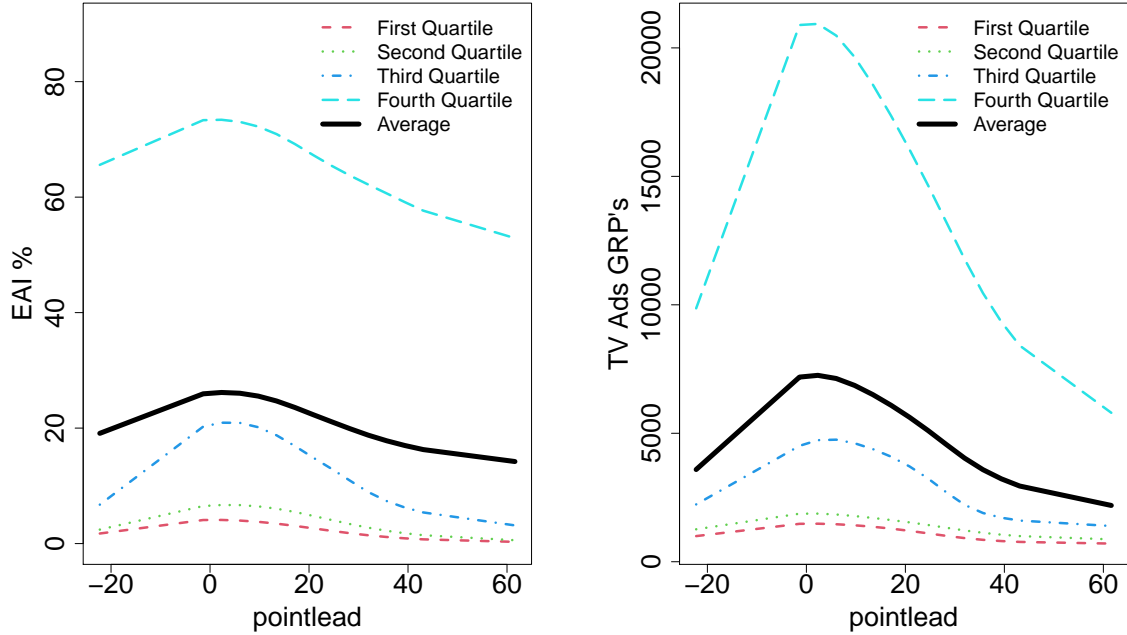


Figure 9: Predicted Electoral Accountability Index and TV advertising as a function of electoral advantage. Quartiles of the distribution of λ (policy) and λ/γ (ads).

electoral advantage. Thus, even at its peak, on average politicians' policy preferences have a much larger weight than constituency preferences in determining senators' policy positions. However (and third), there is a substantial amount of heterogeneity in politicians' responses to their voters. Senators in the top quartile of career concerns have an electoral accountability index close to 74% in close elections. On the other extreme, senators in the bottom quartile never exceed 5%. As a result, their policy positions are almost exclusively determined by their own policy preferences.

The right panel of Figure 9 shows a similar exercise with spending in TV ads. We find that average predicted TV ad-spending also follows a pattern consistent with the "marginality hypothesis": the average TV-ad buy is about 2200 GRPs for large leads (440 ads in 5% rating shows), but increases to about 7250 GRP's per month (1450 ads in 5% rating shows) in close elections. This change is much more pronounced for senators with high career concerns, who go from an average of less than 6000 GRPs when enjoying large leads, to about 21000 GRPs in close elections.

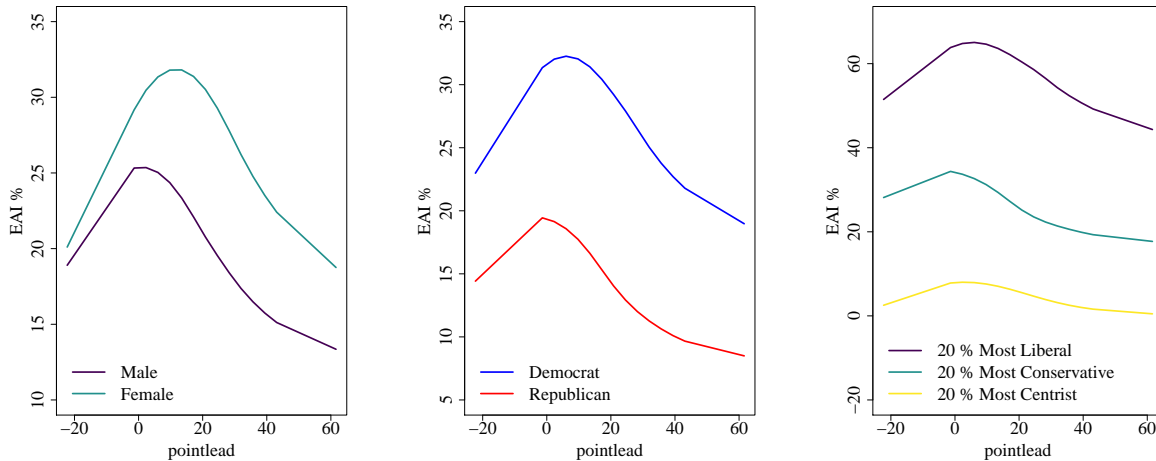


Figure 10: Electoral Accountability by Senator Characteristics

A natural question is how does electoral accountability vary with observable characteristics of the senators. In Figure 10, we explore variation related to senators' gender, party, and ideology. The left panel presents our electoral accountability index for male and female senators in our sample. We find that female senators are on average more responsive to voters than their male counterparts. The middle panel distinguishes between Republican and Democratic senators. Consistent with the individual preference estimates we presented in Figure 8, Democrats are on average more responsive to voters, for all levels of electoral advantage.

In the right panel of Figure 10, we compute the average EAI for the 20% most liberal, conservative, and centrist senators in our sample. We find that ideologically extreme senators – both liberal and conservative – are more responsive to voters than moderates. The reason for this is that ideologically extreme senators have a larger electoral gain from moderating. This is clear from Figure 11, which shows that the distribution of the poll maximizing positions in each state is concentrated in a smaller and more centrist range than that of senators' ideal policies.

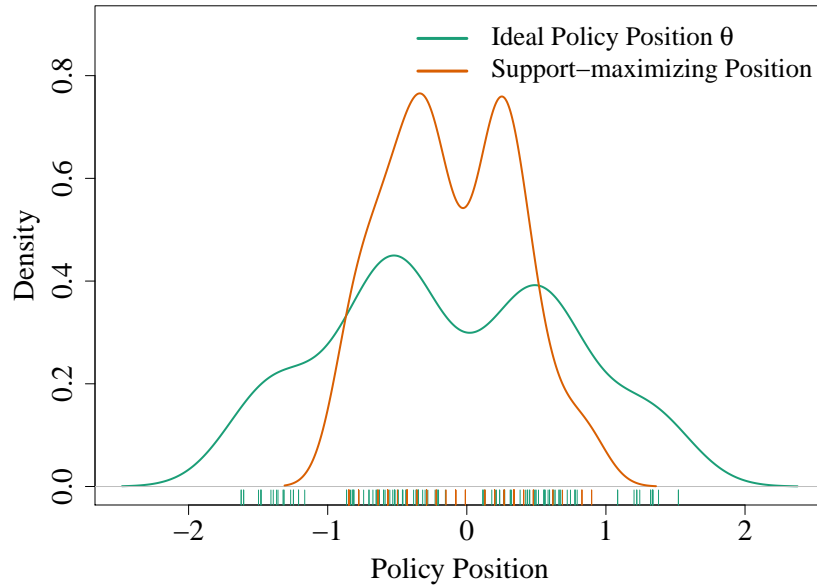


Figure 11: Senators’ ideal policies and poll-maximizing position in each state.

Effectiveness of Policy Moderation and Accountability. As we have shown, the moderate levels of electoral accountability observed in the data can be explained by a combination of preferences, electoral return of ads and position-taking, and electoral conditions. In this section, we perform a counterfactual exercise to further clarify the extent to which the low returns of policy moderation hinder electoral accountability. To do this, we recompute senators’ optimal choices (given the estimated preference parameters) doubling and quadrupling the effectiveness of position-taking from that estimated from the data.

Figure 12 shows the average electoral accountability index in the data and in the counterfactuals, for each quartile of the distribution of career concerns. Doubling the return of policy moderation increases the average EAI from 26% to 32% in close elections, and from 22% to 29% when the incumbent has an advantage of 20% in the polls. Quadrupling the electoral return of policy moderation, in turn, increases the average EAI to about 41% in close elections, and to more than 36% when the incumbent has an advantage of 20% in the polls. This is a substantial concession to voters, which represents a 57 p.p. in electoral accountability with respect to the baseline level of position-taking effectiveness, but is far from perfect accountability.

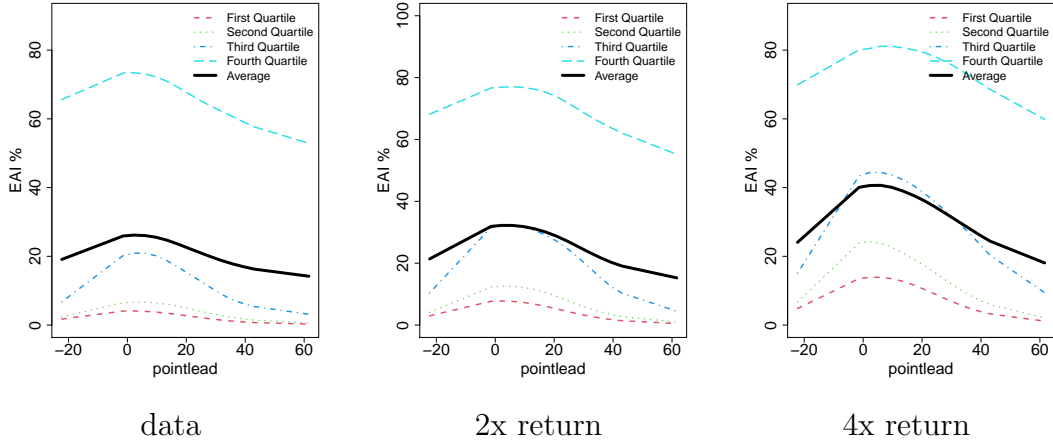


Figure 12: Electoral Accountability Index in a counterfactual increase (2x, 4x) of the electoral returns to policy moderation. (Quartiles of the distribution of λ).

This indicates that the weight most senators give to their own ideology is considerable, and emphasizes the importance of adverse selection on voter welfare.

6.1 Extension: Strategic Challenger

In our benchmark specification, we focused on the optimal dynamic behavior of the incumbent, fixing the challenger’s spending at the levels we observe in the data. This specification simplified the presentation of the problem, and allowed us to focus on the core issue of electoral accountability. The cost of this simplification is that the model does not take into consideration the strategic responses of the challenger in states (p_t, t) that are not observed in the data. To assess the robustness of our estimates, we extend the model to endogeneize the behavior of the challenger, and estimate the parameters of the resulting dynamic game.²⁴ Endogeneizing the challenger’s response also allows us to compute a second counterfactual, which quantifies the extent to which advertising crowds-out electoral accountability.

Figure 13 shows the distribution of the estimated structural parameters for the dynamic game and the baseline model. As the figures show, the two sets of estimates

²⁴ We adopt a similar estimation procedure than for our main model. To avoid multiplicity of equilibria, we assume that in each stage politicians move sequentially, with the challenger moving first (see Appendix D.1 for details).

are remarkably similar. We also compute our electoral accountability index in the extended model. We find that the main results of the benchmark model are qualitatively unchanged. As in the baseline model, equilibrium electoral accountability and TV ad buys by the incumbent increase as the election gets closer, when the race is more competitive, and when the incumbent cares more about retaining office (see Figure D2 in the Appendix). Quantitatively, the results are also largely similar to the benchmark.

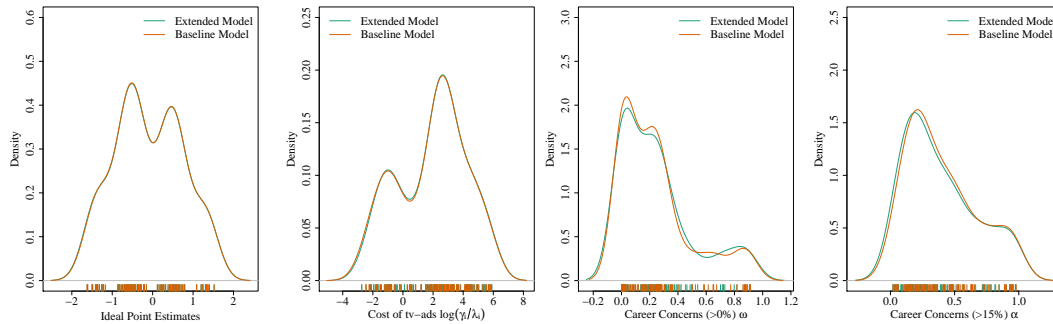


Figure 13: Parameter estimates in the Dynamic Game and Baseline Model

As it is clear from our analysis, politicians see advertising as a substitute to policy compromise. Endogeneizing the challenger’s response allows us to assess the extent to which advertising crowds-out electoral accountability. To do this, we quantify what policy choices senators would have made *in the absence* of advertising, and then compare electoral accountability in the counterfactual with the level of electoral accountability in the data.²⁵

²⁵ In a related exercise, Gordon and Hartmann (2013) estimate the effect of eliminating ads on vote shares in presidential elections. They show significant changes on electoral returns under no advertisement. Our policy counterfactual complements their results, capturing the effect of advertising on policy responsiveness.

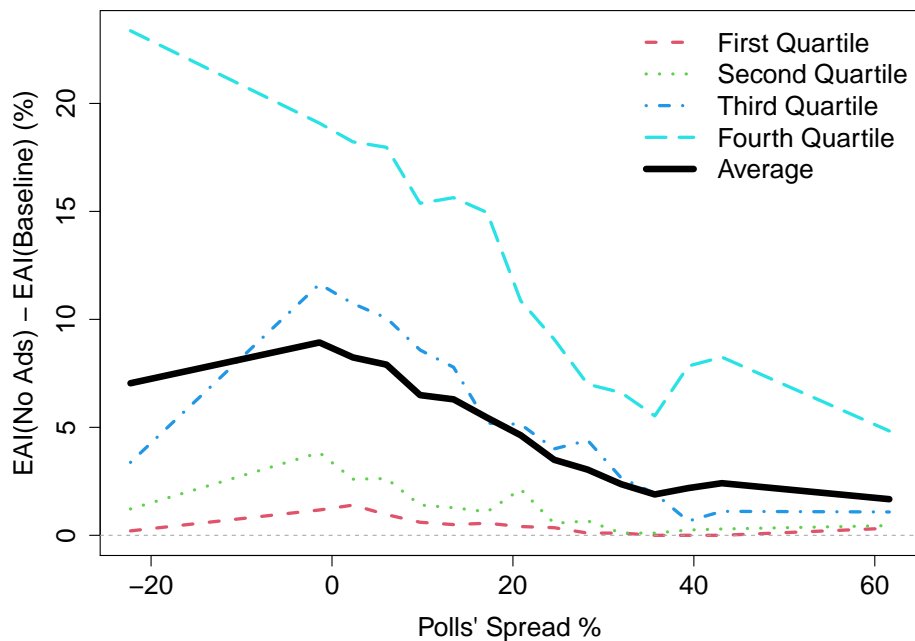


Figure 14: Counterfactual: Ban of Political Advertisements

Figure 14 presents the results. As the figure shows, banning advertisement would increase electoral accountability in close elections by 9 p.p. for the average senator, and by about 20 p.p. for the senators in the top quartile of the distribution of office motivation (the magnitude of the gain decreases for larger advantages in the polls). We conclude that while advertising significantly crowds-out policy accountability (in particular in close elections, and for career-concerned politicians), it is only a contributing factor, and not the main force breaking the electoral connection between politicians and voters.

7 Conclusion

One of the most basic and widely accepted assumptions in the study of electoral politics is that legislators have both policy and office motivations. In this paper, we show that the within-cycle dynamics of position-taking and advertising can be used to quantify how individual legislators value electoral gains relative to policy concessions,

and how their preferences for office and policy feedback into their responsiveness to electoral incentives.

Our results illustrate the usefulness of disentangling politicians' preferences from the electoral conditions they face. The results reconcile the general perception that senators typically do give a large value to being reelected with the moderate levels of responsiveness observed on average. This is due to three factors. First, over a fourth of senators in our sample is heavily ideological, and would only be willing to deviate from their policy preferences in exchange for a large electoral gain. Second, the electoral return of policy moderation is low, both in absolute terms and relative to the electoral return of political advertising. Third, a number of senators generally face a significant advantage in the polls, making them less willing to respond to voters' preferences on average in the observed data.

The results illustrate the pitfalls of conceiving of accountability as a constant. Responsiveness is best understood as a form of behavior that is contingent on attributes of the politician and the nature of the electoral landscape she faces. The exercise in this paper contributes to a better understanding of this mapping.

Appendix

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A Senator Specific Variables and Descriptive Statistics

We incorporate various senator and race-specific characteristics, including **republican** (1 if senator is republican, 0 if democrat), **female** (1 if senator is female, 0 otherwise), **seniority** (number of years of service as a member of the Senate), **membership** (number of standing committees a senator is a member of during a congressional session), **com_leader** (1 if the senator held a leadership position in a senate committee, 0 otherwise), and **leader** (1 if the senator was minority or majority leader, 0 otherwise).²⁶

To capture a measure of electoral preferences at the state level, we follow (Canes-Wrone, Brady, and Cogan 2002) and compute the average vote spread for the period 2000-2012 between the Republican and Democrat candidates in the presidential election at a given state, **presrep.margin**, using data from Dave Leip's *Atlas of U.S. Presidential Elections*. To account for primary elections' characteristics of both incumbents and challengers we include **inc_contested** and **chall_contested** which take a value of 1 if the incumbent (challenger) won the primary election with a spread of less than 10%

We control for demographic characteristics at the state level including median household income (**income**), percent of a state's population older than 64 years old (**pop_64**), percent of a state's population with less than 9th grade of educational attainment (**educ_9th**), percent of a state's population that is black (**black**), and percent of a state's population that is hispanic (**hispanic**), all obtained from the 2000 Census' data. We also include two economic indicators that vary both across states and within electoral cycles. First, we collected data on state unemployment (**unemployment**) obtained from the Bureau of Labor Statistics. Second, we obtained a leading indicator of economic activity (**lead**) gathered monthly by the Federal Reserve of St. Louis.

²⁶The variables **seniority**, **membership**, **comleader**, and **leader** are constructed based on (Stewart and Woon 2017).

Table A1: Summary Statistics: Incumbents' Characteristics

Variable	Levels	n	%	$\sum\%$
Party	Democrat	936	54.5	54.5
	Republican	780	45.5	100.0
	all	1716	100.0	
Membership	0	988	57.6	57.6
	1 or more	728	42.4	100.0
	all	1716	100.0	
Committee Leader	No	1417	82.6	82.6
	Yes	299	17.4	100.0
	all	1716	100.0	
Senate Leader	No	1625	94.7	94.7
	Yes	91	5.3	100.0
	all	1716	100.0	
Female	Male	1443	84.1	84.1
	Female	273	15.9	100.0
	all	1716	100.0	

Table A2: Summary Statistics: States' Characteristics

Variable	n	Min	\bar{x}	\tilde{x}	Max	s	IQR
pointlead	1716	-41.30	19.47	18.63	78.26	15.29	19.30
contributions (1000 \$)	1716	-6.25	6160	4946	29526	5067	5589
tv_ads (1000 GRP's)	521	0.00	6.31	2.60	153.35	11.83	5.74
tv_ads_challenger (1000 GRP's)	369	0.00	4.47	1.70	93.63	9.14	4.04
tv_ads_others (1000 GRP's)	245	0.00	6.49	1.97	58.42	10.58	6.25
tv_ads_others_challenger (1000 GRP's)	241	0.00	7.07	2.24	149.99	14.47	6.61
position	1716	-2.24	-0.09	-0.25	2.13	0.68	1.15
seniority	1716	1.00	12.45	9.00	45.00	9.90	12.00
unemp	1716	2.29	6.10	5.68	13.72	2.10	2.58
lead_index	1716	-5.80	1.25	1.37	6.15	1.31	1.36
pop64	1716	8.20	16.71	16.60	22.80	2.08	1.95
educ_9th	1716	3.20	6.89	5.95	11.70	2.30	3.55
black	1716	0.30	10.78	7.05	36.30	10.04	12.55
hispanic	1716	0.70	7.63	4.30	42.10	9.15	5.80
presrep.margin	1716	-0.26	0.01	-0.03	0.38	0.16	0.24

We complement opinion data with the predicted `pointlead` obtained from three different sources. First, we use incumbent senators' approval rates (in 12% of monthly observations) listed by *Polling Report*, *Real Clear Politics* and *Pollster*. Second, remaining gaps are filled with prediction market data (in 11% of monthly observations) collected by Intrade in real-time.²⁷ Finally, we use national polls included in the *Roper* database that contain partisan congressional approval (in 7% of monthly observations). To include this information we extrapolate a linear fit between `pointlead`, as obtained from opinion data, and the alternative support measures. We control for Congress-session and monthly random effects.

²⁷Intrade sold contracts for some of the senate races in our sample during the years 2004, 2008, 2010, and 2012 that were worth \$10 in the event the candidate won and \$0 in the event the candidate lost.

To transform the raw prediction market data into monthly prices, we take the weighted average of collected prices for the stock that pays out if the incumbent senator wins on Election Day, where the weights are inversely proportional to the number of individual trades. Then, we use the transformation suggested by (Rothschild 2015) to map monthly prices onto estimated vote shares as $share_t = \phi^{-1}(price_t)$, where $share_t$ is the estimated incumbent share in month t and ϕ denotes the normal density function. Approval data at the monthly level is constructed as the weighted average of incumbent approval (as a proportion of the total proportion of respondents that approved and disapproved the incumbent), where the weights are inversely proportional to the number of survey respondents. To transform congressional approval from national polls, first we collected individual information on whether survey respondents approved the job performed by the party of the incumbent in Congress. Then, we predict the probability that a voter in a given state and month supports the incumbent party's job in Congress by regressing individual binary Congressional job approval on state and date random effects.

Figure A1 shows the correlation between `pointlead`, as obtained from opinion data and the alternative support measures.

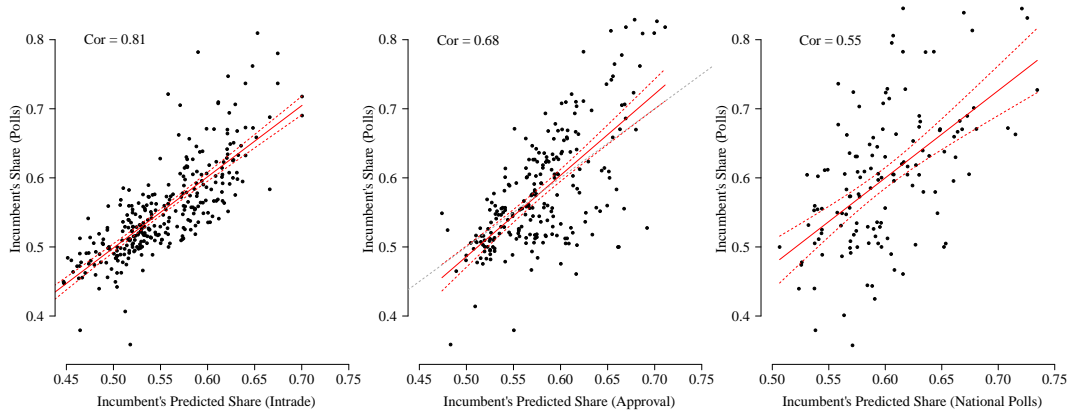


Figure A1: Predicted *vs* Observed Incumbent Share

B Estimation of Model Parameters

B.1 Estimation Procedure

In this section, we expand on our procedure to estimate the structural parameters ρ . As we explained in section 5, the difficulty in estimating ρ directly from the likelihood in (5.1) is that the conditional choice probability $Pr(y_{i,t}|p_{i,t}; \rho_i, \psi)$ is not a known function of ρ_i . Instead, this is given by the optimal response of the politician with characteristics ρ_i in each state $(p_{i,t}, \mu_{i,t})$, which result from the solution to

$$\max_{y_t} \left\{ \underbrace{\lambda(x_t - \theta)^2 - \gamma(e_t)^2 + E[\bar{W}_{t-1}(p_{t-1}) | z_t]}_{h(z_t)} + \mu(y_t) \right\}, \quad (\text{B1})$$

where $W_t(p_t, \mu_t)$ is the value from this problem, $\bar{W}_t(p_t) \equiv E_\mu[W_t(p_t, \mu_t)]$, and

$$E[\bar{W}_0(p_0) | z_1] \equiv \Pr(1/2 < p_0 < \bar{p} | z_1)\omega + \Pr(p_0 > \bar{p} | z_1)(\omega + \alpha).$$

Since the shocks $\{\mu_{it}(y)\}$ are i.i.d. TIEV random variables, we have

$$\Pr(y_{i,t} = y' | p_{i,t}; \rho_i) = \frac{\exp[h(p_{i,t}, y'; \rho_i)]}{\sum_{y \in Y} \exp[h(p_{i,t}, y; \rho_i)]}$$

and

$$\bar{W}_{i,t}(p_{i,t}) = \ln \left(\sum_{y \in Y} \exp[h(p_{i,t}, y)] \right) + C,$$

where C is Euler's constant. For each trial parameter ρ_i , we obtain $h(p_{i,t}, y; \rho_i)$ by solving the politician's problem recursively.

To relate senator's preference parameters to relevant observable attributes, while still allowing heterogeneity *conditional* on covariates, we model structural parameters as latent random variables drawn from distributions with parameters that are functions of senator characteristics, including party, gender, seniority, and leadership positions. This allows the preference estimates to be informed by both their effect on conditional choice probabilities and observable characteristics.

Specifically, we let $\phi_i \equiv \{\lambda_i, \omega_i, \alpha_i\}$, and fix $\lambda + \omega + \alpha = 1$, which is analogous to estimating normalized office payoffs ω/λ and α/λ . To satisfy the normalization, we assume that ϕ_i follows a Logistic Normal distribution, which effectively applies a logistic transformation to an underlying bivariate normal distribution, producing a distribution for $(\lambda_i, \omega_i, \alpha_i)$ over the 2-dimensional simplex. The underlying normals are assumed to have variances σ_ω^2 and σ_α^2 and means $\mathbf{Z}'_i \eta_\omega$ and $\mathbf{Z}'_i \eta_\alpha$, where \mathbf{Z}_i

are senators' characteristics, including: `republican`, `gender`, `leader`, `com_leader`, `seniority`, and `membership`. Denote the density of ϕ_i as $f_\phi(\cdot; (\mathbf{Z}'_i \eta_j, \sigma_j^2)_{j=\alpha, \omega})$. Ideal points θ_i have a normal distribution with mean zero, and variance σ_θ . Denote the density of θ_i as $f_\theta(\cdot; \sigma_\theta^2)$. The cost parameter γ_i follows a truncated normal distribution (truncated at zero) with mean $\mathbf{W}'_i \eta_\gamma$ and variance σ_γ^2 , where \mathbf{W}_i includes the vector of characteristics \mathbf{Z}_i plus senator/race characteristics including: `income`, `pop_64`, `educ_9th`, `black`, `hispanic`, `unemployment`, `lead`, and total contributions (`contributions`). We denote the density of γ_i as $f_\gamma(\cdot; \mathbf{W}'_{it} \eta_\gamma, \sigma_\gamma^2)$.

Our estimation problem is then to choose $\{\phi_i, \theta_i, \gamma_i\}_{i=1}^N$ and $(\vec{\eta}, \vec{\sigma})$ to maximize the posterior distribution, which is proportional to:

$$\prod_{i=1}^N \prod_{t=1}^T Pr(y_{i,t} | p_{i,t}; \rho_i, \psi) f_\phi(\phi_i; (\mathbf{Z}'_i \eta_j, \sigma_j^2)_{j=\alpha, \omega}) f_\theta(\theta_i; \sigma_\theta^2) f_\gamma(\gamma_i; \mathbf{W}'_{it} \eta_\gamma, \sigma_\gamma^2)$$

To solve this problem, we combine a quasi-Newton gradient method (L-BFGS) with the value function obtained from the dynamic programming problem of each senator at each trial parameter. Because this algorithm must fully solve the senator's problem for each trial value of the parameters and then compute the gradients of the likelihood, it can be computationally costly relative to other alternatives proposed in the literature. In our case, this disadvantage is negligible as we compute the gradients required for optimization via a reverse-mode automatic differentiation algorithm ((Carpenter, Hoffman, Brubaker, Lee, Li, and Betancourt 2015)), which is an extremely fast and efficient way to precisely compute exact derivatives.²⁸

We measure uncertainty in the structural parameters' estimates – and other quantities of interest which are functions of these parameters – via a parametric bootstrap. That is, after obtaining parameter estimates, we draw 500 pseudo-samples from the estimated posterior density and re-estimate the parameters for each sample. We use the empirical distribution of these 500 estimates to compute confidence intervals and its sample variance as an estimator of the variance of the structural parameters.

B.2 Discretization

Our estimation approach requires that we discretize the variables measuring senators' advantage in polls and endogenous choices (policy position and TV advertisement). We use a grid of 15 categories for our measure of polls (`pointlead`), 30 categories for our measure of policy position (`position`), and three categories for our measure of

²⁸Usual optimization algorithms use finite differencing, which is a numerical approximation to gradient evaluations. This method turns out to be slow and imprecise for nonlinear and highly multidimensional functions such as the likelihood function we are dealing with in our problem.

TV advertisement (**tv-ads**). We partition each variable into equally-spaced bins and take the average value within bins as the representative value for each category. The bin size of the first and last categories is determined by the 5th and 95th percentiles of the variable distribution, which makes the discretization less sensitive to extreme outliers. We find that this binning captures the main features of the data well (for reference, see Figure B1 below, which plots continuous and discretized variables for two senators in the sample).

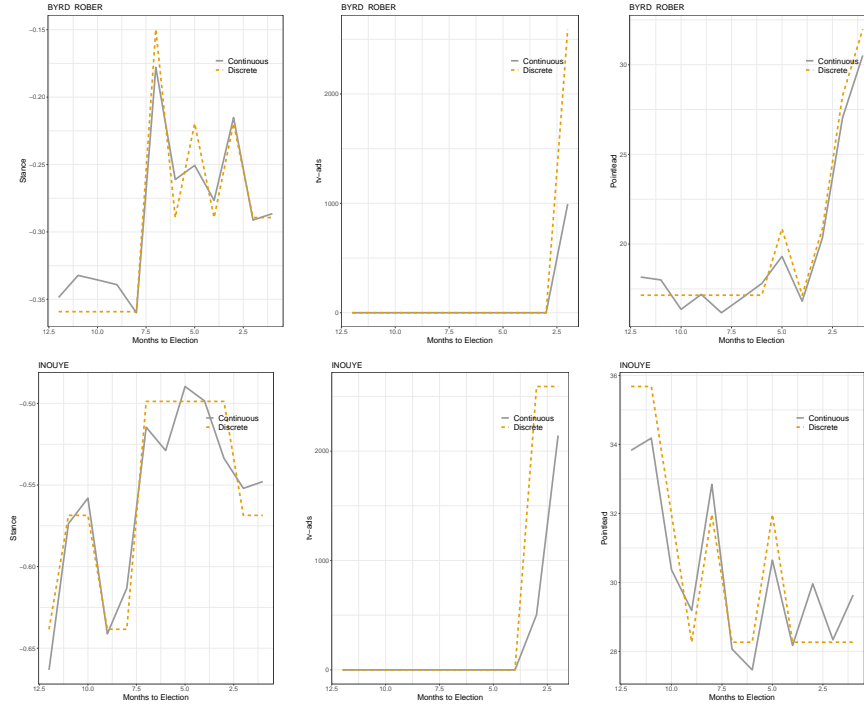
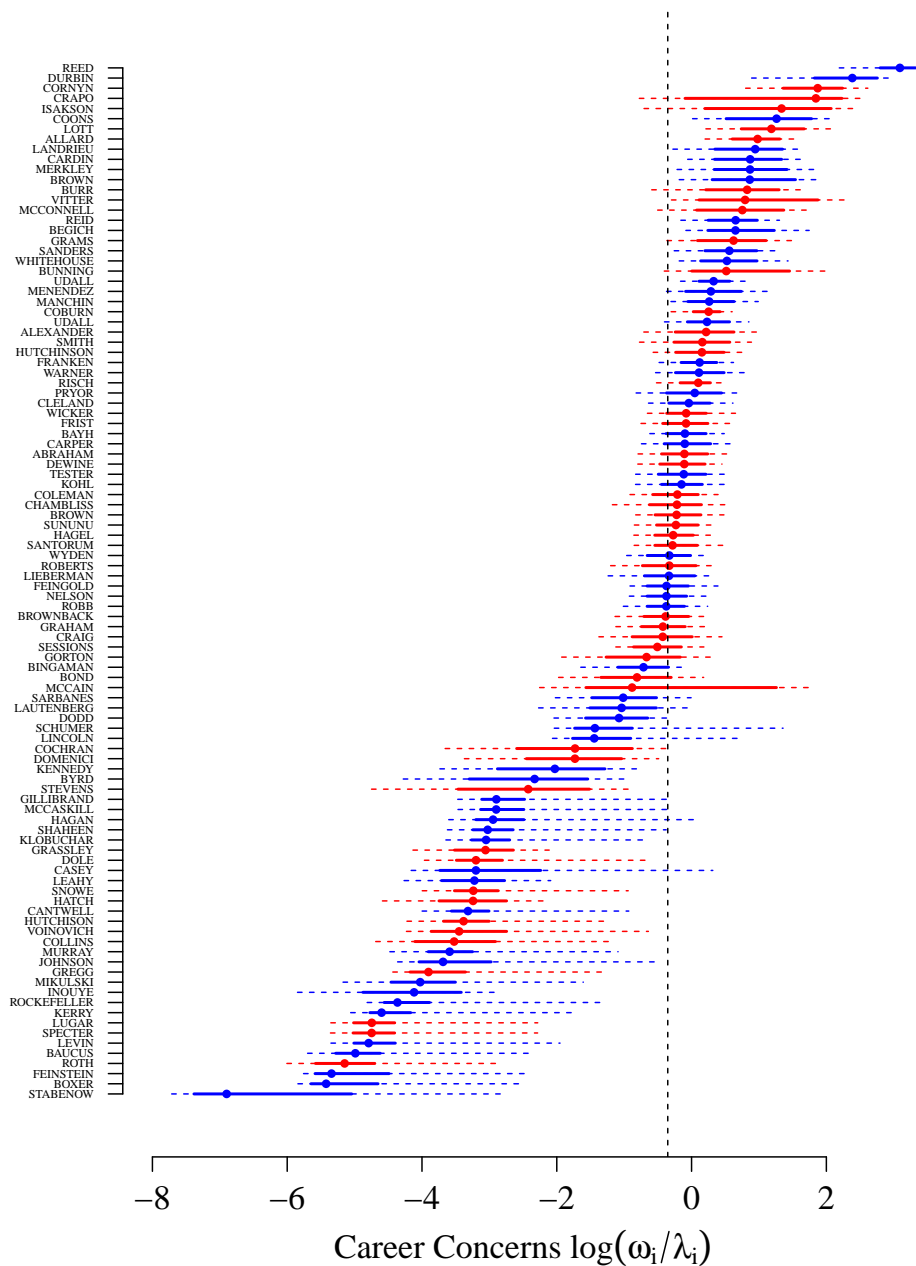


Figure B1: Actual observations and discretized values of polls, policy and TVads for senators Byrd (106th Congress) and Inouye (108th Congress).

The examples in the figure are representative of the results for all non-extreme senators, where the discretization entails only a minor loss of information. For the five most extreme senators in terms of policy position, the discretization induce a larger loss of information, as it fails to capture some of the variation in position taking for very extreme positions. As a robustness check, we recomputed our estimates further partitioning extreme positions and (separately) increasing spending categories to six. We find that the fit remains good with this finer partition, and that all the conclusions we emphasize in the paper remain unchanged.

C Additional Results

C.1 Structural Parameter Estimates



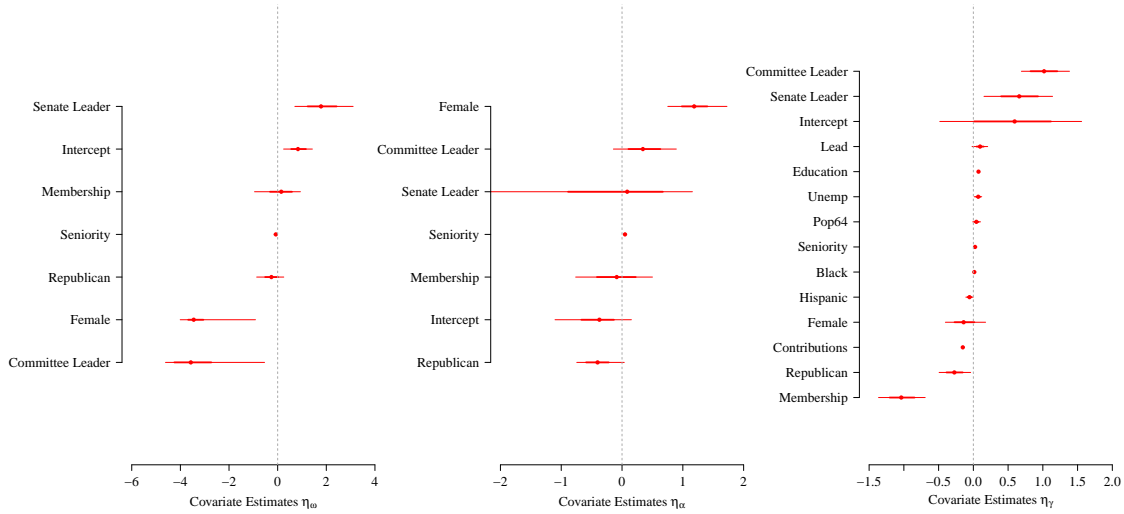


Figure C2: Estimates of the effect of covariates on Structural Parameters ω , α and γ ($\eta_\omega, \eta_\alpha, \eta_\gamma$). Solid thin (wide) lines represent 90% (80%) and bootstrap confidence intervals.

C.1.1 Ideal Point Estimates

Because the impact of position-taking on electoral results varies depending on the senators’ popularity and time to election, certain votes will be more congruent with their policy preferences than others. This implies that senators’ votes on policy issues are not an unfiltered expression of ideological preferences, but rather strategic choices conditioned on the competitiveness of the race at the time of voting.²⁹ Our approach allows us to separate preferences from strategic position-taking.

Figure C3 presents our ideal point estimates for each senator in the sample, with 90% bootstrap confidence intervals. The distribution of ideal points obtained from our model is more heavily populated in the extremes of the political spectrum than the distribution of ideal points in the sincere voting framework (see Figure C4). The difference in the two sets of estimates indicates that while some senators are “pandering in” to more moderate voters, as the conventional wisdom indicates, others are “pandering out” to relatively more extreme voters. Overall, however, the differences between the strategic and sincere estimates in the US senate are relatively minor in this sample.

²⁹The available estimates of legislators’ ideal policies ((Poole and Rosenthal 1984), (Clinton, Jackman, and Rivers 2004a)) are derived under the assumption that all votes in a legislators’ voting records are sincere reflections of their preferences (see however (Clinton and Meirowitz 2003), Iaryczower, Katz, and Saiegh (2013), (Iaryczower, Katz, and Saiegh 2013) and (Spenkuch, Montagnes, and Magleby 2018)).

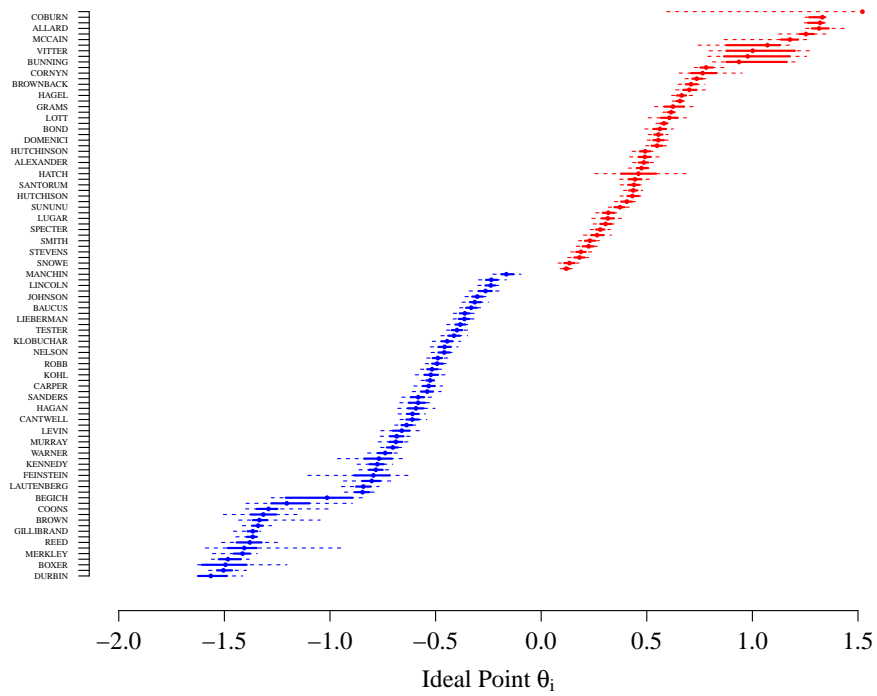


Figure C3: Ideal Point Estimates (Solid lines plot 90% bootstrap confidence intervals)

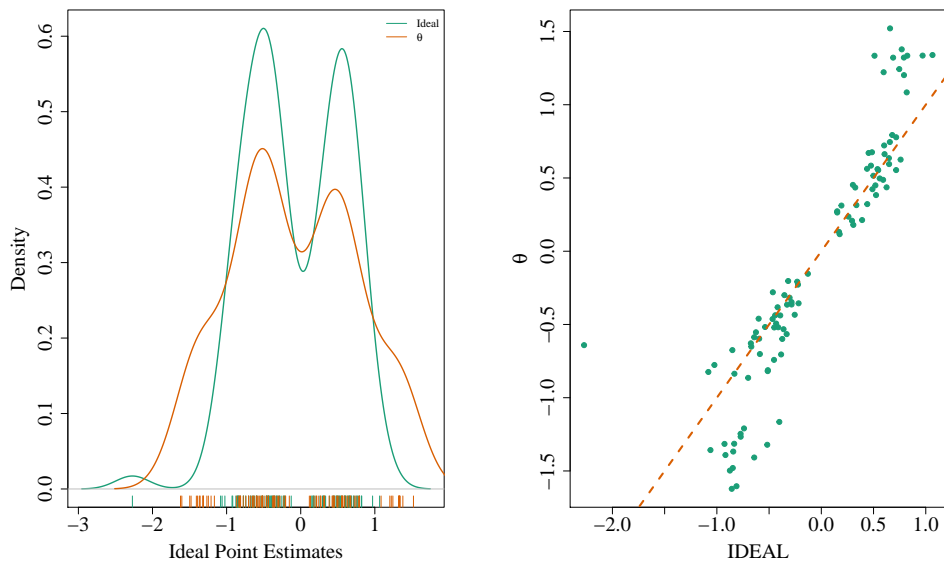


Figure C4: Ideal Point estimates (θ) vs sincere estimates (IDEAL)

C.2 Transition Function Estimates

Table C1: Complete First Stage Results

	<i>Dependent variable: $p_{i,t-1}$</i>			
	(1)	(2)	(3)	(4)
$p_{i,t}$		0.816*** (0.023)	0.763*** (0.025)	0.763*** (0.028)
$(x_{i,t} - \xi)^2$	-6.497*** (2.311)	-1.533*** (0.507)	-2.199*** (0.829)	
$(x_{i,t}^p v - \xi)^2$				-8.291*** (2.707)
$\sqrt{e_{i,t}}$	0.027 (0.017)	0.017*** (0.007)	0.020*** (0.007)	0.023*** (0.008)
$\sqrt{e_{i,t}^{chall}}$	-0.137*** (0.022)	-0.047*** (0.009)	-0.049*** (0.010)	-0.046*** (0.010)
seniority			0.065* (0.036)	0.070* (0.039)
membership			0.732 (0.747)	1.472* (0.794)
com_leader			-1.293 (1.012)	-1.649* (0.962)
leader			-1.355 (0.828)	-2.146** (0.920)
female			0.437 (0.685)	0.937 (0.682)
unemployment			-0.408** (0.172)	-0.276 (0.186)
lead			-0.333 (0.217)	-0.335 (0.224)
income			-0.00001 (0.0001)	0.00003 (0.00005)
pop_64			0.261* (0.144)	0.323** (0.135)
educ_9th			0.023 (0.119)	-0.045 (0.139)
black			-0.031 (0.026)	-0.019 (0.026)
hispanic			0.036 (0.027)	0.028 (0.031)
inc_contested			-1.881 (1.243)	0.090 (1.841)
chall_contested			-0.637 (0.827)	-0.833 (0.954)
republican			0.121 (1.564)	1.054 (1.467)
Observations	1,584	1,584	1,584	1,347
Congress-Party FE	No	No	Yes	Yes
Adjusted R ²	0.128	0.676	0.683	0.689
F Statistic	78.629***	827.425***	110.940***	97.376***

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Robust standard errors clustered at the senator-congress level in parentheses.

Table C2: First Stage OLS Results with Different Grouped Fixed-Effects

	<i>Dependent variable: $p_{i,t-1}$</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
$p_{i,t}$	0.785*** (0.024)	0.809*** (0.022)	0.814*** (0.024)	0.768*** (0.026)	0.765*** (0.026)	0.769*** (0.028)
$(x_{i,t} - \xi)^2$	-1.799** (0.703)	-1.572** (0.633)	-1.908*** (0.517)	-1.978*** (0.515)	-2.272*** (0.517)	-1.932*** (0.458)
$\sqrt{e_{i,t}}$	0.020*** (0.007)	0.008 (0.006)	0.015** (0.006)	0.017*** (0.006)	0.013** (0.006)	0.015** (0.006)
$\sqrt{e_{i,t}^{chall}}$	-0.048*** (0.009)	-0.042*** (0.008)	-0.044*** (0.008)	-0.051*** (0.008)	-0.049*** (0.007)	-0.042*** (0.008)
Observations	1,584	1,584	1,584	1,584	1,584	1,584
Congress-Party FE	Yes	Yes	Yes	Yes	Yes	Yes
Group FE	No	5	10	15	20	25
Adjusted R ²	0.680	0.759	0.799	0.823	0.834	0.849
F Statistic	198.849***	66.684***	47.199***	38.473***	32.015***	29.159***

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Robust standard errors clustered at the senator-congress level in parentheses.

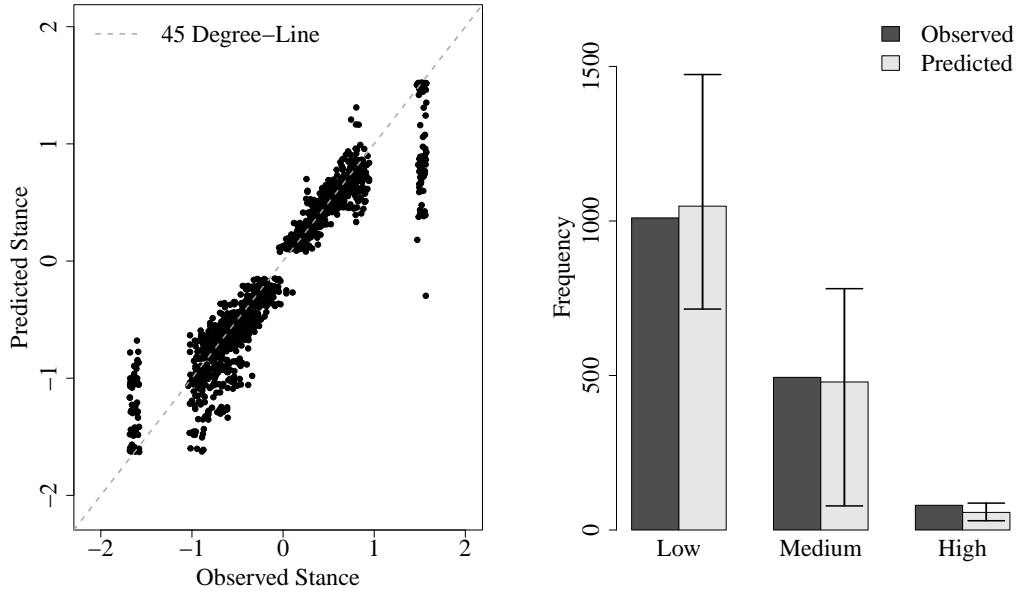
Table C3: First Stage: Alternative Specifications

	<i>Dependent variable: $p_{i,t-1}$</i>		
	(1)	(2)	(3)
$p_{i,t}$	0.714*** (0.028)	0.762*** (0.026)	0.746*** (0.017)
$x_{i,t}$	-2.107** (1.032)		
$x_{i,t}^2$	-1.293** (0.639)		
$x_{i,t} \times \xi$	23.696*** (3.726)		
$(x_{i,t} - \xi)^2$		-2.291*** (0.829)	-2.230*** (0.745)
$\sqrt{e_{i,t}}$	0.023*** (0.007)	0.020*** (0.007)	
$\sqrt{e_{i,t}^{chall}}$	-0.046*** (0.010)	-0.049*** (0.010)	
$\log(e_{i,t} + 1)$			0.215*** (0.082)
$\log(e_{i,t}^{chall} + 1)$			-0.599*** (0.095)
$\xi_{i,t}$	-0.291 (3.030)		
$x_{i,t} \times \sqrt{e_{i,t}}$		-0.006 (0.006)	
Observations	1,584	1,584	1,584
Senator-State Controls	Yes	Yes	Yes
Congress-Party FE	Yes	Yes	Yes
Adjusted R ²	0.693	0.683	0.685
F Statistic	106.299***	107.483***	111.860***

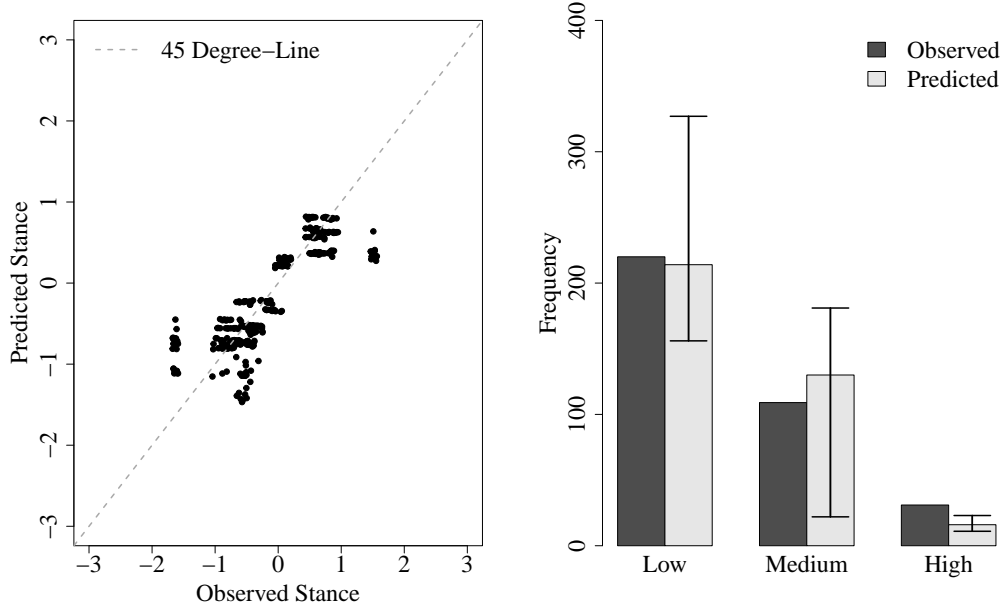
Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Robust standard errors clustered at the senator-congress level in parentheses.

C.3 Goodness of Fit



In Sample



Out of Sample

Figure C5: Goodness of Fit, Within and Out of Sample

D Robustness

D.1 Strategic Challenger

In the paper we focused on the optimal dynamic behavior of the incumbent, fixing the challenger's spending at the levels we observe in the data. This simplified the presentation of the problem, and allowed us to focus on the core issue of electoral accountability. The cost of this simplification is that the model doesn't take into consideration the strategic responses of the challenger in states that are not observed in the data. This can potentially bias the parameter estimates.

To consider this possible concern, we extend the model to endogenize the behavior of the challenger, and estimate the resulting dynamic game. As we show below, we find that the incumbent's parameter estimates of the benchmark model remain essentially unchanged.

We assume that the challenger gets an office payoff of one if she wins office and zero otherwise, and that spending e_t^c has a cost $\gamma^c(e_t^c)^2$ for the challenger. The incumbent's payoffs are as in the benchmark model. To avoid multiplicity of equilibria, we assume that in each stage politicians move sequentially, with the challenger moving first. In particular, we assume the following sequence:

1. At the beginning of each period t , incumbent and challenger observe p_t , which evolves according to eq. (5.2);
2. The challenger observes the shocks μ^c (which are i.i.d. TIEV and unobserved by the researcher), and chooses a level of TV ad buys e_t^c ;
3. The incumbent then observes e_t^c and shocks μ and chooses (x_t, e_t) .

Our solution concept is subgame perfect Nash equilibrium. We solve for the equilibrium of the game and associated conditional choice probabilities by backwards induction. We drop the subindex i for each incumbent for notational convenience. Suppose there are $t = T, \dots, 1$ periods remaining to the election, and let $z_t^I \equiv (p_t, x_t, e_t, e_t^c)$. After observing (p_t, μ_t) and the challenger's ad expenditure e_t^c , the incumbent solves

$$\max_{y_t} \left\{ \underbrace{\lambda(x_t - \theta)^2 - \gamma(e_t)^2 + E[\bar{W}_{t-1}(p_{t-1}) \mid z_t^I]}_{h(z_t^I)} + \mu(y_t) \right\}, \quad (\text{D1})$$

where $W_t(p_t, \mu_t, e_t^c)$ is the value from this problem, $\bar{W}_t(p_t) \equiv E_{\mu, \mu_t^c} [W_t(p_t, \mu_t, \tilde{e}_t^c(p_t, \mu_t^c))]$, and

$$E[\bar{W}_0(p_0) \mid z_1^I] \equiv \Pr(p_0 \in M \mid z_1^I)\omega + \Pr(p_0 \in H \mid z_1^I)(\omega + \alpha).$$

Since the shocks $\{\mu_t(y)\}$ are i.i.d. TIEV random variables, the incumbent's conditional choice probability is given by

$$\Pr(y_t = y' | p_t, e_t^c) = \frac{\exp[h(p_t, y', e_t^c)]}{\sum_{y \in Y} \exp[h(p_t, y, e_t^c)]}$$

Now consider the challenger. At the beginning of the period, the challenger observes (p_t, μ_t^c) , and solves

$$\max_{e_t^c} \left\{ \underbrace{E_{\mu} [E [\bar{W}_{t-1}^c(p_{t-1}) | (p_t, e_t^c, \tilde{y}_t(p_t, \mu_t, e_t^c))]]}_{h^c(p_t, e_t^c)} - \gamma(e_t^c)^2 + \mu^c(e_t^c) \right\}, \quad (\text{D2})$$

where $W_t^c(p_t, \mu_t^c)$ is the value from this problem, $\bar{W}_t^c(p_t) \equiv E_{\mu_t^c} [W_t^c(p_t, \mu_t^c)]$, and $E [\bar{W}_0^c(p_0) | p_1] \equiv \Pr(p_0 < 1/2 | p_1)$. From the TIEV distribution of the shocks, the challenger's conditional choice probability is given by

$$\Pr(e_t^c = e'^c | p_t) = \frac{\exp[h^c(p_t, e'^c)]}{\sum_{e^c \in \mathcal{E}} \exp[h^c(p_t, e^c)]}.$$

The structural parameters of the dynamic game include the vector of incumbent parameters ρ , as well as the challengers' cost of spending, $\gamma^c \equiv \{\gamma_i^c\}_{i=1}^N$. We estimate these structural parameters by first solving for equilibrium strategies for every trial value of the parameters, and then search for the values that maximize the likelihood of the data.

Figure 13 in the paper shows the distribution of the estimated structural parameters in the Baseline Model and in the Extended Model with endogenous challenger response. As the figures show, the two sets of estimates are remarkably similar. The new parameter in this model is the cost of spending for the challenger. Our estimates imply that incumbents enjoy a substantial cost advantage, which partly explains the fact that incumbents outspend challengers almost four to one (see Figure D1).

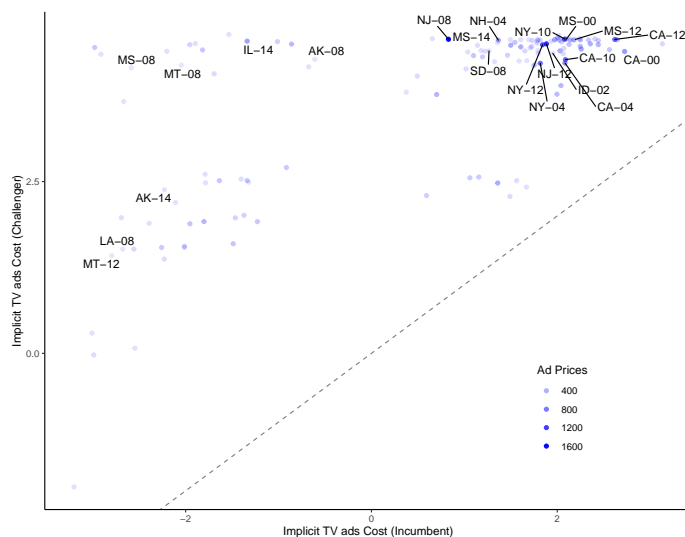


Figure D1: Implicit cost of TV ads for Incumbent and Challenger in the Extended Model with endogenous challenger response.

Figure D2 plots the aggregate *equilibrium* position-taking and TV ad buys by both the incumbent and challenger, as a function of the incumbent’s electoral advantage. As the figure shows, the main results of the benchmark model are qualitatively unchanged. As in the baseline model, equilibrium electoral accountability and TV ad buys by the incumbent increase as the election gets closer, when the race is more competitive, and when the incumbent cares more about retaining office.

Quantitatively, the results are also largely similar to the benchmark. The exception is a moderately higher predicted level of electoral accountability and TV ad spending in close elections, in particular for senators in the top quartile of office motivation. These differences are not surprising. The simplification in the benchmark is to maintain the challenger at the observed level of TV ad spending in all states. When we allow the challenger to choose spending strategically, instead, she tends to spend more the more competitive the election is. This in turn prompts the incumbent to increase her effort in close elections (i.e., the game has strategic complementarities). From a quantitative point of view, however, these results show that introducing the challenger doesn’t significantly change the conclusions from the benchmark model.

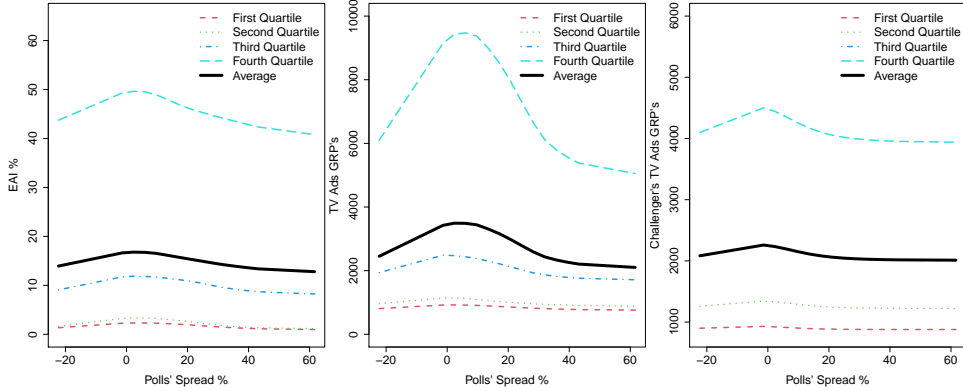


Figure D2: Equilibrium Position-Taking (EAI) and TV Advertising by Incumbent and Challenger, as a function of the incumbent’s electoral advantage. Quartiles of the distribution of λ (policy) and λ/γ (ads).

D.2 No Payoffs for Lopsided Wins ($\alpha = 0$)

In the paper, we assume that the politician gets an office payoff $\omega \geq 0$ if she wins the election, and an additional benefit $\alpha \geq 0$ from a large margin of victory. This formulation nests the model with $\alpha = 0$. The constrained model is rejected by the data for a large majority of senators in the sample. In fact, $\Pr(\alpha \geq 0.1) \geq 0.95$ for 78% of senators in our sample, and $\Pr(\alpha \geq 0.25) \geq 0.95$ for 34% of senators in our sample. In essence, in order to better explain the data, we need to increase the *marginal* return of “effort” (both ads and policy moderation) in non-close elections.

In this section, we present the main results of estimating the model assuming no extra payoffs from lopsided wins ($\alpha = 0$), and how these compare to the estimates of our benchmark specification. Figure D3 presents a comparison of the parameter estimates in the constrained model ($\alpha = 0$) and the baseline model. As the first two panels show, the estimates of θ and γ are essentially unchanged when we set $\alpha = 0$. The third and fourth panel present the comparison of career concern estimates. The third panel plots the empirical distribution of our estimates for ω in both models. The right panel presents the empirical distribution of our estimates of total career concerns in the constrained model (ω) and in the benchmark model ($\omega + \alpha$). As the left panel shows, when we force α to zero, the model adjusts by increasing the value of ω for a large number of senators. Instead, the unconstrained model predicts a heightened responsiveness in lopsided elections for a non-negligible fraction of senators in our sample (right panel).

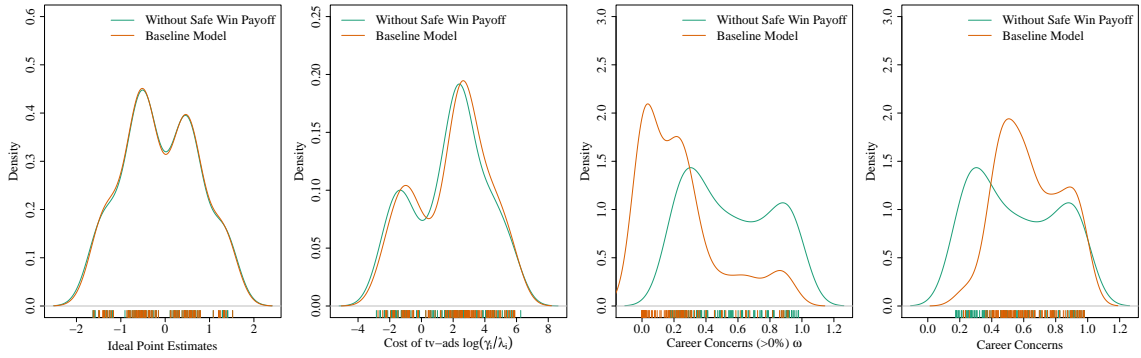


Figure D3: Comparison of Parameter Estimates in the Constrained Model ($\alpha = 0$) and the Baseline Model

Figure D4 presents the aggregate policy functions in the constrained and the benchmark model. Unsurprisingly, in the constrained model, responsiveness in maximized in close elections, and decreases faster with higher advantages in the polls than in the unconstrained model. Both qualitatively and quantitatively, however, the conclusions of the paper remain essentially unchanged.

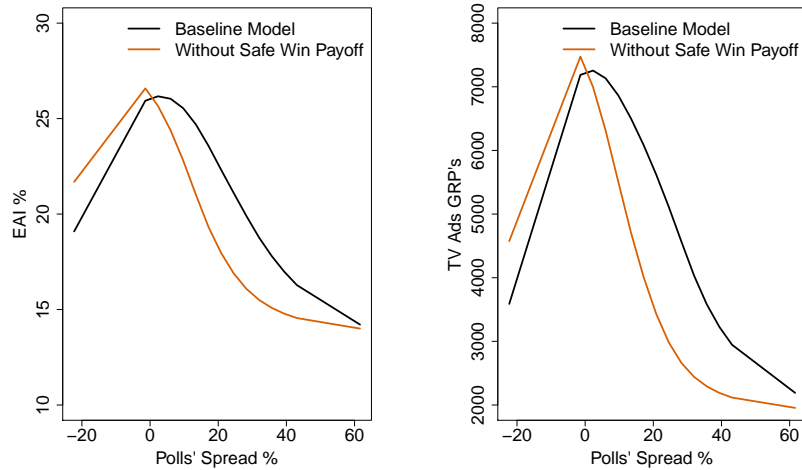


Figure D4: Comparison of Aggregate Policy Functions in the Constrained Model ($\alpha = 0$) and Baseline Model.

Finally, we evaluate the out-of-sample fit of the constrained model with respect to our baseline specification. We reestimate the parameters of the constrained model using only the first instance in which a senator runs for office in the sample, and use the

resulting estimates to predict their behavior in the second or third run. This gives us a total of 360 observations to fit from 30 senators who run for office more than once. We find that the constrained model fits the data roughly as well as the unconstrained model, with a marginal improvement brought by the latter, in particular regarding advertising. This comparison being uninformative, we favor the agnostic approach of the unconstrained model. We reiterate, however, that the conclusions emphasized in the paper are robust to imposing the constraint that $\alpha = 0$ from the outset.

D.3 Threshold for Safe Wins

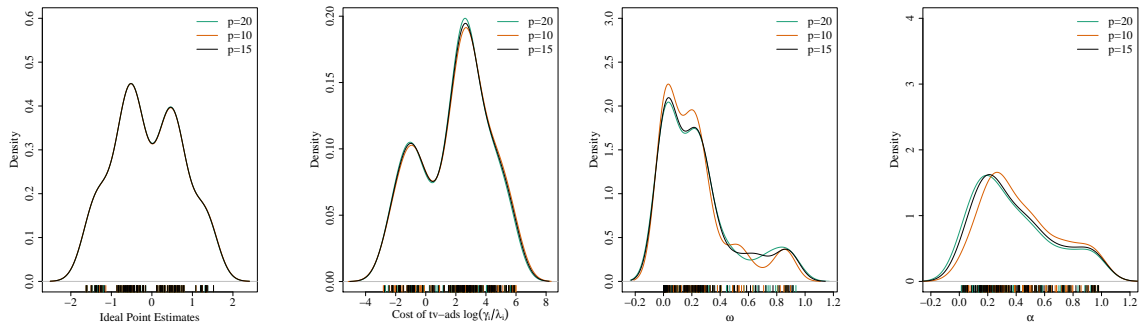


Figure D5: Career Concerns under Different Thresholds for Safe Wins

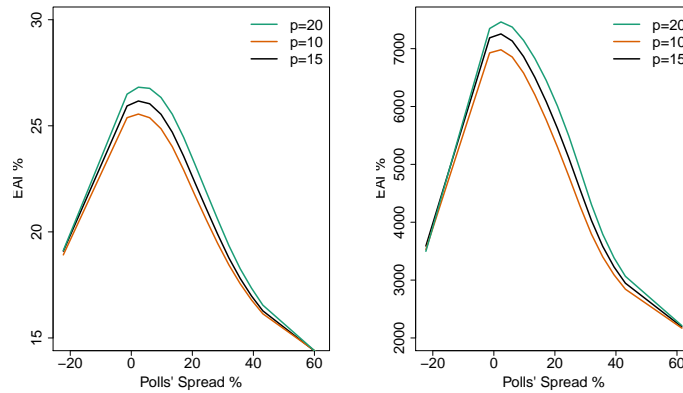


Figure D6: Aggregate (Mean) Policy Functions under Different Thresholds for Safe Wins

D.4 Instrumental Variables

As instruments for TV ads of a senator i , we use variation in TV ads in House races within i 's state, as well as in TV ads from neighboring states. The idea is to use ads in races that face similar changes in ad costs, but that do not affect senator i 's voter support directly. We then exploit a similar idea to instrument for policy positions. In particular, we instrument senator i 's **position** with the position of the median House representative from the senator i 's party and state. The exclusion restriction assumption is that changes in the position-taking of members of the House in the state of Senator i do not directly affect senator i 's voter support. Instead, changes in the political environment that is common to both representatives and senator of the same state lead to similar policy responses by both types of legislators.

As additional instruments for policy positions we use economic conditions, measured by unemployment (**unemployment**) and leading indicators of economic activity (**lead**) in "neighboring" states. In the definition of neighbor, here we substitute geographical distances with distances in *ideological affinity*, as measured by cosponsorship relations. This builds on the idea that senators will tend to support the positions of like-minded senators, that are, in turn, a function of their own economic conditions, which are independent of variation in next period's voter support of the senator of interest.

Table D1: First Stage Results with IV

	<i>Dependent variable: $p_{i,t-1}$</i>	
	OLS	IV
	(1)	(2)
$p_{i,t}$	0.763*** (0.025)	0.720*** (0.028)
$(x_{i,t} - \varepsilon)^2$	-2.199*** (0.829)	-10.152*** (3.225)
$\sqrt{e_{i,t}}$	0.020*** (0.007)	0.034** (0.013)
$\sqrt{e_{i,t}^{chall}}$	-0.049*** (0.010)	-0.053*** (0.015)
Observations	1,584	1,416
Senator/District Covariates	Yes	Yes
Congress-Party FE	Yes	Yes
Adjusted R^2	0.683	0.640

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Robust standard errors clustered at the senator-congress level in parentheses.

Table D2: Instrument Relevance Results

	Dependent variable:		
	$(x_{it} - \varepsilon_i)^2$	$\sqrt{e_{it}}$	$\sqrt{e_{it}^{chall}}$
	(1)	(2)	(3)
$p_{i,t}$	-0.002 (0.001)	-0.293*** (0.061)	-0.309*** (0.055)
$\sqrt{e_{i,t}^{house}}$	0.0002 (0.0004)	0.798*** (0.071)	0.177** (0.069)
$\sqrt{e_{i,t}^{chall}^{house}}$	-0.00003 (0.0005)	0.304*** (0.061)	0.922*** (0.062)
$\sqrt{e_{i,t}^{neighbor}}$	0.001 (0.001)	0.199*** (0.069)	0.099 (0.070)
$\sqrt{e_{i,t}^{chall}^{neighbor}}$	-0.001* (0.001)	0.065 (0.081)	-0.132* (0.079)
$(x_{it}^{house} - \varepsilon_i)^2$	0.200*** (0.041)	5.879** (2.886)	2.746 (2.347)
unemployment ^{cosp}	-0.010 (0.052)	-2.770 (2.604)	-5.303*** (2.200)
lead ^{cosp}	0.101*** (0.030)	-1.104 (2.047)	2.756** (1.390)
Senator-State Controls	Yes	Yes	Yes
Congress-Party FE	Yes	Yes	Yes
IV F-Tests	39.08***	134.31***	223.01***
Observations	1,416	1,416	1,416
Adjusted R ²	0.412	0.741	0.766

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Robust standard errors clustered at the senator-congress level in parentheses.

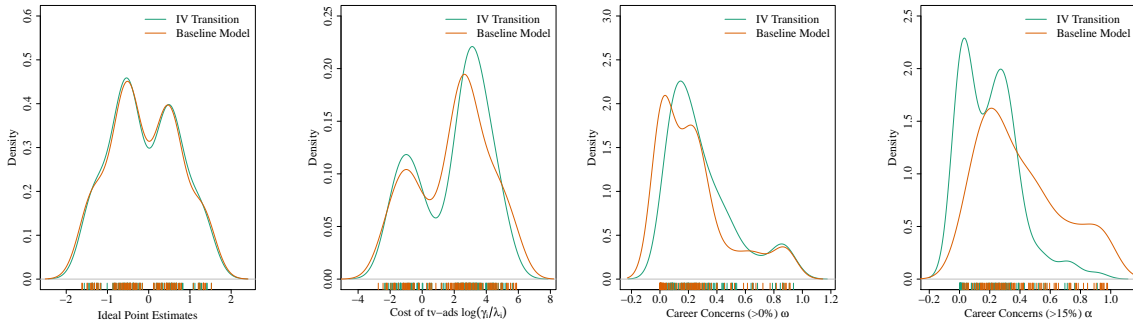


Figure D7: Structural Parameter Estimates in the Benchmark and IV estimates.

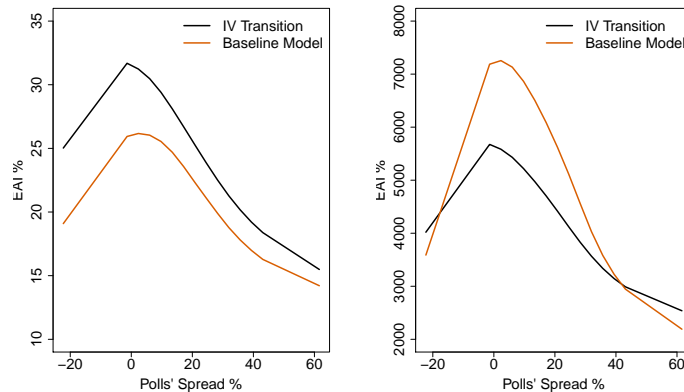


Figure D8: Aggregate (Mean) Policy Functions in the Benchmark and IV estimates.

D.5 Alternative Measures of Voter Ideology

In the benchmark specification of the transition function, we assume that the senators’ policy positions affect voter support through deviations from mean voter preference, as measured by the republican presidential margin in each state. This is of course a simplified model, that might not fully capture the richness of the electoral environment. To evaluate this issue, in this section we explore the robustness of our benchmark specification using the survey-based estimates of the mean and standard deviation of state ideology obtained by (Tausanovitch and Warshaw 2013).

We begin by estimating a transition function that incorporates both the mean ξ and standard deviation v of voters’ preferences in each district. Lower preference heterogeneity should make deviations from the mean of voter ideology more costly, and vice-versa. To capture this logic, we introduced an interaction of the standard deviation of voters’ preferences v with the distance of the policy position to the mean $(x_{i,t} - \xi)^2$. If this mechanism were relevant, we would expect a positive interaction term, indicating that larger variance in voters’ preferences reduces the electoral cost of policy divergence. We find that the estimate for the interaction is positive (0.723) but not statistically different from zero (standard error of 0.625).

With these results in mind, we then reestimate the transition function using only the Tausanovitch and Warshaw (2013) mean voter preference measure, as in the specification we used in the paper. The results are presented in Table D3 below. When we compare these results (column 3) with the main specification in the paper, using presidential vote, we find very similar results. In particular, the point estimate of $(x_{i,t} - \xi)^2$ changes from -2.20 in the paper to -2.08 in the robustness check, and the standard deviation of the coefficient estimate changes from 0.83 to 0.74. Similarly, other coefficient estimates only show relatively small changes.

Table D3: Tausanovitch and Warshaw (2013) Measure: First Stage Results

	<i>Dependent variable: $p_{i,t-1}$</i>			Main Specification (3) in paper
	TW-OLS (1)	TW-LDV (2)	TW-LDV (3)	
$p_{i,t}$		0.816*** (0.023)	0.759*** (0.027)	0.763*** (0.025)
$(x_{i,t} - \xi)^2$	-6.517*** (2.472)	-1.528*** (0.504)	-2.077*** (0.741)	-2.199*** (0.829)
$\sqrt{e_{i,t}}$	0.022 (0.017)	0.016** (0.006)	0.018*** (0.007)	0.020*** (0.007)
$\sqrt{e_{i,t}^{chall}}$	-0.132*** (0.022)	-0.045*** (0.009)	-0.046*** (0.010)	-0.049*** (0.010)
Observations	1,536	1,536	1,536	1,584
Senator-State Controls	No	No	Yes	
Congress-Party FE	No	No	Yes	
Adjusted R ²	0.125	0.678	0.686	0.680
F Statistic	74.194***	810.183***	108.993***	110.940***

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors clustered at the senator-congress level in parentheses. The first three columns reproduce Columns 1-3 in Table 1 in the Paper using the Tausanovitch and Warshaw (2013) measure. Column 4 reproduces column 3 in the paper (our preferred specification), for comparison.

We then re-estimate the structural parameters of the model using the Tausanovitch and Warshaw (2013) data, with the transition function specification in Table D3. Figure D9 presents the results. The figure plots the empirical distribution of our parameter estimates (for $\theta, \gamma, \omega, \alpha$) using the Tausanovitch and Warshaw (2013) measure and in our baseline model with presidential support. Our ideal point estimates and cost parameter estimates are essentially unchanged. Our career concern estimates are also similar, although here we do observe a non-negligible difference in point estimates of ω, α for some senators in our sample. In particular, the empirical distribution of ω and α in the robustness check puts more mass on moderately low values of ω and α relative to the larger mass on higher values in the main specification. In Figure D17, we show the effect of these changes on our aggregate policy functions. With some moderate differences in magnitudes, the results are consistent with all the conclusions we highlighted in the paper, including relatively low electoral accountability on average, and peak of electoral accountability in close elections on average.

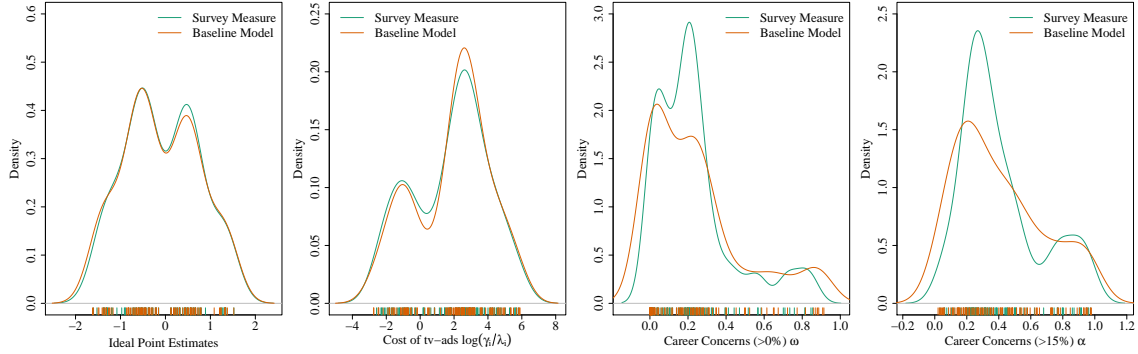


Figure D9: Comparison of Parameter Estimates using Tausanovitch and Warshaw (2013) Measure and Baseline Model.

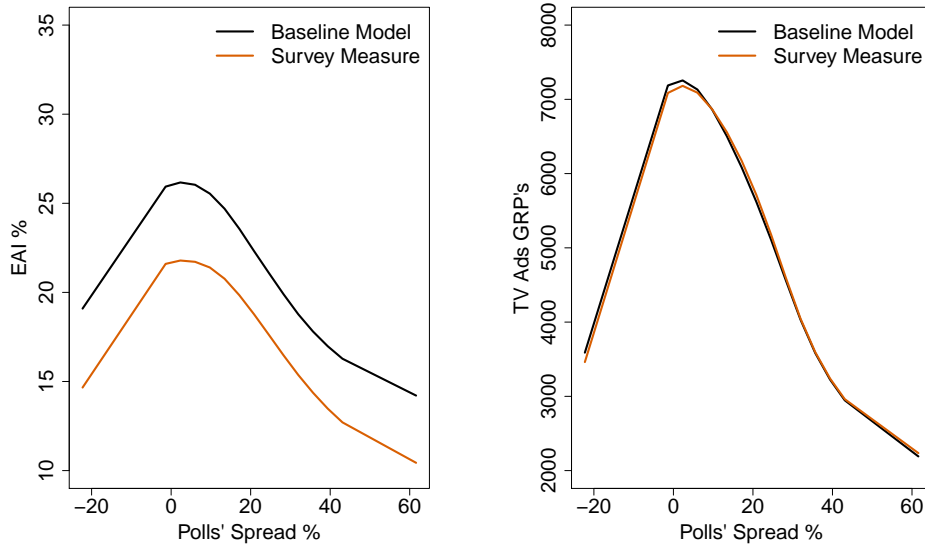


Figure D10: Comparison of Aggregate Policy Functions using Tausanovitch and Warshaw (2013) Measure and Baseline Model.

D.6 Measuring Policy Positions

To quantify senators' policy positions at each point in time, we use scaling techniques to obtain a one-dimensional measure capturing variability in senators' voting records. Specifically, we define senator i 's **position** in month t as her "ideal point" estimate from a Bayesian Quadratic Normal model ((Clinton, Jackman, and Rivers 2004b)).

Unfortunately, in many instances (senator/month) there are just not enough votes in any given month to obtain precise estimates of individual senators’ policy positions. Thus, attempting to measure policy positions by scaling roll calls in a single month results in highly variable point estimates with large standard errors, and missing data. To overcome this problem, we estimate policy positions using a twelve month rolling window of roll calls.

Figure D11 presents a crossplot of our measure of position-taking with a current-date-only measure of position-taking (point estimates only), restricting to periods in which there are at least fifty roll-call votes. As the figure shows, restricting to periods in which there is at least a minimally viable amount of information to obtain relatively precise estimates at the monthly level, the current-date-only measure is highly correlated with our original measure (correlation coefficient of 0.88).

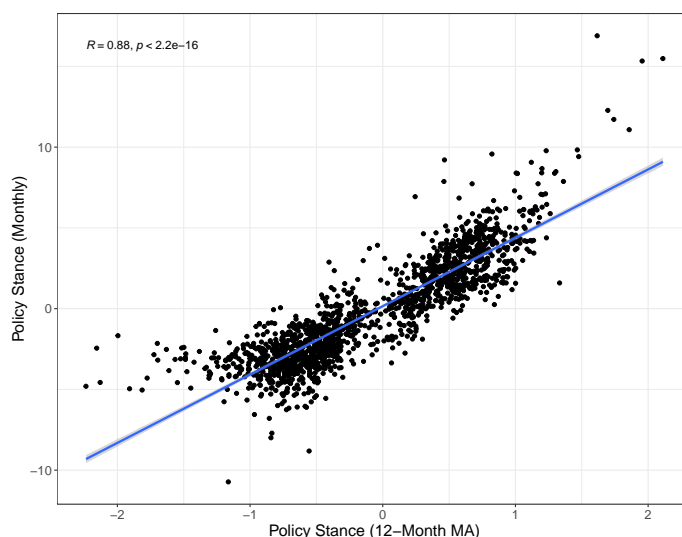


Figure D11: Benchmark measure of position-taking measure (x-axis), and monthly-data-only measure of position-taking (y-axis), whenever the latter can be computed (point estimates).

A possible concern is that our measurement strategy could artificially reduce our estimates of electoral accountability. To assess this possibility, we computed alternative measures of policy positions using alternative “windows” for estimation; i.e., we computed position estimates for any senator i in period t using only votes in the last three (3M) and the last six months (6M). As discussed above, including fewer roll calls in the analysis leads to more imprecise estimates. This can be seen in Figure D12, which plots the density of the standard errors of policy position’s estimates with monthly data, as well as with three, six and twelve month roll call windows. As can be seen, monthly estimates have the largest standard errors, followed by 3M and 6M

windows. Consistent with this, the correlation between our preferred measure and the 6M (point) estimates is 0.926, while the correlation between our preferred measure and the 3M (point) estimates drops to 0.71. The effect of reducing the window size is not limited to adding noise. In fact, as the scaling window gets smaller, we recover a significantly higher portion of extreme positions, which are very imprecisely estimated, due to the small number of roll-call votes available in smaller windows. When we remove the outliers due to imprecisely estimated positions, the correlations between the point estimates increase to 0.944 (6M) and 0.886 (3M).

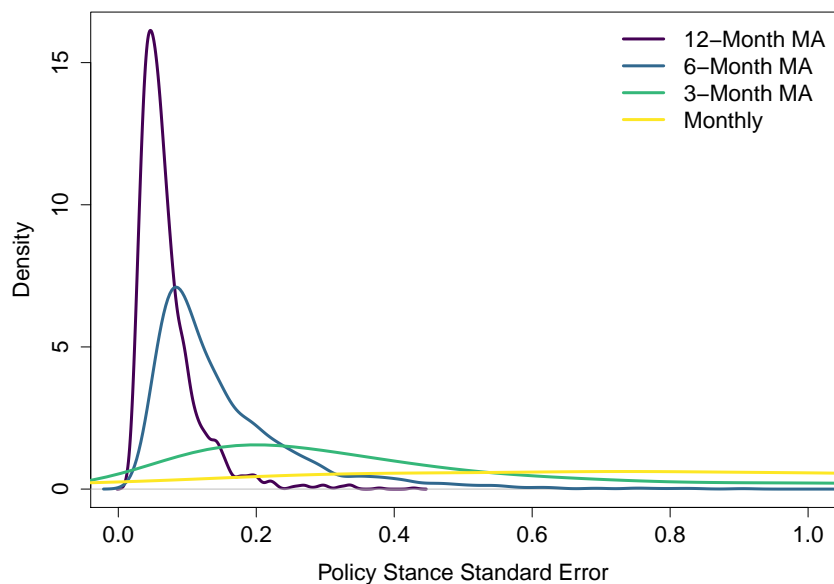


Figure D12: Density of the standard errors of policy position’s estimates at the monthly level and for three, six and twelve month roll call windows.

To assess the potential effect of our measurement strategy on our estimates of electoral accountability, we re-estimate the full structural model with the 6M measure of position-taking, excluding outliers.³⁰ If our measurement strategy were to artificially reduce electoral accountability, reducing the scaling window would result in higher levels of electoral accountability. Figure D13 shows the predicted electoral accountability index and TV advertisement as a function of electoral advantage for our baseline specification and for the 6M model. As the figure illustrates, the aggregate policy functions are very similar using both measures of policy positions. In particu-

³⁰We do not estimate the structural parameters for the 3M measure, as we are left with fewer than 5 incumbent senators with non-missing data after removing extreme observations.

lar, we do not find politicians' responsiveness to be significantly higher for the smaller scaling window (in fact, it is slightly below the estimate for the benchmark model). We read this as reassuring evidence that our conclusion that electoral accountability is only moderate on average is robust to our joint scaling of votes.

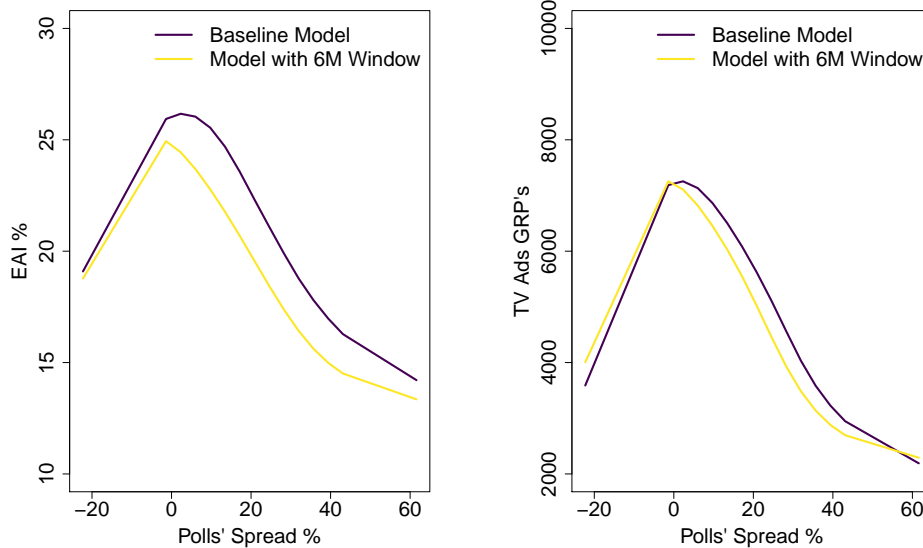


Figure D13: Electoral Accountability and TV Advertising for 12- and 6-Month Moving Averages

D.7 Measurement Error in TV advertising Costs

Available measures of TV advertisement costs can be imperfect due to high-frequency variation in prices or price discrimination by TV stations). Measurement error in the quantity of TV-ad buys would lead to attenuation bias in our transition function estimates (Table 6 in the paper); i.e., the estimated return of ads would be biased towards zero. To assess the consequences of measurement error on our structural parameter estimates and measures of electoral accountability, we re-estimate the model imputing a larger return of ads. In particular, we increase the coefficient of ads by 50% (1.5X) and by 100% (2X).

The result of this exercise for our parameter estimates is depicted in Figure D14. Ideal point estimates (θ) and cost parameters (γ) are essentially unchanged (see top row). However, we see that both the 1.5X and 2X experiments lead to a downward shift in the distribution of both the ω and α estimates. This suggests that if we had significant measurement error in TV ads, our career concern estimates would have an

upward bias (legislators would be even more ideological than what we predict).

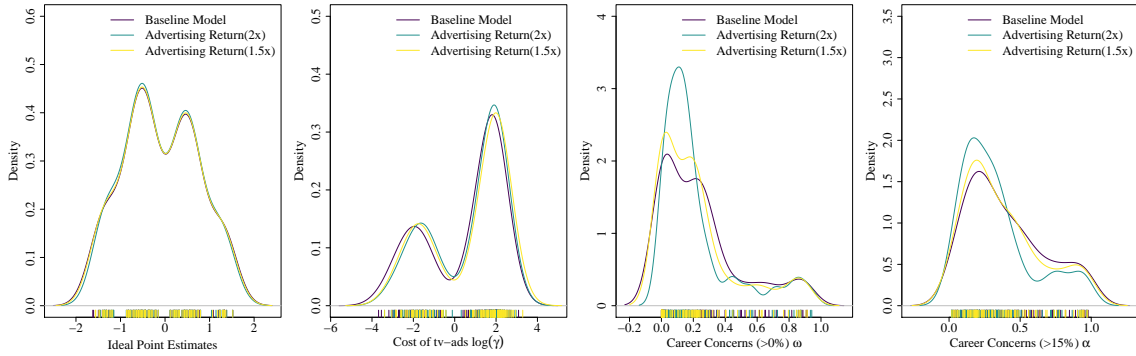


Figure D14: Comparison of Parameter Estimates with 1.5X return on ads, 2X return on ads, and Baseline Model

Figure D15 plots the aggregate policy functions computed from each set of estimates. As the figure shows, increasing the return of ads leads to a small reduction in the predicted level of policy and ad responsiveness. In other words, in the presence of measurement error, we would be moderately overestimating the extent of electoral accountability. This, if anything, would reinforce the main conclusions of the paper.

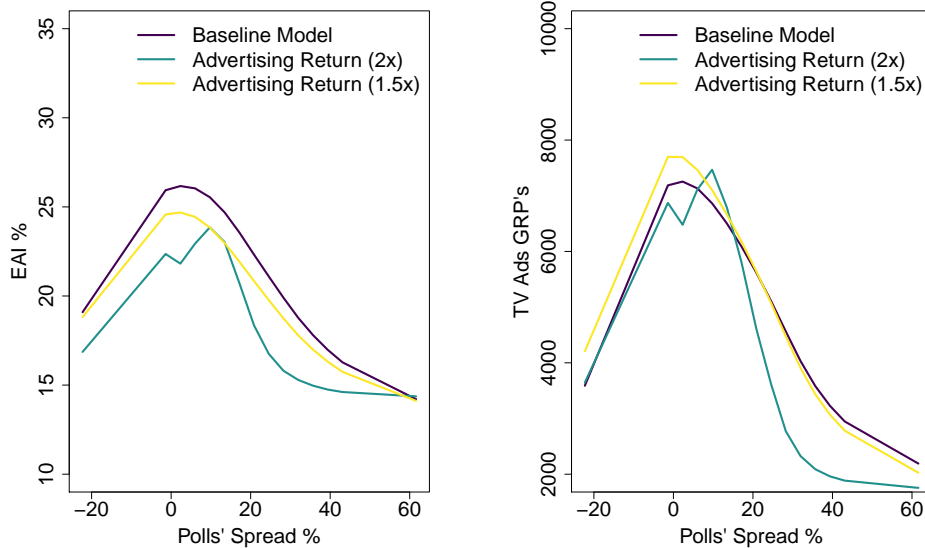


Figure D15: Comparison of Aggregate Policy Functions with 1.5X return on ads, 2X return on ads, and Baseline Model.

In the case that **tv-ads** are measured with an additive error (i.e., classical measurement error), a valid instrument for **tv-ads** will identify the true return of ads on voter support. In Section D.4 of this appendix, we use variation in TV ads in House races within a given state, as well as in TV ads from neighboring states. The IV results from Table D1 indicate an attenuation bias, with an IV estimate 1.7 times larger than the OLS estimate, which is in line with our simulations and our main conclusions regarding electoral accountability.

D.8 TV ads and Total Campaign Spending

In our empirical model, we focus on two instruments available to senators running for reelection: their voting record, and TV advertising. In practice, politicians have other instruments at their disposal (e.g., giving speeches, sending mailers, knocking on doors). It could then seem sensible to include total campaign expenditures as an aggregate measure of these electioneering activities.³¹

Doing this in this context is problematic for three reasons. First, total campaign expenditures include a surprisingly large number of expense items that do not directly influence voters (political consultant fees, surveys, food for campaign workers, database management, software support, legal and banking fees, supplies, etc). Second, even when we identify the electioneering activity itself, we would want to measure the quantity perceived by voters, not the cost for the campaign to influence that voter (price times quantity). In other words, we are not interested in the total expense associated with putting together a speech by the candidate, but the actual electioneering activity—the speech, and how many people watch that speech. Third, the expenditure data often doesn’t allow us to identify the time in which the activity impacted voters, undermining our ability to focus on dynamics. In contrast, the advertising data (though imperfect) measures the quantity of an activity that we know is going directly to voters at a given time, and allows us to separate quantity from total cost.

These caveats being noted, we point out that total campaign expenditures are correlated with TV ad impressions, both across and within candidates. Table D4 presents the results of estimating a linear regression in which TV ad impressions are a function of total campaign spending (in real terms using the price of ads as a deflator), for both incumbent and challenger. Columns (1) and (3) present the unconditional estimates, while columns (2) and (4) present the estimates with Congress Session and Senator fixed effects. As the table shows, the coefficient estimates for total campaign spending are positive and statistically significant for both incumbent and challengers, with and without fixed effects.

³¹Campaign expenditures are available from the Federal Election Commission, including item by item expenditures as entered by the campaign staff.

Table D4: Total Campaign Spending and TV Advertisement

	<i>Dependent variable:</i>			
	TV Ads (Incumbent)		TV Ads (Challenger)	
	(1)	(2)	(3)	(4)
Total Campaign (Inc.)	0.801*** (0.078)	0.847*** (0.083)		
Total Campaign (Chall.)			0.785*** (0.151)	0.881*** (0.171)
Observations	1,584	1,584	1,584	1,584
Legislator-Congress FE	No	Yes	No	Yes
Adjusted R ²	0.466	0.425	0.346	0.296
F Statistic	1,380.070***	1,304.430***	838.019***	799.114***

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors clustered at the senator-congress level in parentheses.

For completeness, we recomputed our estimates using total campaign expenditures in lieu of TV ads. Figure D16 presents the distribution of the estimates of ideal points and career concerns (θ, ω, α) from our empirical model using total campaign spending instead of TV ads. The two sets of results produce similar estimates on the overall policy vs office tradeoffs, which are ultimately reflected in similar estimates of electoral accountability (more on this below). We note, however, that the estimates obtained using total campaign spending shift the distribution of ω estimates upwards, and the distribution of α estimates downwards, implying a relatively larger responsiveness in close than lopsided elections than the corresponding estimates with TV ads on average.

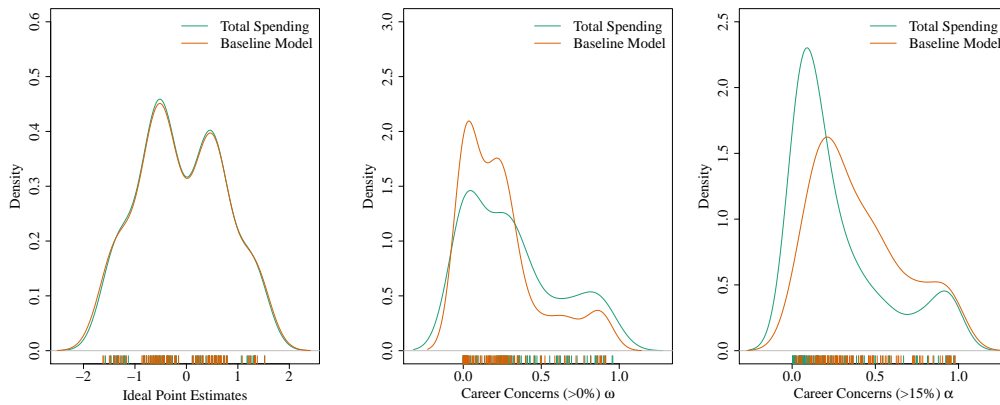


Figure D16: Comparison of Parameter Estimates for (θ, ω, α) using Total Campaign Spending and TV Ads (Baseline Model).

Figure D17 presents the comparison of aggregate policy functions for ads and electoral

accountability using TV ads (Baseline Model) and Total Campaign Spending. To report comparable figures for TV ads and total Campaign Spending, we transform total campaign spending into impression equivalent units by dividing it by the average ad price in the state (this is imperfect of course, so the comparison should be taken with caution).

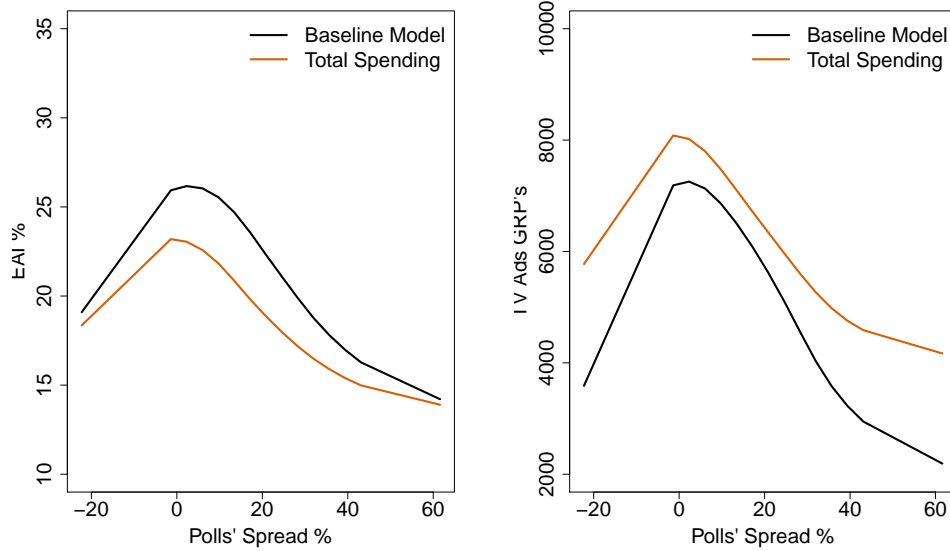


Figure D17: Comparison of Aggregate Policy Functions using Total Campaign Spending and TV Ads (Baseline Model). To report comparable figures for TV ads and total Campaign Spending, we transform total campaign spending into ad equivalent units by dividing it by the average ad price (this is presented only as a rough comparison).

Overall, we find similar patterns of responsiveness as a function of the advantage in the polls, with moderately lower levels of electoral accountability and – to the extent that this comparison is informative – a slightly larger average responsiveness of spending.

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