

# Career Concerns and the Dynamics of Electoral Accountability\*

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## Abstract

We consider a dynamic model of an incumbent politician running for reelection to estimate the relative value of office to policy for US senators seeking reelection. In the model, senators who have idiosyncratic policy and office motivations choose strategically their policy position and TV-ads each period after observing their advantage in the polls. Their choices in turn influence voter support in the next period. We use the estimates of the model to quantify how career concerns and policy preferences affect electoral accountability and advertising in competitive and uncompetitive elections.

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“Whether they are safe or marginal, cautious or audacious, congressmen must constantly engage in activities related to reelection. There will be differences in emphasis, but all members share the root need to do things – indeed, to do things day in and day out during their terms.” *David Mayhew, The Electoral Connection.*

## 1 Introduction

A central tenet of democratic theory is that elections serve to discipline serving politicians. The basic idea is that if the politician were to deviate too much from the preferences of her constituency, voters would simply remove the politician from office (Mayhew (1974), Barro (1973), Ferejohn (1986)). Thus, politicians who value reelection will not stray far from the voters’ preferred policy.

Elections, however, are a blunt instrument, which affect politicians differently depending on the proximity of the election (Thomas (1985), Levitt (1996)), how competitive the election is perceived to be (Lee, Moretti, and Butler (2004), Griffin (2006), Gordon and Huber (2007)), or how informed voters are about policy and politicians (Snyder and Stromberg (2010), Lim, Snyder, and Stromberg (2015)).

The power of electoral accountability, moreover, depends fundamentally on individual characteristics of the politicians. A key factor in nearly all models of political agency is the value individual politicians place on policy versus office motivations (see e.g. Alesina and Cukierman (1990)). In the extreme, if office motivation dominates all policy considerations, representatives would not mind compromising their policy ideas to gain an electoral edge, even if slight. But if they cared both about office and policy, adjusting their policy positions to please voters would be costly and their actions would reflect a weighting of these two conflicting goals.

In spite of the central role of the career versus policy tradeoff in the literature, we know relatively little about how legislators value policy concessions relative to office. The closest contribution in this regard is Diermeier, Keane, and Merlo (2005), who quantify the monetary value of holding office in a dynamic model of the career decisions of a member of Congress. Their results show that a significant fraction of legislators give a large value to non-pecuniary rewards from holding office, such as obtaining major legislative achievements.

While the results by Diermeier, Keane and Merlo are important to understand selection into politics, they do not inform the discussion on electoral accountability. In order to evaluate how career concerns affect legislators’ policy decisions we need to understand how legislators

trade off policy concessions against an increase in the value or the probability of attaining office. This relative value between office and policy informs the differential responsiveness in close or lopsided elections, the degree to which more or less ideologically moderate politicians will cater to voters, and how politicians will use advertising to substitute for policy responsiveness.

In this paper we consider a model of an incumbent politician running for reelection. We estimate the relative value of office to policy for US senators seeking reelection, and use these estimates to quantify how career concerns and policy preferences affect electoral accountability in competitive and uncompetitive elections.

The model incorporates two features that we believe are essential in an empirical model of a senator running for reelection. First is the dynamic nature of the decision-making process within each electoral cycle. Indeed, as the opening quote by Mayhew illustrates, legislators typically revise their choices multiple times before election day, responding to the best of their ability to the information available at each point in time. This presents a dynamic programming problem for the politician, where her current decisions are valuable not because of their direct effect on the probability of getting elected, but because of their effect on next period polls. Second – and also in line with Mayhew – we include advertising as a competing instrument to position-taking to obtain voter support. While simple models of political agency typically do not include advertising, ignoring it in an empirical model would be ill advised. If political advertising provides an alternative mechanism to obtain voter support – and the available evidence suggests it does – politicians can substitute adjustments in policy position with advertising. In order to ascertain the potential for advertising to crowd out accountability, it is important to allow the politician to substitute advertising and policy responsiveness in response to the relative cost and effectiveness of each instrument.

In our model, senators with idiosyncratic policy and office motivations strategically choose their policy position and TV-ad buys each period after observing their advantage in the polls. Their choices in turn influence voter support in the next period. Senators get flow policy payoffs  $u_i(x_{it}, \theta_i) = -\lambda_i(x_{it} - \theta_i)^2$  in each period (where  $\theta_i$  is senator  $i$ 's ideal point), and an individual-specific office payoff  $\omega_i$  if they attain reelection. To allow the possibility that individual senators are also responsive to voters even when anticipating large victory margins (Bartels (1991), Lee, Moretti, and Butler (2004)), we also allow the possibility that senators get an additional benefit  $\alpha_i$  from a lopsided win.

We estimate the model using data on monthly observations of polls, campaign contributions, voting records, and TV advertising expenditures for 77 incumbent senators who ran for

reelection at least once in the period 2000-2012, for a total of 88 electoral cycles.

The estimation of our dynamic model follows the approach pioneered by Rust (1987). As usual in this literature, we estimate the model in two steps. In the first we estimate the transition functions, quantifying how policy positions and TV ads affect voter support. This first stage overlaps with a large literature in political science and political economy.<sup>1</sup> Our estimate of the effect of TV ads on voter support is positive and remarkably close in magnitude to that of comparable estimates in the literature (Huber and Arceneaux (2007), Gordon and Hartmann (2013)). Also consistent with previous findings, we estimate a positive and significant effect for changes in senators' policy positions on voters' support (see Canes-Wrone, Brady, and Cogan (2002), Ansolabehere and Jones (2010)). However, in contrast to the literature – where the conventional wisdom is that incumbents are penalized for ideological extremity – we find that both republicans in conservative districts and democrats in liberal districts are penalized from taking moderate positions.

In the second step we take the transition function as given, and estimate policy and career concern parameters solving the problem of each senator for every trial value of the parameters, and then searching for the values that maximize the likelihood function.

To provide a stand-alone measure of our office-ideology estimates we compute the size of the policy concession that each senator would be willing to give up for a one percent increase in the probability of reelection, and a one percent increase in the probability of a lopsided win. While there is substantial heterogeneity among individual senators, most senators are willing to make non-negligible policy concessions for a higher probability of retaining office: the median senator is willing to give up 0.5% of the average policy distance between parties for a 1% increase in the probability of reelection, and 2.7% of this distance for a 1% increase in the probability of a lopsided win.<sup>2</sup>

The previous results show that a vast majority of senators in our sample are in principle willing to deviate from their preferred policy choices to increase voter support, even in uncompetitive elections. The degree to which they will in fact do this, however, depends both on the electoral effectiveness of position taking vis-a-vis the cost of compromising ideology, and on how the net benefit from policy compromise compares to what can be

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<sup>1</sup>See Canes-Wrone, Brady, and Cogan (2002), Carson, Koger, Lebo, and Young (2010), and Green and Krasno (1988), Green and Krasno (1990), Gerber (1998), Stratmann (2009), Gordon and Hartmann (2013), Kawai (2014) for policy and advertising, respectively.

<sup>2</sup>We also estimate senators' ideal points. Since senators' voting records will typically not reflect their preferences truthfully, commonly used methods to estimate ideal points, which assume sincere voting, can lead to biased estimates (see Poole and Rosenthal (1985), Heckman and Snyder (1997), and Clinton, Jackman, and Rivers (2004)). Our estimation addresses this issue by explicitly taking strategic position-taking into consideration.

achieved through advertising. To compute predicted ad and policy choices for each senator and any level of electoral support and time period, we simply solve the politician’s problem at the estimated parameters. We show that policy functions can be monotonic or peak at higher levels of voter support depending on each senator’s preference parameters and transition distributions.

To summarize aggregate patterns of electoral accountability we construct an *electoral accountability index* (EAI). The EAI measures the strength of electoral accountability for senator  $i$  in period  $t$  by the relative weight of voters’ preferences in  $i$ ’s optimal policy stance in period  $t$  and poll advantage  $p$ . We find that while individual senators *can* be equally or even more responsive when elections are not close, on average electoral accountability is higher in competitive elections than in lopsided elections. The effect is relatively modest for the average senator – a 5 point swing in the polls reduces the electoral accountability index by about 2.6 points on average – but increases for senators with higher career concerns. These results give credence to the *marginality hypothesis*, which states that legislators should be more responsive to voters in more competitive elections.<sup>3</sup>

Our results indicate that in spite of being able to rely on advertising, senators adjust their policy positions strategically to gain voter support. To give a definite answer to whether advertising crowds-out electoral accountability we consider a policy experiment in which we ban political advertising. We show that if advertisement were set to zero, a typical office-motivated senator in our sample would have increased electoral accountability 20%, while this would have a negligible impact on policy-motivated senators. We conclude that although advertising does seem to partially crowd-out policy accountability, this effect is moderate and far from being capable of breaking the electoral connection between politicians and voters.

The main results of the paper focus on the constrained dynamic problem of the incumbent given the observed behavior of challengers in the data. This simplifies the presentation of the problem and allows us to focus on the core issue of electoral accountability. In reality, of course, the challenger is also a fully strategic player, and a complete analysis of the problem requires modeling the interactions of incumbent and challenger as a dynamic game. In Section 6 we extend our benchmark model to capture the dynamic game, and show that our main results on the incumbent’s structural parameters remain qualitatively unchanged when we consider equilibrium outcomes of the dynamic game.

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<sup>3</sup>The marginality hypothesis received mixed support from the empirical literature. Griffin (2006) finds that incumbents’ voting records vary more with district liberalness in more competitive districts. Bartels (1991) and Lee, Moretti, and Butler (2004), however, find that incumbents in safe districts are as responsive as those in competitive races, and Ansolabehere, Snyder Jr, and Stewart III (2001) argues that responsiveness to constituents ideological shadings changed significantly across electoral cycles.

Our paper connects to a broad literature. In our core goal of relating policy and office motivations to electoral accountability, however, our paper is most closely related to Lim (2013), who studies the behavior of appointed and elected state trial court judges in Kansas. Lim considers an extended version of Diermeier, Keane, and Merlo (2005) with endogenous policy decisions (the harshness of sentencing). This allows her to do counterfactual exercises in which changes in the value of office affect policy decisions. Differently than in our paper, however, Lim does not focus on the dynamics over the electoral cycle, and as a result she can only estimate a distribution over policy types (harsh, standard and lenient), with average career and policy parameters for each of these types. In contrast, the focus on the dynamics between elections allows us to estimate individual specific parameters, and to obtain predicted advertisement and policy choices for each individual senator as a function of advantage in the polls and time to election.

The results of our paper also complement the lessons from the political agency literature, which has emphasized informational asymmetries between voters and politicians. The key takeaway from this literature is that the same reelection concerns that can serve to discipline politicians can also lead them to choose inefficient policies in order to signal competence or congruence with the voter (pandering).<sup>4</sup> Related empirical work has focused on exploring some of the implications of these models. Snyder and Stromberg (2010) and Lim, Snyder, and Stromberg (2015), for instance, show that heightened media coverage leads politicians to be more responsive to voters, and Ash, Morelli, and Van Weelden (2015) show that media coverage leads representatives to engage in more divisive speech.<sup>5</sup>

## 2 Data

Our data consist of monthly observations of polls, campaign contributions, voting records, and TV advertising expenditures for 77 incumbent senators who ran for reelection at least once in the period 2000-2012, for a total of 88 electoral cycles.<sup>6</sup> We supplement this with demographic and economic indicators at the state level, as well as with individual characteristics of incumbent senators.

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<sup>4</sup>Early contributions include Harrington (1993), Cukierman and Tommasi (1998), Canes-Wrone, Herron, and Shotts (2001) and Maskin and Tirole (2004); see Ashworth (2012) for a review of recent work. Kartik, Squintani, Tinn, et al. (2013) show that posturing can lead to anti-pandering.

<sup>5</sup>See also Aruoba, Drazen, and Vlaicu (2015), who structurally estimate a political agency model with adverse selection and moral hazard in the spirit of Banks and Sundaram (1998) and Duggan (2015). They show that reelection leads to an increase in the fraction of governor who exert high effort.

<sup>6</sup>We do not include the electoral cycle 2005/06 in the analysis, as there is no available data of monthly expenditures in TV advertising for this period.

We use public opinion data for each senate race (which we obtain from individual polls collected by *Polling Report*, *Real Clear Politics* and *Pollster*) to quantify the electoral advantage of a senator at each point in time. The `pointlead` of senator  $i$  in month  $t = 1, \dots, 12$ , measures the difference between the share of respondents in favor of the incumbent senator and the challenger  $t$  months before the election. This quantity is constructed as the monthly average of available individual polls in the period under study.<sup>7</sup>

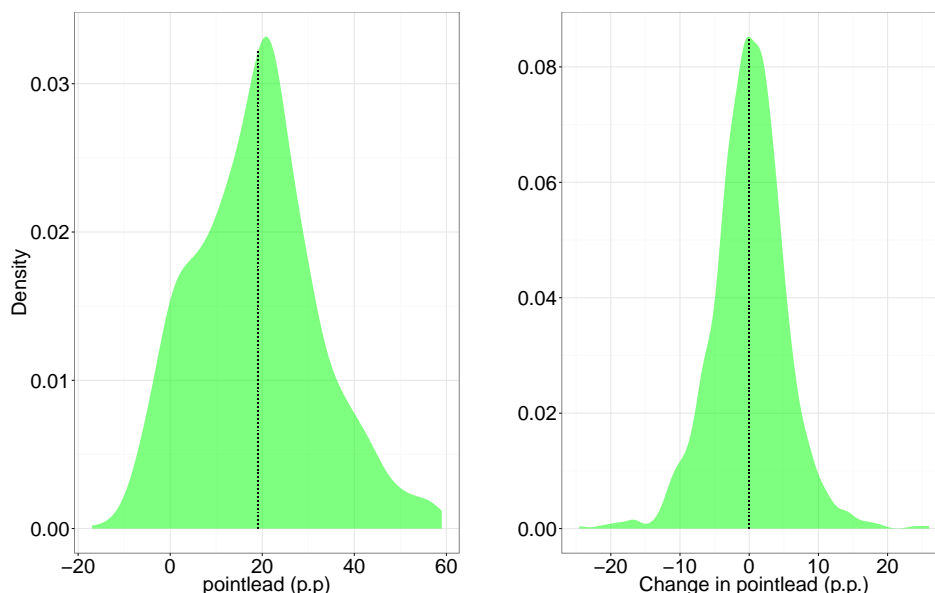


Figure 1: Distribution of `pointlead` (left) and monthly change in `pointlead` (right)

As has been extensively documented elsewhere (Erikson (1971), Gelman and King (1990), Levitt and Wolfram (1997), Ansolabehere, Snyder Jr, and Stewart III (2000)), incumbents enjoy a significant electoral advantage vis-a-vis their challengers. However, we know less about the early indicators of voter support, and their evolution throughout the electoral cycle. Figure 1 plots the empirical distribution of `pointlead` (left) and the month to month change in `pointlead` (right) for all senators in the sample, in each of the last twelve months before the election. On average, incumbents enjoy an advantage in the polls of close to 18 p.p. But there is also significant heterogeneity in poll advantage, both across and within legislators. In fact, the right panel shows that while the current value of `pointlead` is a

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<sup>7</sup>Whenever possible, we fill the gaps in senate races' opinion data with senators' approval rates (in 15% of monthly observations), as well as with national polls that contain state-level information on congressional races (in 16% of monthly observations). For these observations we extrapolate a linear fit between `pointlead` and the alternative support measures accounting for both senator and month fixed effects. In particular, estimates from approval rates and national polls explain around 80% and 50% of the observed variation in incumbent's `pointlead`, respectively.

good predictor of the **pointlead** in the next period, the advantage in the polls changes significantly over time for given senators.

To quantify senators’ policy positions at each point in time, we use an aggregate measure of senators’ roll-call voting behavior. In particular, we summarize senator  $i$ ’s **stance** in month  $t$  as her one-dimensional “ideal point” estimate from a Bayesian Quadratic Normal model (Clinton, Jackman, and Rivers (2004)) using all roll call votes taken within the previous 12 months (i.e., with a sample from months  $t$  to  $t + 11$  before the election).<sup>8,9</sup> As in Ansolabehere, Snyder Jr, and Stewart III (2001), Clinton (2006) and Griffin (2006), we take these estimates only as a summary of senators’ position-taking, and do not assume that senators’ votes reflect their preferences sincerely.

Figure 2 plots **stance** for selected senators. As the figures illustrate, there is significant variation in the positions that senators adopt through time for a given electoral cycle. Interestingly, for a relatively large fraction of senators in our sample, changes in **stance** are correlated with variation in next period polls. In fact, for 25% of senators in our sample the correlation between current position and next period polls is larger than 0.42, while another 25% have a correlation coefficient of less than  $-0.31$ . Thus, half the senators exhibit correlations of greater magnitude than .31.<sup>10</sup>

To measure the expenditure in **tv-ads** of senator  $i$  during month  $t$  before the election we use micro data on TV advertisements obtained from the *Wisconsin and Wesleyan Advertisement Projects*, which monitor senate races in the largest 100 media markets, covering around 85% of the population.<sup>11</sup> For each incumbent senator, we compute the total monthly TV ads spending in USD by adding up the unit costs of all ads aired during each month on her behalf. The estimated cost of airing each ad is provided by the *Campaign Media Analysis Group (CMAG)* based on airing day, time, and media market the ad aired on. This quantity includes ads sponsored by the candidate, her party, interest groups and coordinated efforts

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<sup>8</sup>The posterior median of ideal point estimates are obtained via the MCMC algorithm, as implemented in the function `ideal()` from the `pscl` package in `R`. The identification (up to an affine transformation) of position estimates is obtained by fixing the policy positions of senators Tom Harkin (D) and James Inhofe (R) -who were present throughout the entire period under study- at positions  $-1$  and  $1$ , respectively. In this way, our measure is comparable across senators and over time.

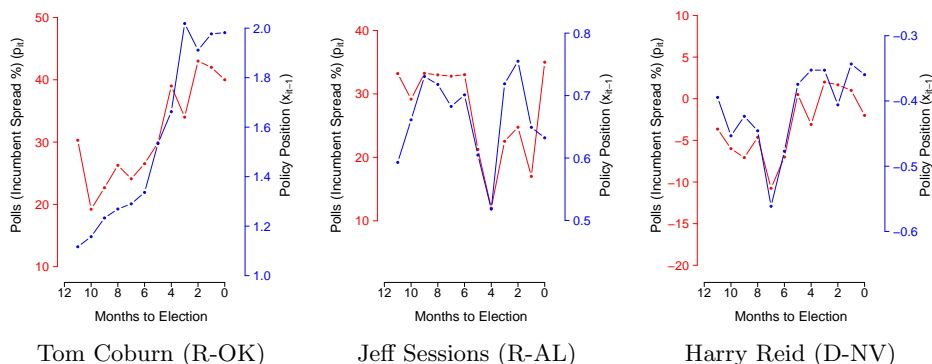
<sup>9</sup>Given data limitations, computing policy positions using only monthly data provides noisy estimates.

<sup>10</sup>The data also speaks to the existence of electoral cycle trends, which have received some attention in the literature. In particular, Thomas (1985) investigates the hypothesis that senators tend to moderate their positions as the election approaches. He finds that among senators who served between 1959 and 1976 and were seeking reelection, Democrats tend to become more conservative and Republicans more liberal in the last years of their tenure. In our data, we see that this appears to be true for some senators. However, other senators become either more extreme as the election approaches, or show no discernible trend (see Figure A.1 in the Appendix).

<sup>11</sup>In the 2000/01 election the Wisconsin Ad project covered the top 75 media markets, which encompassed around 80% of the population



### Positive Correlation



### Negative Correlation

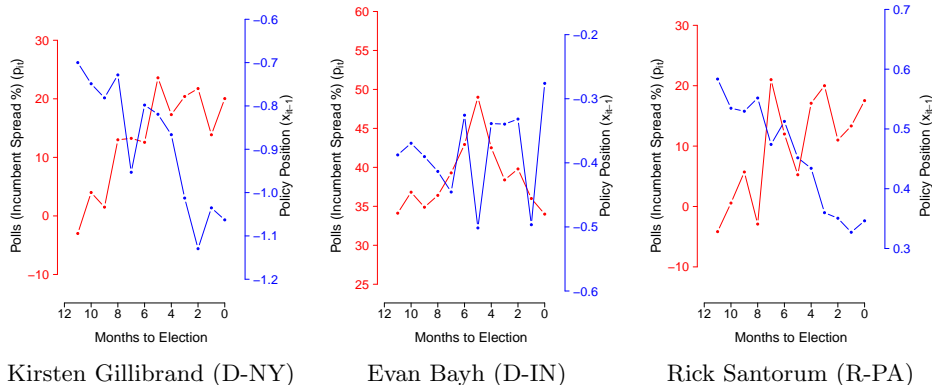


Figure 2: Policy Positions and Next Period Poll Advantage for Selected Incumbent Senators

between any of these entities, all aimed at the general election race. To make TV ad spending comparable across senators and over time, we measure the quantity of TV-ad buys in gross rating points. To obtain these, we use the data collected by Martin and Peskowitz (2015) on ad prices in dollars per rating point for the third quarter of each election year during the period 2002-2010, which are quoted by *Spot Quotation and Data* (SQUAD).<sup>12</sup> With this data at hand, we also collect a measure of the challenger's period  $t$  total spending in TV ads, which is sponsored by both by the challenger and third parties on her behalf.

The left panel of Figure 3 plots the average proportion of total TV ad expenditures disbursed

<sup>12</sup>Prices are weighted by the fraction of the population in each congressional district residing in a given media market. We take the average across districts within a state as our measure for price at any given senate race. As the price data is not publicly available for the elections of 2000/01 and 2011/12, for these cycles we use the prices for the 2002/03 and 2009/10 elections, respectively.

up to  $t$  months before the election,  $t = 0, 1, \dots, 12$ . In contrast to contributions, which arrive gradually throughout the electoral cycle and start well before election year, senators tend to concentrate expenditures in the last 6 months before the election, and typically spend more than 50% of their total TV ads expenditures in the last three months before the election. Nonetheless, there is considerable variability across senators, with several senators starting to spend in the third or fourth month before the election. The right panel of Figure 3 plots TV ad spending in periods where polls indicate a close, solid, or landslide election. This shows that senators tend to spend more in TV ads as elections become more competitive (no causal emphasis intended).

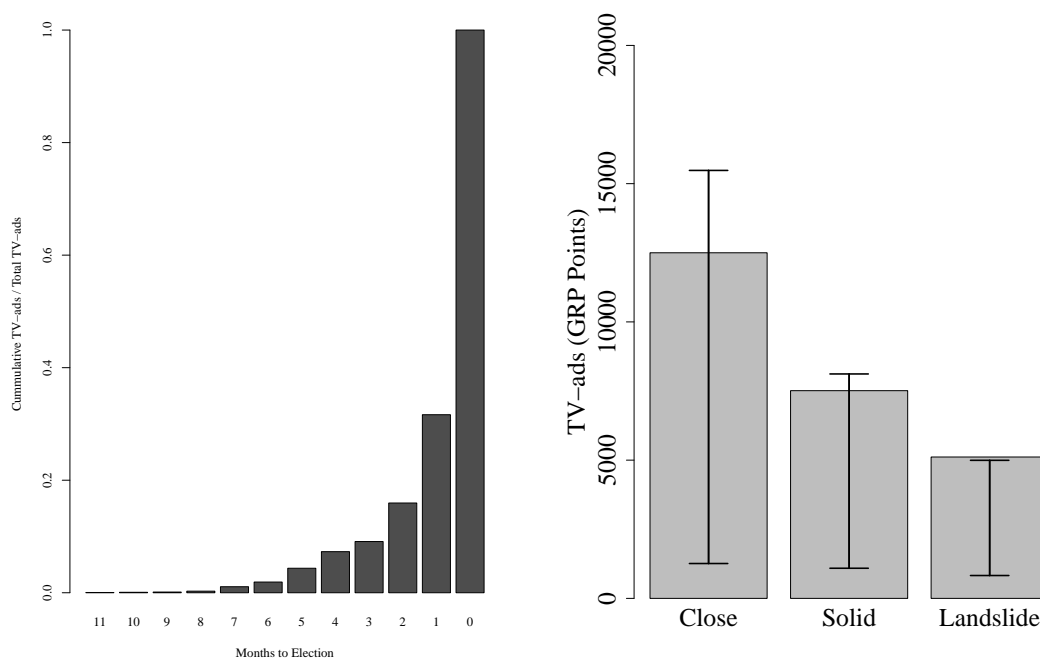


Figure 3: Average TV ad buys conditional on time to election and advantage in the polls

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).<sup>13</sup> To capture a measure of electoral preferences at the state level, we follow Canes-Wrone, Brady, and Cogan (2002)

<sup>13</sup>The variables `seniority`, `membership`, `comleader`, and `leader` are constructed based on the data on congressional committee assignments collected by Charles Stewart and Jonathan Woon.

and compute the variable `presrep.margin` given by the average vote spread for the period 2000-2012 between the Republican and Democrat candidates in the presidential election at given state (which we obtained from Dave Leip’s *Atlas of U.S. Presidential Elections*).

We control for demographic and economic characteristics at the state level including average state 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`), and percent of a state’s population that is black (`black`), all obtained from the 2000 Census’ data. Finally, we include monthly data on state unemployment (`unemployment`) obtained from the Bureau of Labor Statistics.

Tables A.1 and A.2 in Appendix A present descriptive statistics of the main variables.

### 3 The Model

We consider the decision-making problem of an incumbent politician  $t$  months away from the election,  $t = 1, \dots, T$ . At the beginning of each period  $t$ , the incumbent observes polls in her district measuring voter support,  $p_t \in \mathcal{P}$ , in a finite set  $\mathcal{P} = \{p^1, p^2, \dots, p^K\}$ . After observing  $p_t$ , the incumbent decides (i) her  $t$ -period policy position  $x_t \in \mathcal{X}$  and (ii) her expenditure in TV ads,  $e_t \in \mathcal{E}$ , for finite sets  $\mathcal{X}, \mathcal{E}$ .

Both position taking and TV ads affect next period polls. In particular, letting  $y_t = (x_t, e_t)$  and  $z_t \equiv (y_t, p_t)$ , we assume that polls evolve according to a Markov process

$$f_k(z_t) \equiv \Pr(p_{t+1} = p^k | z_t) \quad \text{for all } p^k \in \mathcal{P} \quad (3.1)$$

with CDF  $F(\cdot | z_t)$ . Investing  $e$  dollars in 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 stance  $x_t$  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  $\lambda$  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 econometrician we assume that a choice  $y_t$  also produces flow payoffs  $\mu(y_t)$ , where  $\mu$  is i.i.d. with pdf  $g(\cdot)$ .

Voter support at election time,  $T + 1$ , determines the result of the election. We assume that the politician gets a payoff  $\omega$  if she wins the election (if  $p_{T+1} \geq 1/2$ ) and an additional payoff of  $\alpha$  if she obtains a lopsided win,  $p_{T+1} \geq \bar{p}$  for some  $\bar{p} \in [1/2, 1]$ . The payoff of losing the election is normalized to zero. Let  $\tilde{y}^t(\cdot)$  denote a policy function  $\{\tilde{y}_\tau(\cdot)\}_{\tau=t}^T$

specifying how the politician behaves in each period  $\tau = t, \dots, T$  and state  $(p_\tau, \mu_\tau)$ , and let  $\tilde{z}_t \equiv (p_t, \mu_t, \tilde{y}_t(p_t, \mu_t))$ . Given  $\tilde{y}^t(\cdot)$ , we can compute the total expected office rent at any time  $t$  and state  $(p_t, \mu_t)$ , call this  $\mathcal{U}((p_t, \mu_t); \tilde{y}^t)$ . In particular,

$$\mathcal{U}((p_T, \mu_T); \tilde{y}_T) = [1 - F(1/2|\tilde{z}_t)]\omega + [1 - F(\bar{p}|\tilde{z}_t)]\alpha$$

The incumbent's problem is then to choose a policy function  $\tilde{y}^1(\cdot) = \{\tilde{y}_\tau(\cdot)\}_{\tau=1}^T$  so that for any time  $t$  and state  $(p_t, \mu_t)$  this maximizes

$$V_t = E \left[ \sum_{r=t}^T u(\tilde{x}_r(\cdot); \theta) + \mu(\tilde{y}_r(\cdot)) - C(\tilde{e}_r(\cdot)) \right] + \mathcal{U}((p_t, \mu_t); \tilde{y}^t) \quad (3.2)$$

s.t. (3.1).

We solve the incumbent's problem by backward induction. The incumbent's ex post value function (after the realization of the  $\mu$  innovations) in the last period before the election is

$$W_T(p_T, \mu_T) = \max_{y_T} \left\{ \underbrace{u(x_T; \theta) - C(e_T) + \mathcal{U}((p_T, \mu_T); y_T)}_{h(z_T)} + \mu(y_T) \right\}, \quad (3.3)$$

The solution to the politician's problem in period  $T$  is a policy function  $y_T^*(\cdot)$ , where  $y_T^*(p_T, \mu_T)$  solves (3.3) in state  $(p_T, \mu_T)$ . We can then define the ex ante value function

$$\bar{W}_T(p_T) \equiv \int W_T(p_T, \mu_T) g(\mu_T) d\mu_T. \quad (3.4)$$

Using (3.4) we can define recursively the ex post value for each  $t = T - 1, \dots, 1$ ,

$$W_t(p_t, \mu_t) = \max_{y_t} \left\{ \underbrace{u(x_t, \theta) - C(e_t) + E[\bar{W}_{t+1}(p_{t+1}) | z_t]}_{h(z_t)} + \mu(y_t) \right\}, \quad (3.5)$$

where

$$\bar{W}_t(p_t) \equiv \int W_t(p_t, \mu_t) g(\mu_t) d\mu_t. \quad (3.6)$$

denotes the politician's expected value in state  $p_t$ .

The solution to the politician's problem in period  $t = T - 1, \dots, 1$  is a policy function  $y_t^*(\cdot)$ , where  $y_t^*(p_t, \mu_t)$  solves (3.5) in state  $(p_t, \mu_t)$ . The solution to the incumbent's problem is  $\{y_t^*(\cdot)\}_{t=1}^T$ , indicating how the politician will respond in any state  $(p_t, \mu_t)$  at period  $t$ .

### 3.1 Intuition in a Simplified Model

To highlight the key tradeoffs in the model, we consider a smooth two period model of policy and expenditure choice. In particular, we ignore the unobservable shocks  $\mu$ , and assume that  $p_t \in \mathbb{R}$ ,  $x_t \in \mathbb{R}$  and  $e_t \in \mathbb{R}_+$ . We assume that the politician has an ideal point  $\theta > 0$  and that the representative voter has an ideal point at 0. Polls evolve according to

$$p_{t+1} = \eta_p p_t + \eta_e e_t + \eta_x |x_t| + \varepsilon_t, \quad (3.7)$$

where  $\varepsilon_t$  is i.i.d.  $\mathcal{N}(0, 1)$ . For convenience we write the deterministic component of polls as  $\eta z_t = \eta_p p_t + \eta_e e_t + \eta_x |x_t|$ . Here  $\eta_x < 0$  and  $\eta_p, \eta_e > 0$ . With this specification, in period 2 the incumbent solves

$$\max_{x_2 \in \mathbb{R}, e_2 \geq 0} u(x_2; \theta) - C(e_2) + [1 - \Phi(1/2 - \eta z_2)]\omega + [1 - \Phi(\bar{p} - \eta z_2)]\alpha$$

It is easy to show that in the solution,  $e_2^* > 0$  and  $x_2^* \in [0, \theta)$ . With this, the FOCs can be written as

$$[\phi(1/2 - \eta z_2)\omega + \phi(\bar{p} - \eta z_2)\alpha] \eta_e = \gamma e_2 \quad (3.8)$$

and

$$- [\phi(1/2 - \eta z_2)\omega + \phi(\bar{p} - \eta z_2)\alpha] \eta_x \begin{cases} = \lambda(\theta - x_2) & \text{if } x_2 > 0, \\ \geq \lambda\theta & \text{if } x_2 = 0 \end{cases} \quad (3.9)$$

From (3.8) and (3.9) a solution with  $x_2^* > 0$  satisfies

$$\frac{e_2^*}{(\theta - x_2^*)} = \frac{\eta_e \lambda}{-\eta_x \gamma} \quad (3.10)$$

Equation (3.10) pins down the *composition* of the incumbent's electoral effort in period 2. The ratio of TV-ad buys to policy moderation  $e_2^*/(\theta - x_2^*)$  increases with the return to TV-ads and with policy motivation, and decreases with the electoral return of policy moderation and the opportunity cost of funds.

Moving from the relative electoral response to levels is obtained by solving (3.10) for  $\tilde{e}_2(x_2^*) \equiv \frac{\eta_e \lambda}{-\eta_x \gamma} (\theta - x_2^*)$ , and substituting into (3.8) to obtain an implicit solution with only the endogenous variable  $x_2^*$ . We apply the implicit function theorem to this expression and obtain

$$\frac{\partial x_2^*}{\partial p_2} = -\frac{\frac{\eta_x \eta_p}{\lambda} [\psi'(\frac{1}{2})\omega + \psi'(\bar{p})\alpha]}{\frac{\eta_e^2}{\gamma} [\psi'(\frac{1}{2})\omega + \psi'(\bar{p})\alpha] + 1} \quad (3.11)$$

with the identity,  $\psi'(k) = \phi'(k - \eta_p p_2 - \eta_e \tilde{e}_2(x_2^*) - \eta_x x_t)$ . It follows that in a solution with  $x_2^* > 0$ , a small reduction in the importance of policy,  $\lambda$ , increases the degree to which policy is responsive to polls,  $\partial x_2^*/\partial p_2$ . Note that it is possible to have  $\partial x_2^*/\partial p_2 < 0$ , so that moderation increases as the incumbent does better in the polls. This is the case if the incumbent is either doing badly in expectation ( $\hat{p}_3 < 1/2$ ) or if she expects to be in a close election and puts enough value on a lopsided win ( $1/2 < \hat{p}_3 < \bar{p}$  and  $\alpha \gg \omega$ ), provided that  $\lambda/\eta_x$  is sufficiently large. Otherwise  $\frac{\partial x_2^*}{\partial p_2} \geq 0$ , and the incumbent goes weakly towards her ideal policy as  $p_2$  increases.

Now consider period 1. The objective in period 1 is

$$u(x_1, \theta) - C(e_1) + \int_0^1 W_2(\eta z_1 + \varepsilon_1) \phi(\varepsilon_1) d\varepsilon_1$$

Observing that by the same argument as above,  $e_1^* > 0$  and  $x_1^* \in [0, \theta]$ , the period  $t = 1$  necessary FOCs for optimality are

$$\eta_e \int W_2'(\eta z_1 + \varepsilon_1) \phi(\varepsilon_1) d\varepsilon_1 = \gamma e_1 \quad (3.12)$$

$$-\eta_x \int W_2'(\eta z_1 + \varepsilon_1) \phi(\varepsilon_1) d\varepsilon_1 \begin{cases} = \lambda(\theta - x_1^*) & \text{if } x_1^* \in (0, \theta], \\ \geq \lambda\theta & \text{if } x_1^* = 0. \end{cases} \quad (3.13)$$

It follows that if  $x_1^* > 0$ , then as in the last period,  $e_1^* = \tilde{e}(x_1^*) \equiv \frac{\eta_e}{\eta_x} \frac{\lambda}{\gamma} (\theta - x_1^*)$ . Regarding the optimal level of policy moderation in the first period, we show in Appendix C that, provided there is not much poll persistence, responsiveness to voters increases in the last periods for comparable levels of  $p$ ; i.e.,  $x_2^*(p) < x_1^*(p)$ . Since  $e_t^*$  and policy moderation are complements this means that in the first period there is also less spending at any particular level of poll support.

## 4 Estimation

We are interested in the estimation of the structural parameters of the model presented in Section 3: 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 and let  $\psi$  denote the

parameters of the transition distribution function.

As in Section 3, we let  $y_{i,t} = (x_{i,t}, e_{i,t})$  denote the  $t$  period control for Senator  $i$  and  $z_{i,t} \equiv (y_{i,t}, p_{i,t})$  denote her vector of actions and observable state variables. Given a panel of data  $\{z_{i,t}\}$  for senators  $i = 1, \dots, N$ , over  $t = 1, \dots, T$  periods before election, the likelihood can be written as

$$L(\rho, q) \equiv \prod_{i=1}^N \prod_{t=1}^T Pr(\mathbf{z}_{i,t} | z_{i,t-1}; \rho_i, q) = \prod_{i=1}^N \prod_{t=1}^T Pr(y_{i,t} | p_{i,t}; \rho_i, q) \cdot Pr(p_{i,t} | z_{i,t-1}, \psi), \quad (4.1)$$

where the equality comes from the fact that the transition function does not depend on either individual-specific parameters ( $\rho$ ) or individual unobservable state variables (e.g., taste shocks).

A consistent estimate of the transition function can be obtained by pooling information across senators (Rust (1994)). 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  $\psi$ . In the second step, we estimate the individual-specific parameters  $\rho$  given the estimated transition probabilities (see Aguirregabiria and Mira (2010)).

#### 4.1 First Step: Transition Parameters

We assume that voter support evolves according to:

$$p_{i,t+1} = \alpha p_{i,t} + \gamma_1 x_{i,t} + \gamma_2 x_{i,t}^2 + \gamma_3 e_{i,t} + Q'_{it} \beta + x_{i,t} \times Q'_{it} \lambda + \delta_t + \mu_c + \epsilon_{i,t}, \quad (4.2)$$

where  $\psi = \{\gamma_1, \gamma_2, \gamma_3, \beta, \lambda, \delta_t, \mu_c\}$  is the vector of first-stage parameters to be estimated.  $Q_{it}$  is a vector of senator and state specific characteristics that include challenger's behavior captured in her `tv-ads`, state electoral preferences through `presrep.margin`, state socio-economic indicators given by `unemployment`, `income`, `pop_64`, `educ_9th`, `black`, senator characteristics in the form of `membership`, `republican`, `female`, `seniority`, `leader`, and `com_leader`.  $\delta_t$  and  $\mu_c$  are fixed effects that capture all monthly- and session- specific shocks to polls, respectively, and  $\epsilon_{i,t}$  represent idiosyncratic shocks to Senator  $i$ 's polls released  $t$  month before election day, with  $\epsilon_{i,t} \sim \mathcal{N}(0, \sigma_\epsilon^2)$ .

The specification in equation (4.2) allows the effect of `stance` ( $x_{it}$ ) on voter support to differ based on the incumbent's party (`republican`) and state electoral preferences (`presrep.margin`).<sup>14</sup> Thus, a Republican taking a more conservative position can in-

<sup>14</sup>Using the republican vote in presidential elections to measure partisan preferences at the state level is standard in the literature. See for example Levitt (1996), Griffin (2006), Ansolabehere, Snyder Jr, and

crease voter support in a conservative state but decrease voter support in a liberal state, and this might in turn differ for a Democratic Senator. This is intuitive, and consistent with the analysis in Appendix 3.1, but generally not considered in the previous literature. This specification also allows the effect of position-taking to vary with economic conditions (**unemployment**), as well as based on the senator’s status position within the Senate (**leader**). In addition, the coefficient  $\gamma_2$  associated with the quadratic term  $x_{it}^2$  captures any potential moderation effects in **stance**.<sup>15</sup>

Note that the panel structure of our data alleviates some of the concerns of omitted variable bias in previous estimations of empirical models of voter support in the literature. Specifically, in past studies an observation reflects the entire electoral cycle for a given senator, which conflates variation in voter support due to temporal shocks with responses to changes in position-taking or TV ads.<sup>16</sup> With higher frequency data for policy stances and voter support, however, we are able to distinguish the effect of ads or responsiveness from variation in voter support that is due to transitory shocks.

Some inference problems remain. In particular, if the correlation between unobservables and **tv-ads** changes over time and is not captured by observables, our estimators might still suffer from omitted variable bias. To address endogeneity concerns, we use variation of **tv-ads** in races in neighboring states as instruments for both incumbents’ and challengers’ **tv-ads**.<sup>17</sup> In particular, we construct a distance weighted **tv-ads** instrument given by  $\sum_{j=1, j \neq i}^N \omega_{ij} e_{j,t}$ , where  $\omega_{ij} = 1/d_{ij}^2$  is the inverse of the squared distance between the centroids of states  $i$  and  $j$ .

Estimation of equation (4.2) is done via standard panel data methods and all standard errors are fully robust to heteroskedasticity and serial correlation at the electoral race level (i.e., we clustered them at the senator-congress level). As we require contiguous observations to estimate the transition function from  $p_{i,t}$  to  $p_{i,t+1}$  at every  $t$ , the first stage model is

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Stewart III (2001), and Canes-Wrone, Brady, and Cogan (2002).

<sup>15</sup>Less parsimonious specifications containing additional interactions between **stance** and other senator-specific characteristics, as well as between **tv-ads** and senator- and state-specific covariates produce qualitatively identical estimated transitions functions.

<sup>16</sup>As has been emphasized in previous literature on campaign spending (e.g., Green and Krasno (1988), Green and Krasno (1990), Gerber (1998), Stratmann (2009), Gordon and Hartmann (2013)), the amount that both incumbents and challengers invest in advertising can be potentially correlated with unobserved shocks when estimating models of electoral support, leading to inconsistent estimates of the effect of advertising. This could be the case, for instance, if politicians’ decisions to spend money on the campaign respond to their perceived chances of winning.

<sup>17</sup>Ads in neighboring states are likely to directly influence tv-ads, as candidates in neighbor states face similar changes in ads rates, driven in many cases by the actual overlap of media markets across state boundaries (see Huber and Arceneaux (2007)). In addition, changes in tv-ads for a given state might be partially driven by party national committees’ strategies at a regional or national level, irrespective of the evolution of state senate elections. Most importantly, these variables do not directly affect voter support in the state.



estimated on a balanced panel dataset, with polls at every month within a year before election. To fill remaining missing values on senate races, which are usually intermittently measured over an electoral cycle, we implement a multiple imputation technique via the EM algorithm (Honaker and King (2010)), which is a commonly applied method to efficiently analyze unbalanced opinion survey data in American politics (see Appendix D for details).

Our final step is to adapt the empirical model specified in equation (4.2) to the finite grid assumed in the structural model. Given our parametric assumption that  $\epsilon_{i,t} \sim \mathcal{N}(0, \sigma_\epsilon^2)$ , we can write  $\hat{p}_{i,t+1}|z_{i,t} \sim \mathcal{N}(m_p(z_{i,t}), \sigma_p^2(z_{i,t}))$ , where  $m_p(z_{i,t})$  and  $\sigma_p^2(z_{i,t})$  are computed directly from the estimates of equation (4.2). On the one hand  $m_p(z_{i,t}) = \mathbf{X}'_{i,t}\hat{\psi}$ , where  $\mathbf{X}_{i,t}$  is the data vector in equation (4.2) and  $\hat{\psi}$  is the estimate of  $\psi$ . On the other hand,  $\sigma_p^2(z_{i,t}) = J(\hat{\psi})\hat{\Sigma}J(\hat{\psi})'$ , where  $J(\hat{\psi})$  is the Jacobian matrix of  $m_p(z_{i,t})$  evaluated at  $\hat{\psi}$  and  $\hat{\Sigma}$  is an estimate of the variance-covariance matrix of  $\hat{\psi}$ . We construct a partition  $\{a_0, a_1, \dots, a_{K(v)}\}$  of the feasible set of values  $A$ , and let  $p_{i,t} = p^k$  if  $p_{i,t} \in [a_{k-1}, a_k]$ .<sup>18</sup> Since  $\hat{p}_{i,t+1}|z_{i,t} \sim \mathcal{N}(m_p(z_{i,t}), \sigma_p^2(z_{i,t}))$ , then senators' beliefs given the  $t$  period state  $p_{i,t}$  and control  $y_{i,t}$  are given by

$$f_k(z_t) = \Phi\left(\frac{a_k - m_p(z_{i,t})}{\sigma_p(z_{i,t})}\right) - \Phi\left(\frac{a_{k-1} - m_p(z_{i,t})}{\sigma_p(z_{i,t})}\right) \quad \text{for } k = 1, \dots, K(p) \quad (4.3)$$

## 4.2 Second-Stage Estimates

In the second stage we estimate the structural parameters  $\rho \equiv \{\theta_i, \lambda_i, \omega_i, \alpha, \gamma_i\}_{i=1}^N$ . The difficulty in estimating  $\rho_i$  directly from the likelihood in (4.1) is that  $Pr(y_{i,t}|p_{i,t}; \rho_i, q)$  is not a known function of  $\rho_i$  but rather reflects optimal decision-making for the politician with characteristics  $\rho_i$  in each state  $(p_{i,t}, \mu_{i,t})$ , as given by the policy function  $y_{i,t}^*(p_{i,t}, \mu_{i,t})$  that solves (3.5). This problem, however, falls within the general class of single-agent dynamic problems that have been extensively studied in the structural econometrics literature. We estimate the structural parameters by first solving the dynamic problem of each senator for every trial value of the parameters, and then searching for the values that maximize the data likelihood.<sup>19</sup>

<sup>18</sup>For the empirical estimation we generate  $k$  bins by splitting `pointlead` into  $k$  equal parts and set the value of  $p^k$  as the bin midpoint. We let  $k = 15$ , which is large enough to capture the variation of `pointlead` in the data, although we experimented with  $k \in \{5, 10, 15, 20, 25, 30\}$  and obtained similar results. To capture the variation in `stance` across senators in the sample into a common grid to all, we selected a finer partition of 30 bins, whereas for `tv-ads` splitting the data into three spending categories (i.e., “low”, “medium” and “high”) was enough to capture the main spending choices in the data.

<sup>19</sup>This approach contrasts with variants of the Conditional Choice Probability (CCP) estimation procedure (Hotz and Miller (1993)), in which value functions and structural parameters are recovered from conditional choice probabilities without explicitly solving the optimization problem for each trial value of the parameters. However, under this approach we would have needed to pool groups of senators and their respective preference

Recall from (3.5), that given  $p_{i,t}$ , senator  $i$  chooses  $y_{i,t}$  to maximize  $h(z_{i,t}) + \mu(y_{i,t})$ . Assuming that  $\{\mu_{it}(y)\}$  are i.i.d. type 1 extreme value random variables, senator  $i$ 's expected value in equation (3.6) and choice probability become

$$\bar{W}_{i,t}(p_{i,t}) = \ln \left( \sum_{y \in Y} \exp [h(p_{i,t}, y)] \right) + C, \quad \Pr(y_{i,t} = y' | p_{i,t}; \rho_i) = \frac{\exp [h(p_{i,t}, y'; \rho_i)]}{\sum_{y \in Y} \exp [h(p_{i,t}, y; \rho_i)]}, \quad (4.4)$$

where  $C$  is Euler's constant. Here  $h(p_{i,t}, y; \rho_i)$  is a nonlinear function of  $\rho_i$  that has to be computed from the Bellman equation of the dynamic programming problem. To do this, we solve for the value function  $\bar{W}_{i,t+1}(p_{i,t})$  and choice probabilities  $\Pr(y_{it} = y' | s_{it}; \rho)$  by backwards induction.

We let  $\phi_i \equiv \{\lambda_i, \omega_i, \alpha_i\}$ , and fix  $\lambda + \omega + \alpha = 1$ . We assume  $\phi_i$  follows a Logistic Normal distribution with a mean vector parametrized as a linear function of Senator  $i$ 's characteristics captured by the  $P$ -length vector  $\mathbf{Z}_i$ ; i.e.,

$$\phi_i \sim \text{LogisticNormal}(\Xi' \mathbf{Z}'_i, \Sigma_\phi), \quad \xi_l \sim \mathcal{N}(\mathbf{0}, \sigma_l^2 \mathbf{I}_p), \quad (4.5)$$

where  $l \in \{\omega, \alpha\}$  and  $\Xi = \{\xi_\omega, \xi_\alpha\}$  is a  $P \times 2$  matrix of coefficients associated with the vector of characteristics  $\mathbf{Z}_i$  that includes: `republican`, `gender`, `leader`, `com_leader`, `seniority`, `membership`. In turn, we model ideal points  $\theta_i$  and the cost parameter  $\gamma_i$  as normal and truncated normal (at zero), respectively:

$$\theta_i \sim \mathcal{N}(0, \sigma_\theta), \quad \gamma_i \sim \mathcal{TN}(0, \sigma_\gamma). \quad (4.6)$$

Our problem then is to select  $\{\xi, \phi, \theta, \gamma, \Sigma_\phi\}$  to maximize:

$$\begin{aligned} & \sum_{i=1}^N \sum_{t=1}^T \log [\Pr(\mathbf{y}_{i,t} | p_{i,t}; \rho_i, q)] \\ & + \sum_{i=1}^N \left\{ \log [\mathcal{N}(\theta_i | 0, \sigma_\theta^2)] + \log [\mathcal{TN}(\gamma_i | 0, \sigma_\gamma^2)] + \log [\text{LogisticNormal}(\phi_i | \Xi' \mathbf{Z}'_i, \Sigma_\phi)] \right\} \\ & + \sum_{l \in \{\omega, \alpha\}} \log [\mathcal{N}(\xi_l | 0, \sigma_l^2)]. \end{aligned} \quad (4.7)$$

We obtain the mode of the above equation by combining a quasi-Newton gradient method (L-BFGS) that maximizes (4.7) with a value function obtained from the dynamic programming problem of each senator, similar to Rust (1987).<sup>20</sup> Because this algorithm must fully

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parameters to non-parametrically estimate these conditional choice probabilities.

<sup>20</sup>The main difference relies on the fact that we add to the likelihood the distribution of the individual

solve the senator’s problem for each trial value of the parameters and then compute the gradients of (4.7), 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 (available in the C++ Stan Math Library Carpenter, Hoffman, Brubaker, Lee, Li, and Betancourt (2015)), which is an extremely fast and efficient way to precisely compute exact derivatives-via arithmetic operations and the multiple implementations of the chain rule- needed for the gradient iterative search method.<sup>21</sup>

We measure uncertainty in the structural parameters’ estimates and other quantities of interest via the parametric bootstrap. That is, after obtaining the parameter estimates from the mode of the logposterior density in (4.7) for the observed panel, we draw 1000 pseudo-samples from this density and re-estimate the parameters that maximize (4.7) for each. We use the empirical distribution of these 1000 estimates to compute confidence intervals and its sample variance as an estimator of the variance of the structural parameters.

## 5 Results

In this section we present our results. We begin in Section 5.1 by describing the first stage estimates, which capture the effect of position-taking and TV ads on voter support. In Section 5.2 we report our estimates for politicians’ career concern and policy preference parameters. In Section 5.3 we describe the predicted ad and policy choices and return to the central questions about electoral accountability.

### 5.1 Electoral Return of Position-Taking and TV-ads

Table 1 presents the results for various specifications, incrementally controlling for heterogeneity at the individual, congress, and monthly levels. Column (1) presents the estimates controlling for senator/state specific factors. This allows us to control for variation in voter support that is due to individual-specific shocks at the electoral cycle level, such as unemployment or party preference at the state level. Column (2) adds Congress fixed effects, which controls for variation in voter support that is due to common shocks to all senators at the electoral cycle level, such as the legislative agenda, general partisan swings, or national structural parameters, whereas Rust’s original algorithm is equivalent to assuming that structural parameters are fixed effects.

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<sup>21</sup>Usual optimization algorithms use finite differencing, which is a numerical approximation to gradient evaluations. This method turns out to be extremely slow and imprecise for nonlinear and highly multidimensional functions such as the likelihood function we are dealing with in our problem.

economic shocks. Column (3) also includes month fixed effects, controlling for variation in voter support that is due to common shocks to all senators at the much more fine-grained monthly level, such as changes in presidential support. Column (4) – our main specification – replicates (3) but instruments for TV-ads, as described in Section 4.<sup>22</sup>

Table 1: First Stage Results

	<i>Dependent variable: <math>p_{i,t+1}</math></i>			
	OLS	OLS	OLS	IV
	(1)	(2)	(3)	(4)
$p_{i,t}$	0.768*** (0.029)	0.744*** (0.028)	0.745*** (0.028)	0.760*** (0.029)
$x_{i,t}$	-7.928*** (2.726)	-6.409** (2.855)	-6.383** (2.840)	-6.377** (3.153)
$x_{i,t}^2$	-2.973* (1.718)	-2.376 (1.806)	-2.443 (1.808)	-2.423 (1.961)
$x_{i,t} \times \text{republican}$	7.964 (5.363)	4.444 (5.570)	4.687 (5.545)	5.062 (6.054)
presrep.margin	-1.591 (3.027)	-0.635 (3.108)	-0.711 (3.102)	-0.373 (3.062)
$x_{i,t} \times \text{presrep.margin}$	18.083*** (4.815)	21.384*** (4.893)	21.176*** (4.894)	21.189*** (4.913)
$e_{i,t}$	0.0001*** (0.00004)	0.0001*** (0.00004)	0.0001** (0.00005)	0.0004*** (0.0002)
$e_{i,t}^{chall}$	-0.0002*** (0.00005)	-0.0002*** (0.00005)	-0.0002*** (0.00005)	-0.0003** (0.0001)
First- stage F-statistic ( $e_{it}$ )				19.178***
First- stage F-statistic (tv-ads(challenger))				9.809***
<b>Senator-State Controls</b>	Yes	Yes	Yes	Yes
<b>Congress FE</b>	No	Yes	Yes	Yes
<b>Time FE</b>	No	No	Yes	Yes
Observations	1,056	1,056	1,056	1,056
Adjusted R <sup>2</sup>	0.754	0.753	0.747	0.738

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

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

Our results indicate that both position-taking and political advertising have a significant effect on voter support. First, in all specifications political ads have a positive and sta-

<sup>22</sup>For this last column we report the first-stage F-statistic of excluded regressors (i.e., one for the incumbent and one for the challenger), which shows our instruments are sufficiently strong.

tistically significant effect on voter support, for both incumbent and challenger.<sup>23</sup> In our benchmark specification, increasing incumbent’s spending in advertisement by 1,000 gross rating points (GRP’s) has an implied cumulative increase of electoral support of 1.78%, whereas the same increase in spending gives the challenger an extra 1.38% in her electoral support.<sup>24</sup> The magnitude of this effect is consistent with comparable estimates. For example, Huber and Arceneaux (2007), focusing on survey evidence on non-battleground states, find that a 1,000 GRP’s increase leads to a 1.7% increase in the probability of voting for Bush in the 2000 presidential election, and Gordon and Hartmann (2013), using data for the 2000 and 2004 presidential elections, estimate that an increase of 1000 GRP’s increases the vote shares of the Republican candidate by 1.5%, and that of the Democratic candidate by 1.7%.<sup>25</sup>

We also find that changes in position-taking have a significant effect on voter support, with differential effects for democrats and republicans and according to the partisan leaning of voters in each state. First, the positive coefficient of  $x_{i,t} \times \text{presrep.margin}$  implies that as the district becomes more conservative, senators on average gain voter support when they take more conservative positions. For instance, in a relatively conservative district (i.e., with an average of 15% lead in Republican presidential vote share), a standard deviation increase in a Republican conservative **stance** increases next period’s electoral support by around 0.54% with a cumulative positive effect of 7.76% for the campaign. However, the same conservative shift in a liberal state (i.e., with an average of 15% lead in Democratic presidential vote share) would cause a Republican incumbent to loose around 1.31% in next period’s support, with an implied cumulative loss of 5.43%. In the case of Democratic incumbents in liberal states, a standard deviation increase in their liberal position implies an increment of 2.64% in next month’s polls and a cumulative gain of 11%. For Democrats the same change in liberal **stance** in a conservative state would still increase her electoral support around 0.88% in next month’s polls and 2.64% in cumulative terms.

In summary, in liberal districts the electoral return of adopting liberal positions increases for both democrats and republicans. In conservative districts instead, democrats still have an electoral incentive to adopt a liberal position, while republicans have an incentive to adopt a more conservative position. All in all, we find that the electoral forces push for divergence in conservative states, and for convergence in liberal ones.

Our results imply that while some incumbents are penalized for ideological extremity, this

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<sup>23</sup>Table A.3 in the Appendix shows that the effects of **tv-ads** for incumbent and challenger are robust to allowing for decreasing marginal effects of advertising.

<sup>24</sup>Since lagged **pointlead** has a coefficient of 0.76, the cumulative effect of 1000 GRP’s is  $\frac{.0004}{1-.76} \times 1000$ .

<sup>25</sup>In a field experiment, Gerber, Gimpel, Green, and Shaw (2011) find a larger effect of around 5% in the intention to vote for the incumbent in the 2006 Texas gubernatorial election.

is not the case for everyone (i.e., democrats in liberal states or republicans in conservative states). This result contrasts with the received wisdom from the political science literature, where the general finding is that incumbents are penalized for ideological extremity unconditionally. The difference in results has two sources. One is the data: while we use a panel of monthly observations of position-taking and forward voter support, previous papers have had as the unit of analysis a senator/electoral cycle pair of position-taking and electoral return. But there is also a conceptual difference at the heart of the model specifications. The idea in previous studies is that controlling for district ideology, democrats lose electoral support by voting more liberally and republicans lose support by voting more conservatively. These papers, however, do not allow the effect of position-taking on voter support to vary with the partisan leaning of each state. In our model, instead, we allow this possibility.

## 5.2 Career Concerns and Policy Preferences

The second stage of our estimation recovers the unobservable characteristics of each politician from their individual behavior. In this section we report these results, starting with our estimates for office and policy motivation. Figure A.2 in the Appendix provides the estimates for  $\lambda$  for each individual senator in the sample with 90% bootstrap confidence intervals, and Figure A.3 provides the distribution of our estimates for  $\omega$  and  $\alpha$ .

We are interested in quantifying how each politician trades off an increase in the probability of winning office by a close or large margin with policy losses. Note that if we keep a policy  $x$  fixed for  $T^0$  periods, along with a probability of a close win  $\pi$  and a probability of a lopsided win  $\pi^+$ , we can write politician  $i$ 's payoff as

$$U_i = -\lambda_i T^0 (x - \theta_i)^2 + \omega_i \pi + (\omega_i + \alpha_i) \pi^+$$

We can then compute the  $T^0$ -period change in policy that would keep senator  $i$  indifferent after a small increase in  $\pi$ , keeping the probability of a lopsided win constant. Differentiating, this is given by

$$dx = \left( \frac{\omega_i}{\lambda_i} \right) \left( \frac{1}{2T^0(x - \theta_i)} \right) d\pi \tag{5.1}$$

The relevant parameter of interest is given by the ratio  $\omega_i/\lambda_i$ . To provide a stand-alone figure of this ratio, we compute the compensating variation in policy (5.2) for a 1% change in the probability of winning and  $T^0 = 6$  periods, fixing the initial policy difference at the average difference between  $x_i$  and  $\theta_i$  in the sample in the final six months before the election. We then express this result as a proportion of the average policy distance between democrats

and republicans. The result can be interpreted as the proportion of the ideological gulf between democrats and republicans that senator  $i$  would be willing to give up for a 1% increase in the probability of a close win.

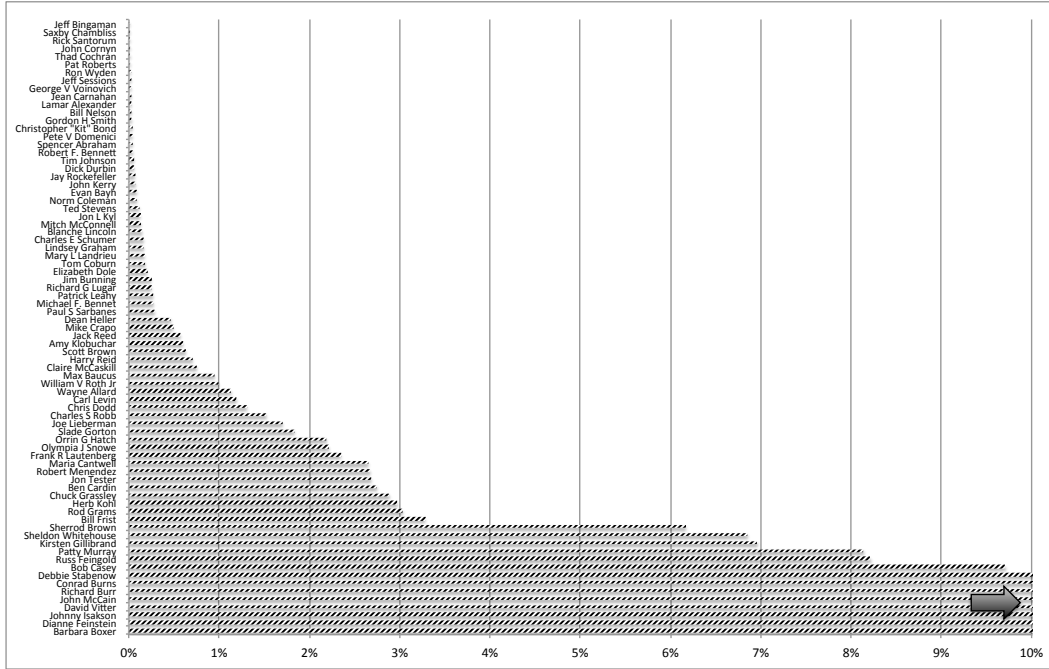


Figure 4: Proportion of the ideological difference between democrats and republicans senator  $i$  would be willing to give up for a 1% increase in the probability of a **close** win.

Figure 4 plots the result. As the figure illustrates, there is a substantial amount of heterogeneity in the importance that senators give to reelection versus policy. Some senators (Rick Santorum, John Cornyn, Thad Cochran, Pat Roberts and Jeff Sessions among them) are largely unwilling to compromise policy. Others are willing to give up very large policy concessions for a small increase in the probability of winning (e.g., Barbara Boxer, Dianne Feinstein, Johnny Isakson, David Vitter and John McCain).<sup>26</sup> Most senators are somewhere in between, and are willing to make non-negligible policy concessions for a higher probability of retaining office. The median (Senator Mike Crapo) is willing to give up 0.5% of the average distance between democrats and republicans for a 1% increase in the probability of a close win. The average value of the policy concession is closer to 6.5% but this value is heavily influenced by a few outliers at the top of the distribution. In fact, the policy concession is below 3% for 80% of senators in our sample.

Proceeding in the same way, we can compute the policy concession that each senator would

<sup>26</sup>In the graph we bound the results for these outliers at 10% for presentation purposes, some of these are considerably larger.

be willing to give for a 1% increase in the probability of a lopsided win. This is essentially the same computation as before, except that the relevant parameter ratio is now  $(\omega_i + \alpha_i)/\lambda_i$ ; i.e., the change in policy (lasting  $T^0$  periods) that would keep senator  $i$  indifferent after a small increase in the probability of a lopsided win  $\pi^+$ , keeping the probability of a close win constant is

$$dx = \left( \frac{\omega_i + \alpha_i}{\lambda_i} \right) \left( \frac{1}{2T^0(x - \theta_i)} \right) d\pi \quad (5.2)$$

Figure 5 plots the compensating policy variation for each senator for a 1% increase in the probability of a lopsided win. The results share the features of the previous figure. As before, there is significant heterogeneity in the importance that senators give to policy versus office motivations. However, the results are an order of magnitude higher in the lower parts of the distribution. In particular, the median is willing to give up 2.74% of the average distance between democrats and republicans for a 1% increase in the probability of a lopsided win. Moreover, more than 80% of senators are willing to give up more than 1% of the average policy difference across parties for a 1% increase in the probability of a lopsided win. This indicates that a large fraction of senators will be responsive to voters even in uncompetitive elections.<sup>27</sup>

All together, the results show that for a vast majority of senators in our sample office considerations are a fundamental goal. This implies that a large fraction of senators will be quite responsive to voters under some circumstances, and it is therefore incorrect to treat the voting records of these senators as sincere reflections of their policy preferences. Importantly, because the impact of voting on voter support varies depending on the state and time to election, certain votes may be more congruent with legislator policy preferences than others. This structure allows us to gain traction on the problem of estimating policy preferences in the next section.

### 5.2.1 Policy Preferences

In contrast to preferences over office and policy, there is a well established literature on the estimation of legislators' ideal policies, following Poole and Rosenthal (1985), Clinton, Jackman, and Rivers (2004) and Heckman and Snyder (1997). With few exceptions, however, papers in this literature estimate politicians' ideal policies under the assumption that politicians vote sincerely; i.e. senators have an ideal point in the policy space, and vote

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<sup>27</sup>In the estimation we set  $\bar{p} = .575$ , which defines a close election with a pointlead of less than 15 p.p. Figure A.4 in the Appendix shows that changing this threshold from 10 to 25 p.p. leads to relative adjustments between  $\alpha$  and  $\omega$ , leaving the value of career concerns,  $1 - \lambda$  practically unchanged.



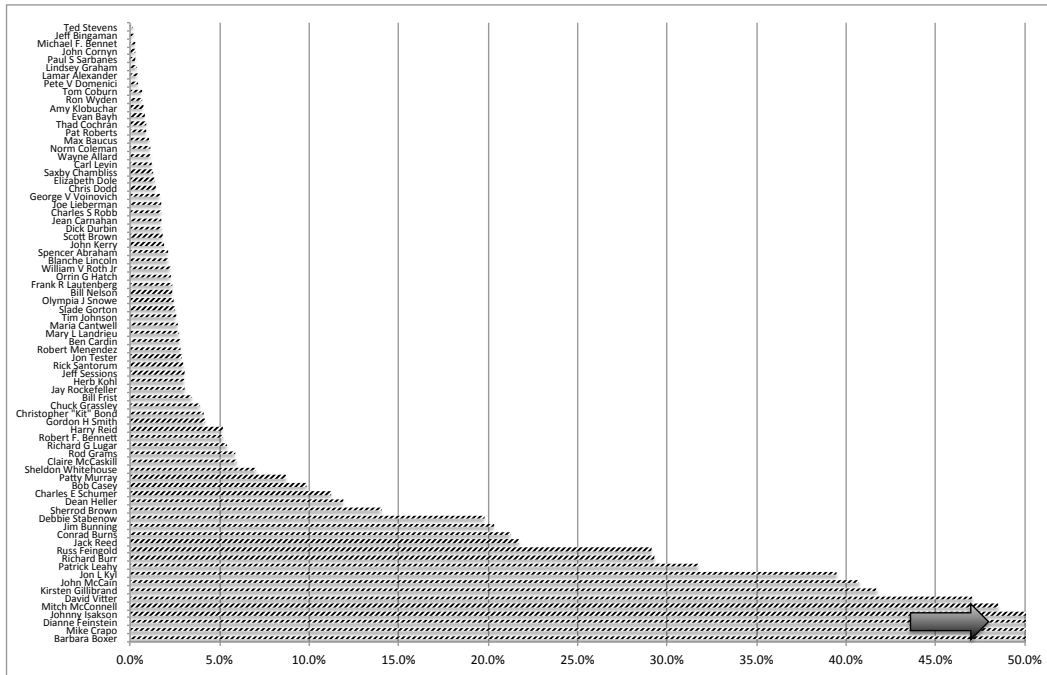


Figure 5: Proportion of the ideological difference between democrats and republicans senator  $i$  would be willing to give up for a 1% increase in the probability of a **lopsided** win.

for the alternative that is closest to it.<sup>28</sup> In our model, instead, votes are not an unfiltered expression of ideological preferences, but rather strategic choices conditioned on the circumstances faced by the politician at the time of voting. Taking this into consideration, our approach allows us to separate preferences from strategic position-taking.

Taking strategic position-taking into consideration leads to some significant differences with the sincere voting estimates. In particular, the distribution of ideal points obtained from our model is more heavily populated in the center and the extremes of the political spectrum than the distribution of ideal points in the sincere voting framework. This is illustrated in Figure 6, which compares our ideal point estimates side by side with IDEAL estimates (Clinton, Jackman, and Rivers (2004)). 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. This is the case of most moderate democrats, for whom the vote maximizing position leans to the left of senators’ ideal points (this is illustrated in Figure A.6 in the Appendix, which plots senators’ ideal policies and the poll-maximizing positions computed from our first stage

<sup>28</sup>Clinton and Meirowitz (2004) incorporate strategic voting in binary agendas, and Iaryczower, Katz, and Saiegh (2009) estimate legislators’ preferences in a model that incorporates information transmission across chambers. See also Iaryczower and Shum (2012) for the estimation of preferences with strategic voting in the court.

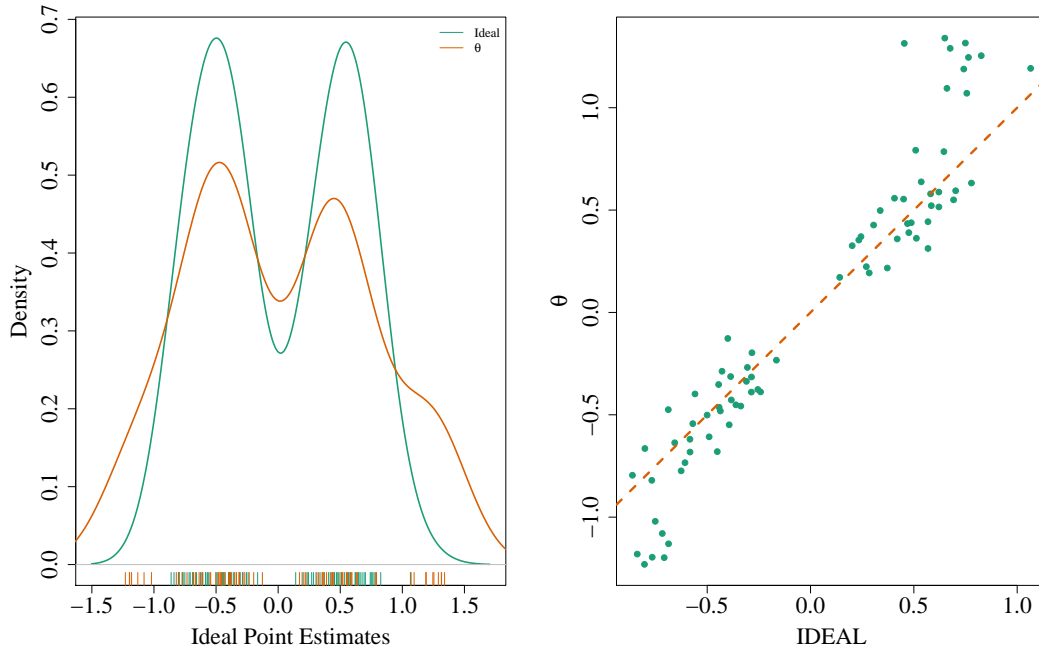


Figure 6: Ideal Point Estimates ( $\theta$ ) vs IDEAL Estimates

estimates). Among republicans, however, there is substantially more heterogeneity in the difference between politicians' and voters' preferred policies, with a relatively large number of cases facing inward and outward pressures.

All in all, however, the differences between the strategic and sincere estimates in our sample are relatively minor. Moreover, in general terms we find that the ordering of senators' ideal policies corresponds well to the previous estimates. Figure A.5 presents our ideal point estimates for each senator in the sample, with 90% bootstrap confidence intervals.

### 5.3 Advertising and Electoral Accountability

As we discussed in the previous section, most senators give electoral prospects a high value relative to policy, and are thus in principle willing to deviate from their preferred policy choices to increase voter support. The degree to which they will in fact do this, however, depends both on the electoral effectiveness of position taking vis-à-vis the cost of compromising ideology, and on how the net benefit from policy compromise compares to what can be achieved through advertising (see eq. (3.10)). Because both of these factors will tend to vary with the competitiveness of the election and with idiosyncratic characteristics of each politician, so will the strength of electoral accountability. The policy functions quantify

this relationship, yielding predicted ad and policy choices for each senator for any level of electoral support and time period given the estimated structural parameters.

As we anticipated in Section 3.1, the optimal degree of responsiveness to voters for each level of polls and time to election can vary significantly across senators depending on their individual characteristics. To illustrate this heterogeneity, in Figure 7 we plot the optimal policy stance as a function of `pointlead` and time period for three senators, with parameters fixed at their corresponding estimates.<sup>29</sup>

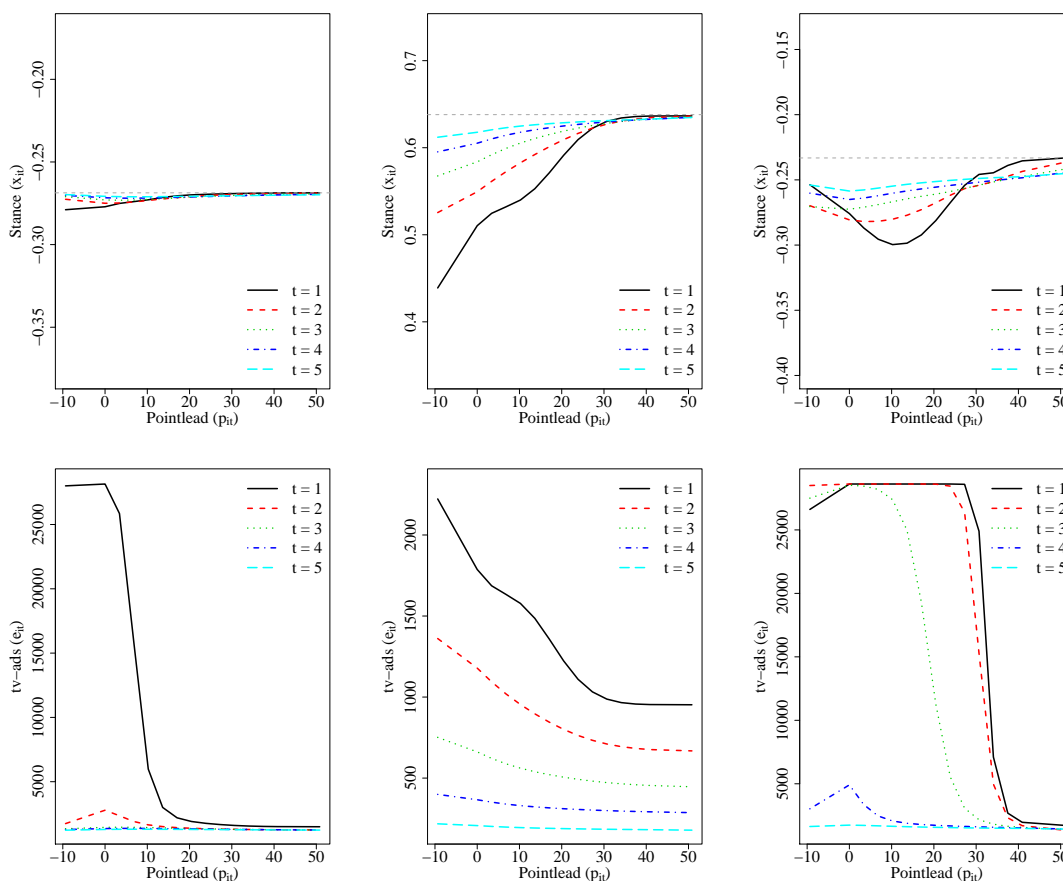


Figure 7: Predicted Position-Taking (top) and TV-ad buys (bottom) for individual senators: Michael Bennet (R-OK), Chuck Grassley (R-IA), and Claire McCaskill (D-MO).

The first chart plots the policy functions for a senator, Michael Bennet (D-CO), who according to our estimates assigns much higher weight to ideology than reelection ( $\lambda = 0.78$ ;

<sup>29</sup>Recall that the politician responds to shocks that are unobservable for the econometrician, which gives a distribution over optimal choices. In these plots we present the mean optimal `stance` consistent with the distribution of  $\mu$  shocks.

in the top decile of the empirical distribution). Because Bennet is a moderate liberal in a solidly liberal state, he faces an electoral pull towards a more liberal position than his ideal policy. However, given the relatively large weight of ideology vs reelection concerns, the model predicts Bennet would not significantly adjust his position towards voters even when elections are close, with the brunt of reelection effort falling on TV ads.

As the value of office increases, senators become more responsive to the electorate. The middle chart plots the estimated policy functions for senator Chuck Grassley (R-IA), with estimated parameters  $\omega = 0.58$  and  $\alpha = 0.21$ . As the figure illustrates, Grassley’s median predicted policy position is close to his ideal point when he enjoys a large advantage in the polls, but adjusts towards the voter and away from his preferred policy as the election gets tighter, consistent with the marginality hypothesis.<sup>30</sup> Senators who give a higher value to lopsided wins are also responsive to voters even in safe districts. In fact, this can induce a U-shaped responsiveness curve if the ratio  $\alpha/\omega$  is high. This is the case of senator Claire McCaskill (D-MO). As Grassley, McCaskill is estimated to give a large value to office vis-à-vis policy ( $1 - \lambda = 0.85$ ), but contrary to Grassley, McCaskill is estimated to give a large value to winning by a large margin ( $\omega = 0.11, \alpha = 0.74$ ). The policy functions of a senator of this type are not consistent with the marginality hypothesis. 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.

To summarize aggregate patterns of electoral accountability we first make responsiveness in policy choices comparable across senators. To do this we construct an *electoral accountability index*,  $EAI_{it}$ , defined by the relative weight of voters’ preferences in  $i$ ’s optimal policy stance at time  $t$ ,

$$EAI_{it} \equiv \frac{x^*(p, t, \rho_i) - \theta_i}{(\xi_i - \theta_i)} \times 100, \quad (5.3)$$

where  $\xi_i$  denotes the policy stance that maximizes  $i$ ’s electoral support. We then regress the electoral accountability index on politicians’ parameters and state variables, where each observation is a point in the policy function of each politician.

The results are presented in Table 2. In Column 1 we present the simplest specification, linear in state variables  $p, t$  and parameters  $\omega, \alpha, \gamma$ , and with no interactions. The negative coefficient of time to election,  $t$ , indicates that electoral accountability increases on average as the election gets closer, as in Thomas (1985). The negative coefficient of  $p$  indicates that the strength of electoral accountability increases on average in close elections, as predicted by the marginality hypothesis. The effect, however, is relatively modest on average: a 10

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<sup>30</sup>Moreover, the degree of adjustment towards the voter is both higher in magnitude and relatively more responsive to polls as the election approaches.

point increase in the poll advantage (a 5 point swing) reduces the electoral accountability index by about 2.6 points on average.

The coefficients of  $\omega$  and  $\alpha$  quantify the average effect of the career concern parameters on electoral accountability. A one standard deviation increase in  $\omega$  (0.34) increases electoral accountability by about 15 points on average, while a one standard deviation increase in  $\alpha$  (also 0.34) increases the EAI by 18.3 points.

Table 2: Predicted Electoral Accountability

	<i>Dependent variable: Electoral Accountability Index</i>			
	(1)	(2)	(3)	(4)
$p_{i,t}$	-0.262***	0.335***		
Close Election			9.776***	-12.565***
Solid Win			4.011***	-5.091***
$\omega$	44.368***	59.673***	44.387***	30.587**
$\alpha$	53.740***	71.925***	53.778***	33.408***
$\gamma$	-0.103	-0.115	-0.102	-0.116
Time	-2.221***	-2.195***	-2.222***	-2.193***
$p_{i,t} \times \omega$		-0.782***		
$p_{i,t} \times \alpha$		-0.939***		
Close Election $\times \omega$				27.373***
Close Election $\times \alpha$				36.524***
Solid Win $\times \omega$				8.247***
Solid Win $\times \alpha$				17.537***
Constant	-5.059	-16.866**	-15.425*	-3.637
Observations	6,647	6,647	6,647	6,647
Adjusted R <sup>2</sup>	0.284	0.301	0.283	0.302

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

Robust standard errors clustered at the senator-congress level.

In column 2 we reproduce the first regression including the interactions of  $p_{it}$  with career concerns  $\omega$  and  $\alpha$ . The results show that the heightened effect of electoral accountability in close elections increases with career concerns. In column 3 we switch from the linear specification on  $p$  to two categorical variables: close elections ( $\text{pointlead} \leq 15$ ), and solid wins ( $\text{pointlead} \in (15, 30)$ ), with landslide wins ( $\text{pointlead} \geq 30$ ) as the omitted category. Figure 8 plots the differential effects. In red we show the level of responsiveness for a senator with career concerns set at the sample mean (i.e.,  $1 - \lambda_i = 0.7$ ). Relative to its level in landslide elections, the electoral accountability index increases by more than 40% on average in solid wins, and almost doubles in close elections, from 10.8 to 20.8. In column 4 we include

the interaction of the categorical variables with the career concern parameters  $\omega$  and  $\alpha$ . The results show that the strength of electoral accountability increases significantly with career concerns, particularly in close elections. Figure 8 plots the estimates of the differential effects for a senator with a level of career concerns one standard deviation (i.e., 30%) higher than the average. Relative to landslide elections, the electoral accountability index increases from 17.1 to 23.8 on average in solid wins, similar to the benchmark case of average levels of career concerns. In close elections, however, electoral accountability increases 23.6 points on average for highly office-motivated senators.

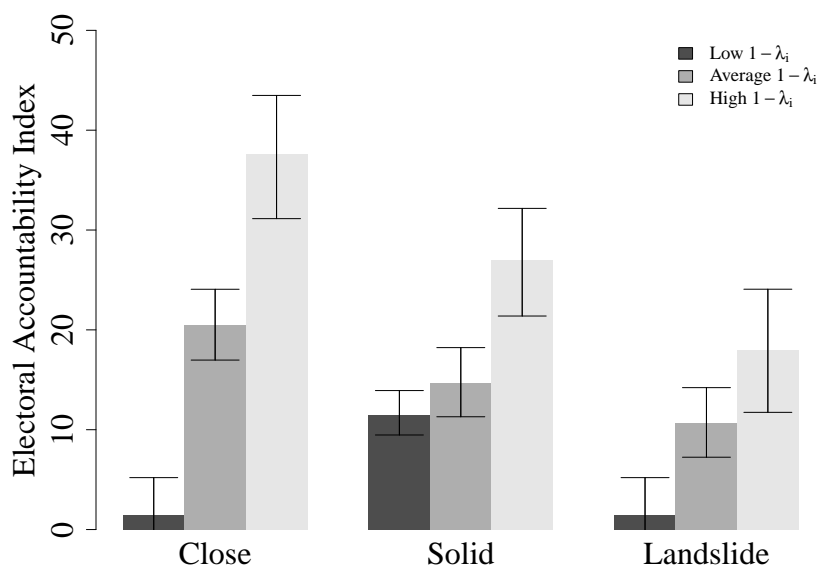


Figure 8: Electoral Accountability in Close, Solid and Landslide Elections.

All together, the results strongly support the marginality hypothesis in the aggregate: 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.

A natural question is how do the patterns of electoral accountability correlate with senators' observable characteristics. Figure 9 plots conditional averages of the electoral accountability index across senators in our sample (as a function of their advantage in the polls) for senators' party, gender, ideology, and state income.<sup>31</sup> The figure illustrates some interesting

<sup>31</sup> In all cases, we compute average responsiveness for the last 6 months before the election. The results are qualitatively the same, but smaller (larger) in magnitude if we focus instead on the 12 (3) months before

patterns. First, while democrats and republicans are equally responsive to voters in close elections, democrats tend to be more responsive to voters than republicans in safe elections. Second, female senators tend to be more responsive than male senators when elections are close, but the opposite pattern holds when the incumbent has a large advantage in the polls. Third, senators in low income states tend to be substantially more responsive to voters than senators in richer states.

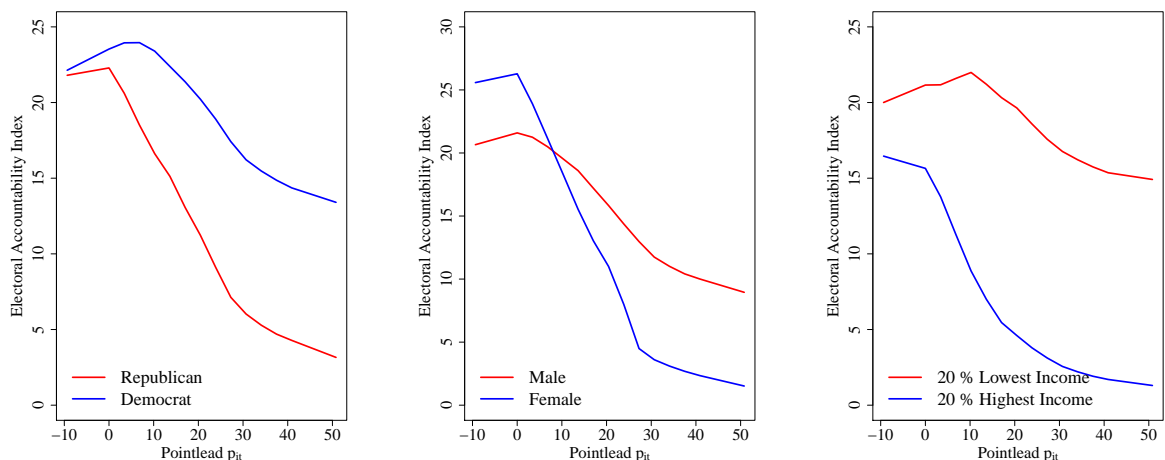


Figure 9: Electoral Accountability by Party, Gender and State Income (last six months before the election).

### 5.3.1 Advertising in Close and Lopsided Elections

In the spirit of Table 2 for electoral accountability, Table 3 summarizes the aggregate response of TV ads by regressing predicted TV-ad buys on parameters and state variables, where each observation is a point in the policy function of a senator in our sample.

In column (1) we regress TV-ad buys on polls, time to election, and deep parameters. The negative sign of  $p_{it}$  indicates that TV-ad buys increase as the election becomes more competitive. In particular, increasing the poll advantage by 10 points implies a decrease in TV-ad buys of around 580 GRPs per month, the equivalent of 58 more ads in 10% rating shows. At the median state prices, this is around \$70,000, but goes from \$11,000 in Montana to more than \$560,600 in New Jersey or New York at 2002 prices. Advertising increases for politicians with higher career concerns, with one standard deviation increase in  $\omega$  increasing TV-ad buys in 940 GRPs (almost double the effect of lowering  $p$  by 10 points)

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the election.

Table 3: Predicted TV Ad Buys

	<i>Dependent variable: tv-ads</i>			
	(1)	(2)	(3)	(4)
$p_{i,t}$	-58.0***	-7.7		
Close Election			2,346.6***	-100.1
Solid Win			1,374.6***	-86.6
$\omega$	2,780.2*	3,974.9*	2,769.2*	1,367.4
$\alpha$	4,225.1***	5,825.3***	4,216.9***	1,039.5**
$\gamma$	-222.5**	-223.8**	-223.0**	-136.2**
Time to Election	-1,187.5***	-1,185.5***	-1,186.6***	-430.1***
$p_{i,t} \times \omega$		-60.9		
$p_{i,t} \times \alpha$		-82.8**		
Close Election $\times \omega$				1,301.4
Close Election $\times \alpha$				2,458.9***
Solid Win $\times \omega$				257.6
Solid Win $\times \alpha$				1,873.9***
Constant	6,242.3***	5,250.9***	3,750.9***	3,352.0***
Observations	6,647	6,647	6,647	12,895
Adjusted R <sup>2</sup>	0.181	0.182	0.183	0.152

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

Robust standard errors clustered at the senator-congress level.



and one standard deviation increase in  $\alpha$  increasing TV-ad buys in 1400 GRPs (more than two times the effect of lowering  $p$  by 10 points).

In column (2) we interact  $p$  with career concerns. This shows that it is predominantly senators who care about winning in lopsided wins who increase TV-ad buys as the lead in the polls tightens. In column (3) we use categorical variables for electoral support, distinguishing between landslide elections (our baseline category), close elections and solid wins. Relative to landslide elections, the incumbent increases TV-ad buys on average by 1,375 GRPs in solid wins and 2,347 GRPs in close elections. Column (4) echoes the result in column (2), and shows that it is those senators with large  $\alpha$  who increase TV-ad buys as the election tightens. In particular, a standard deviation change in  $\alpha$  leads to an average increase of TV-ad buys of 984 GRPs in solid wins and 1182 GRPs in close elections.

Across all specifications, increasing the cost of TV ads lowers predicted advertising significantly: a one standard deviation increase in  $\gamma$  (4.8) reduces TV-ad buys between 650 and 1000 GRPs. Moreover, as the left panel of Figure 10 shows, the estimates of  $\gamma$  vary widely across senators in the sample. As a result, variation in costs explains a significant amount of variation in TV-ad buys across senators.

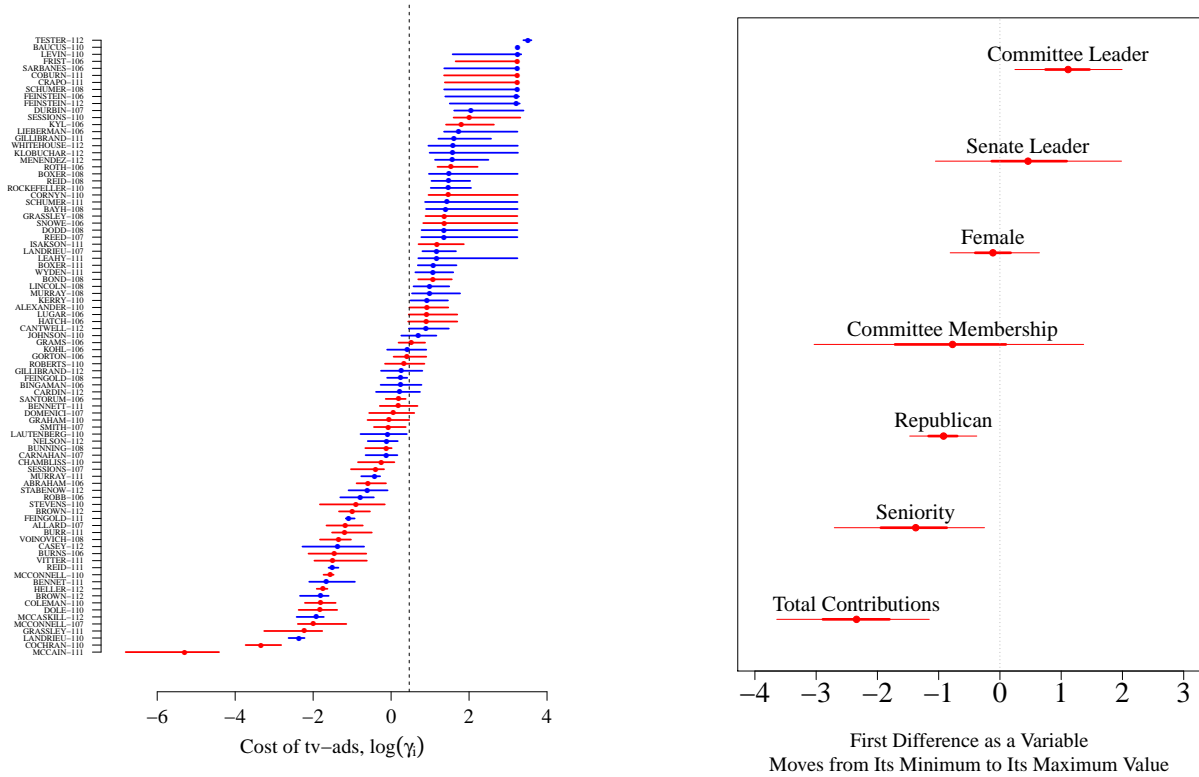


Figure 10: Cost of Spending ( $\gamma$ ).

Because our estimate of  $\gamma$  is allowed to vary freely for each senator, our cost estimates potentially capture all senator/race specific factors. To examine how this correlates with observable characteristics, we regress our estimates of  $\gamma$  on available covariates. The results are presented in the right panel of Figure 10. We find that the most significant factor explaining variation in the cost of spending across senators is the amount of money raised by the senator during the campaign. We also find that even after having controlled for total contributions, republican senators have a cost advantage on average, as do senators with more **seniority**. On the other hand, leadership positions either have no effect (senate leadership) or are associated with larger costs (committee leadership).

#### 5.4 Advertising and the Crowding-Out of Electoral Accountability

As our results show, in spite of being able to rely on advertising, senators significantly adjust their policy positions to gain voter support. Obtaining a more precise measure of the crowding-out of electoral accountability requires that we know what policy choices senators would have made in the absence of advertising. In this section we undertake this policy experiment, shutting down tv-ads spending in the empirical model.

To compute the counterfactual, we solve the constrained problem of each incumbent senator in our sample in which advertising is constrained to be zero, taking as given the estimated transition distributions and the structural parameter estimates.

The results are shown in Table 4. We present the effects in the form of percentage changes in the electoral accountability index (eq. (5.3)), relative to the baseline results.

Table 4: Counterfactual: Electoral Accountability without TV Advertisement

	Close Elections	Solid Elections	Landslide Elections
<b>Baseline EAI</b>	<b>20.72</b>	<b>14.82</b>	<b>10.00</b>
$\Delta\%$ in EAI			
Low Career Concerns	5.21	9.41	10.40
Avg. Career Concerns	9.90	11.26	10.43
High Career Concerns	19.84	14.90	10.39

The effect of banning advertising differs significantly depending on the state of the race and the senator’s value of office relative to policy. To capture these differences we distinguish between close (i.e.,  $\text{pointlead} \leq 15$ ), solid (i.e.,  $15 \geq \text{pointlead} < 30$ ) and landslide (i.e.,  $\text{pointlead} \geq 30$ ) elections, and cluster senators according to their value of career concerns, into low (i.e.,  $1 - \lambda = 0.4$ ), average (i.e.,  $1 - \lambda = 0.6$ ) and high values (i.e.,  $1 - \lambda = 0.9$ ). As the table shows, the level of career concerns matters more in close elections, where the

change in electoral accountability goes from a change of 5 to 20 % for low and high career concerns, and is inconsequential in landslide elections, where barring advertising increases electoral accountability by roughly 10% for low, average and high career concerns.

The key takeaway from these results is that advertising changes but does not fundamentally hamper electoral accountability. Even banning advertising would only lead to relatively modest changes in electoral accountability on average.

## 5.5 Goodness of Fit

In this subsection we assess the overall fit of our model. We present the results of this exercise in Figure 11. The left panel of this Figure presents a summary of the model fit by comparing senators' expected policy stances under their predicted conditional choice probabilities with their observed policy positions. On average, the model predictions follow the observed policy stance of incumbent senators remarkably well, with a  $R^2$  of the linear fitting procedure of 0.94. This overall fit does not take into account the uncertainty in senators' choices, as it is an average over the conditional choice probabilities. In this respect we find that 91.5% of all observed policy stances fall between the 10th and the 90th percentile of the model predicted choices. Note as well that the best model fit comes from predicting moderate stance positions compared to extreme ones. In fact, the model systematically underestimates the policy positions of 10 senators at both extremes of the political spectrum.

The right panel of Figure 11 shows the overall model fit with respect to the observed level of tv-ads, which are discretized in the empirical model into low (0 to 2556 GRP's), medium (2557 to 28,616 GRP's), and high spending levels (larger than 28,616 GRP's). The pattern of tv-ads spending is well predicted by the model. In the data 70% of monthly levels of advertisement is either zero or very low compared to 78% in our model. Incumbent senators spend a moderate amount of spending 24% of the time against 17% in our model. Finally, incumbent senators invest in high levels of tv ads only in 5% of all monthly observations in both the data and in our model. Moreover, when we incorporate the uncertainty coming from the conditional choice probabilities, all of the observed advertisement decisions fall within the 10th and 90th percentiles of the choice distribution.

## 6 Strategic Challenger

In the baseline model we focused on the optimal dynamic behavior of the incumbent, conditioning on the challenger's spending that we observe in the data. This simplifies the

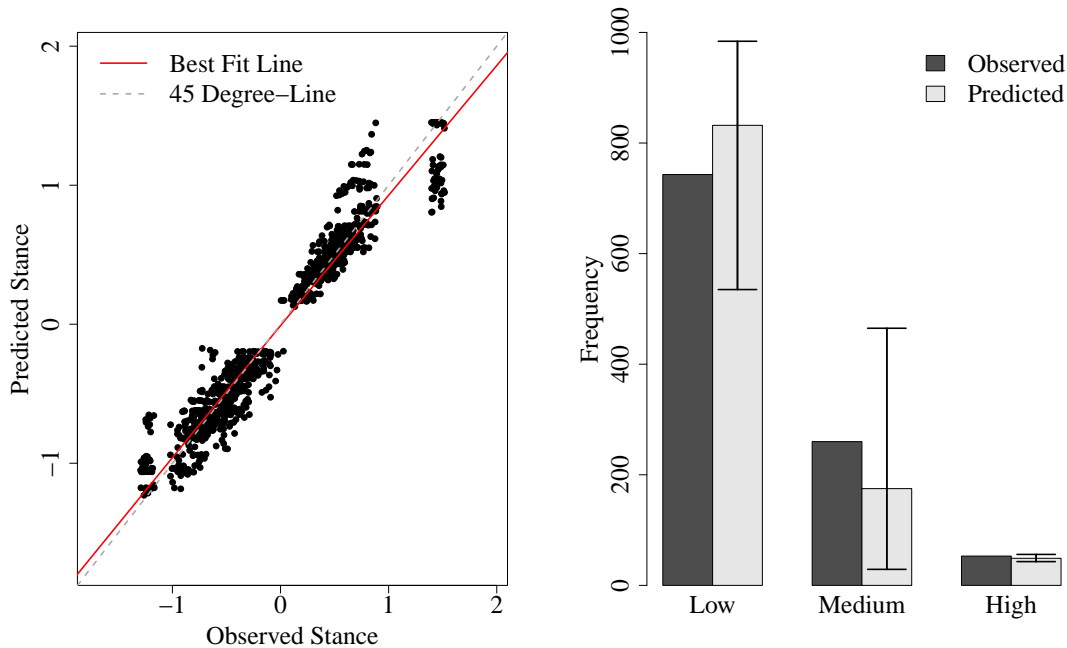


Figure 11: Goodness of Fit for policy stance (left) and tv-ad buys (right).

presentation of the problem and allows us to focus on the core issue of electoral accountability. In reality, of course, the challenger is also a fully strategic player, and a complete analysis of the problem requires modeling the interactions of incumbent and challenger as a dynamic game. In this section we extend our benchmark model to capture the dynamic game, and show that our main results on the incumbent's structural parameters remain qualitatively unchanged when we consider equilibrium outcomes of the dynamic game.

Besides the inclusion of the challenger, the game remains unchanged. We assume that the challenger can only choose TV ad buys  $e_t^c$ , and only cares about winning office; i.e., obtains an office payoff of 1 if  $p_{T+1} < 1/2$  and zero otherwise. Ad spending has an opportunity cost  $\gamma^c(e_t^c)^2$  for the challenger. 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. At the beginning of each period  $t$  both politicians observe  $p_t$ , which evolves according to eq. 3.1. The challenger observes the shocks  $\mu^c$  (which are i.i.d. with extreme value type 1 distribution and unobserved by the econometrician), and chooses a level of TV ad buys  $e_t^c \in \mathcal{E}^c$  for a finite set  $\mathcal{E}^c$ . The incumbent then observes  $e_t^c$  and shocks  $\mu$  and as before chooses  $(x_t, e_t)$ .

Our solution concept is SPE. This is a pair of policy functions  $y^*(\cdot)$  for the incumbent and  $e_c^*(\cdot)$  for the challenger such that (i)  $y^*(\cdot)$  maximizes (3.2) given  $e_c^*(\cdot)$  and (ii)  $e_c^*(\cdot)$  is

optimal for the challenger given  $y^*(\cdot)$ ; i.e.,  $e_c^*(\cdot)$  is  $\tilde{e}_c(\cdot)$  that for any time  $t$  and state  $(p_t, \mu_t^c)$  maximizes

$$V_t^c = E \left[ \sum_{r=t}^T \mu^c(\tilde{e}_r^c(\cdot)) - \gamma^c(\tilde{e}_r^c(\cdot))^2 \right] + \mathcal{U}^c((p_t, \mu_t^c); y^*, \tilde{e}^c) \quad (6.1)$$

We solve the period  $t$  game by backwards induction, starting with the optimal second-stage choice of the incumbent for each level  $e_t^c$ . Analogous to baseline model, the incumbent's optimal choice is given by her conditional choice probability, as in equation (4.4), which now depends on the challenger's choices. In the first stage, the challenger's optimal choice is also a conditional choice probability given by

$$\Pr(e_{i,t}^c = e^{c'} | p_{i,t}; \rho_i, \gamma_i^c) = \frac{\exp \left[ h^c(p_{i,t}, e^{c'}; \rho_i, \gamma_i^c) \right]}{\sum_{e^c \in \mathcal{E}} \exp \left[ h^c(p_{i,t}, e^c; \rho_i, \gamma_i^c) \right]}.$$

Here

$$h^c(p_{i,t}, e_{i,t}^c; \rho_i, \gamma_i^c) = E \left[ \overline{W}_{i,t+1}^c(p_{i,t+1}) - C(e_{i,t}^c) \mid p_{i,t}, e_{i,t}^c \right]. \quad (6.2)$$

where the expectation in equation (6.2) is taken with respect to future values of polls and also with respect to realizations of the incumbent's shock  $\mu_{it}$  that are unknown to the challenger when choosing her spending level.

The structural parameters of the dynamic game include the vector of incumbent parameters  $\rho$  from the baseline model, as well as the challengers' opportunity cost of spending,  $\gamma^c \equiv \{\gamma_i^c\}_{i=1}^N$ . As in the benchmark model, we estimate the structural parameters by first solving for subgame perfect equilibrium strategies for every trial value of the parameters, and then search for the values that maximize the data likelihood.

Figure 12 shows the distribution of incumbents' estimated structural parameters for the dynamic game and the baseline model. As the figures show, the parameter estimates in the dynamic game are remarkably similar to those obtained in the baseline model.

In addition to the incumbent's parameters, the dynamic game allows us to provide estimates of the challenger's cost of spending ( $\gamma^c$ ), which are depicted in Figure B.1 in the Appendix. In contrast to incumbents, the distribution of challengers' spending costs is bimodal, with a small cluster of challengers facing similar tv-ads costs as the incumbent in their states, but with most of them facing significantly higher costs than incumbents. These differences in spending costs between incumbent and challengers is reflected in the pattern of TV-ads in the data, where incumbents outspend challengers almost four to one.

In the spirit of Tables 2 and 3, Table 5 summarizes equilibrium choices in each state – which differ for every incumbent-challenger pair – by regressing equilibrium actions on

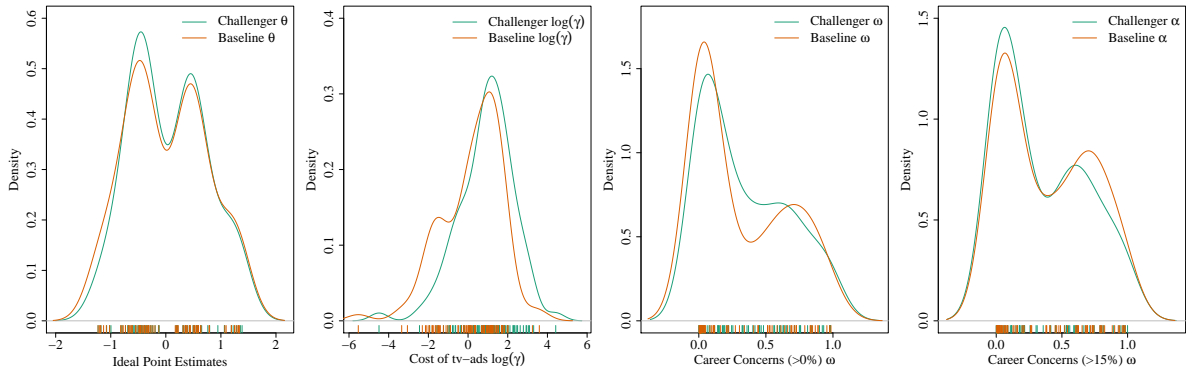


Figure 12: Parameter estimates in the Dynamic Game

state variables and parameters. The first two columns show the results for the electoral accountability index and the last two columns for optimal TV-ads buys. These specifications are comparable to columns (3) and (4) of Tables 2 and 3.

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. The new element in the dynamic game is a heightened level of TV ad buys by the incumbent in close elections in response to the higher effort of the challenger in equilibrium (compare the increase of 2805 GRPs in close elections in the dynamic game with the corresponding 2347 GRP increase in the benchmark model).

Table 5: Equilibrium accountability and tv-ad buys as a function of state and parameters (w.Strategic Challenger)

	<i>Dependent variable:</i>			
	(1)	(2)	(3)	(4)
Close Election	6.5***	-8.5***	2,805.0***	1,150.1
Solid Win	4.1***	-5.7***	1,475.0***	506.9
$\omega$	49.3***	40.0***	1,119.4	205.9
$\alpha$	56.1***	38.7***	3,296.1**	1,366.2
$\gamma$	-0.1	-0.1	-73.7	-73.8
$\gamma^c$	0.02	0.02	-25.1***	-25.2***
Time to Election	-1.7***	-1.7***	-1,406.0***	-1,403.1***
Close Election $\times \omega$		15.7***		2,057.9
Close Election $\times \alpha$		28.4***		2,843.8*
Solid Win $\times \omega$		10.2***		170.0
Solid Win $\times \alpha$		19.0***		2,608.1**
Constant	-18.6**	-9.6	7,583.6***	8,538.8***
Observations	6,647	6,647	6,647	6,647
Adjusted R <sup>2</sup>	0.3	0.3	0.3	0.3

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

Robust standard errors clustered at the senator-congress level.

## 7 Conclusion

While elections have the potential to keep politicians in check, the power of electoral accountability varies with characteristics of the politicians, and the state of the electoral race. Politicians' incentives to vote with their constituency can vary based on the proximity of the election, with how close the election is perceived to be, with the value that politicians give to office relative to policy, and with the relative cost and effectiveness of advertising and position-taking. In this paper, we examine empirically under what conditions legislators will be responsive to constituency interests, and quantify the strength of electoral accountability under these varied conditions.

To do this, we use data on US senators who ran for office between 2000-2012 to structurally estimate a dynamic model of the problem of an incumbent politician running for reelection. Modeling explicitly the problem of the politician allow us to take into consideration the dynamic aspects of the problem naturally through the farsighted calculations by the politicians, it allows us to incorporate the preferences of the politician in the analysis, and

it allows us to rationalize policy and advertising choices in relation to the relative cost and effectiveness of advertising and position-taking.

We show that most senators are willing to make non-negligible policy concessions for a higher probability of retaining office: the median senator is willing to give up 0.5% of the average policy distance between parties for a 1% increase in the probability of reelection, and 2.7% of this distance for a 1% increase in the probability of a lopsided win.

The previous results show that a vast majority of senators in our sample are in principle willing to deviate from their preferred policy choices to increase voter support, even in uncompetitive elections. The degree to which they will in fact do this, however, depends both on the electoral effectiveness of position taking vis-a-vis the cost of compromising ideology, and on how the net benefit from policy compromise compares to what can be achieved through advertising. We show that in spite of being able to rely on advertising, senators adjust their policy positions strategically to gain voter support. In particular, while individual senators *can* be equally or even more responsive when elections are not close, on average electoral accountability is higher in competitive elections than in lopsided elections. The effect is relatively modest for the average senator – a 5 point swing in the polls reduces the electoral accountability index by about 2.6 points on average – but increases for senators with higher career concerns.

To evaluate the extent to which advertising crowds-out electoral accountability, we consider a policy experiment in which we ban political advertising. We show that if advertisement were set to zero, a typical office-motivated senator in our sample would have increased electoral accountability 20%, while this would have a negligible impact on policy-motivated senators. We conclude that although advertising does seem to partially crowd-out policy accountability, this effect is moderate and far from being capable of breaking the electoral connection between politicians and voters.



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## A Additional Figures and Tables

Table A.1: Descriptive Statistics: Main Variables

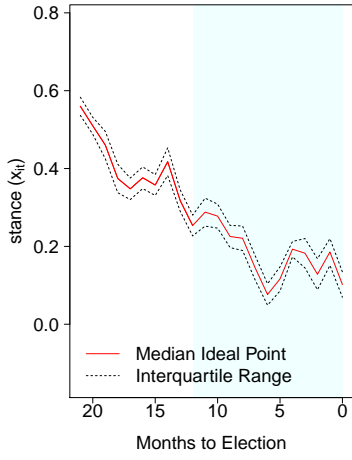
Variable	Obs	Min	Mean	Median	Max	S.D	IQR
pointlead (p.p.)	1056	-17	18.741	19	59	13.471	17.964
contributions (Millions of U.S \$)	1056	-0.123	0.542	0.231	16.149	1.224	0.355
tv_ads* (GPR Points)	279	0.443	7373	3754	71607	10142	8307
tv_ads_challenger* (GPR Points)	129	2.267	6762	2545	66934	10625	6946
tv_ads_others* (GPR Points)	313	0.443	9359	4029	110086	15248	9636
tv_ads_total* (GPR Points)	283	0.213	9178	2786	125515	16450	9909
stance	1056	-1.472	-0.047	-0.226	2.019	0.641	1.092
seniority (Years)	1044	1	11.471	9	39	8.973	12
income (U.S. Dollars)	1056	29696	41812	41828	55146	6085	8287
unemp (% of State Pop.)	1056	2.350	6.318	5.733	13.625	2.457	3.392
pop64 (% of State Pop.)	1056	8.200	16.640	16.650	22.800	2.067	2.150
educ_9th (% of State Pop.)	1056	3.200	6.822	6.400	11.700	2.243	3.100
black (% of State Pop.)	1056	0.300	10.500	7.300	36.300	9.128	11.825
presrep_margin (vote share)	1056	-0.263	-0.002	-0.032	0.405	0.161	0.250

Note: \* Summary statistics for observations with positive spending

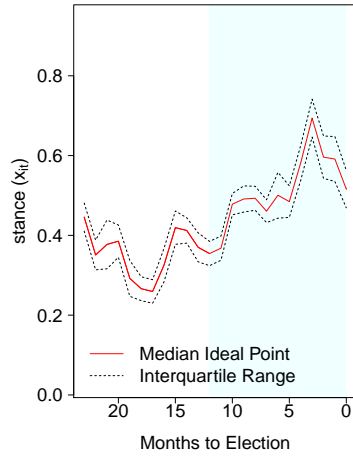
Table A.2: Summary Statistics: Incumbents' Characteristics

Variable	Levels	n	%	$\sum$ %
Party	Democrat	564	53.4	53.4
	Republican	492	46.6	100.0
Membership (# of Committees)	0	648	61.4	61.4
	1	372	35.2	96.6
	2	24	2.3	98.9
	3	0	0.0	98.9
	4	12	1.1	100.0
Committee Leader	No	864	81.8	81.8
	Yes	192	18.2	100.0
Senate Leader	No	1020	96.6	96.6
	Yes	36	3.4	100.0
Gender	Male	852	81.6	81.6
	Female	192	18.4	100.0

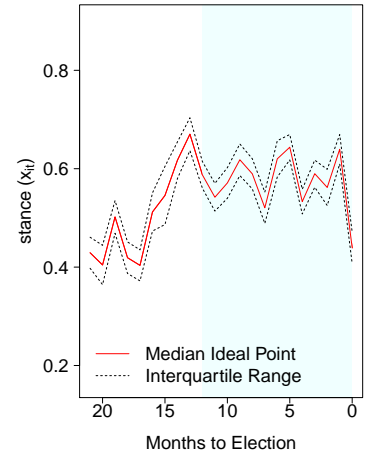
*Republicans*



Scott Brown (R-MA)

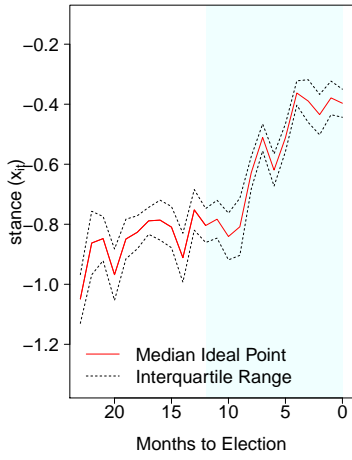


Thad Cochran (R-MS)

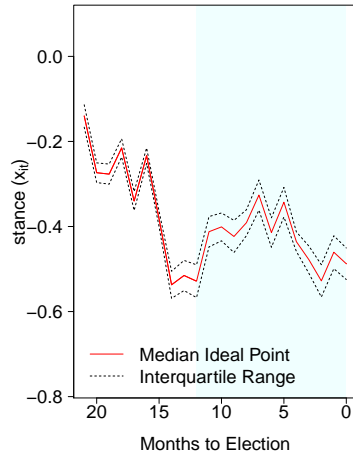


Lindsey Graham (R-SC)

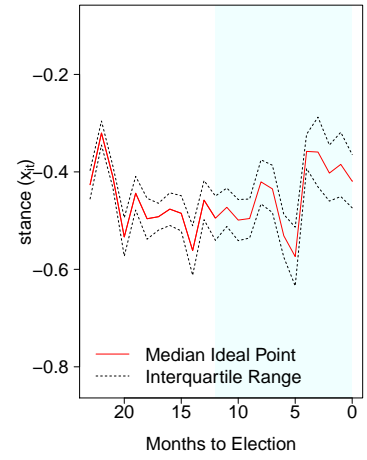
*Democrats*



Debbie Stabenow (D-MI)



Chuck Robb (D-VA)



Bill Nelson (D-FL)

*Moderating*

*To Extreme*

*No Trend*

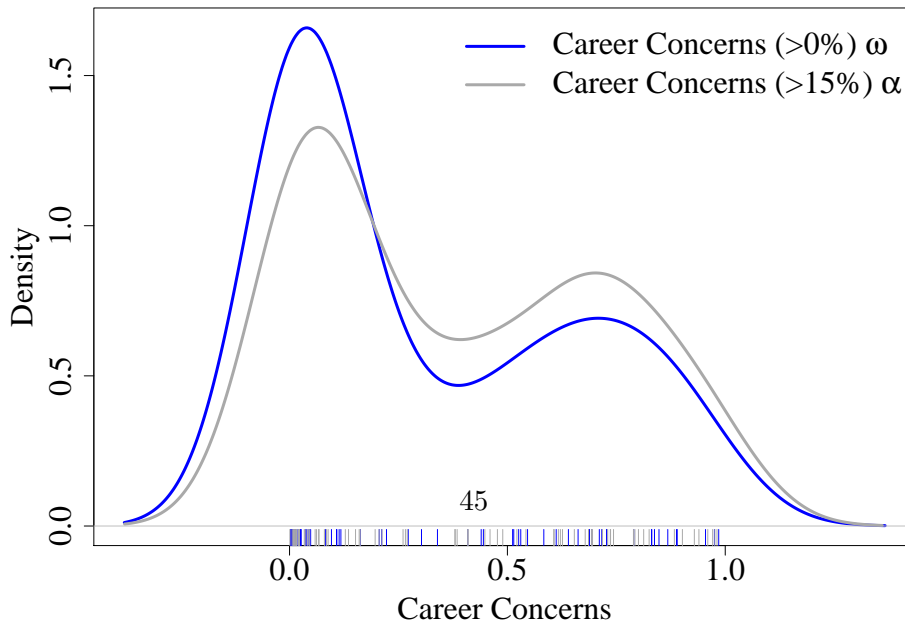
Figure A.1: Policy Positions for Selected Incumbent Senators

Table A.3: Decreasing Returns on tv-ads First Stage Results

	<i>Dependent variable:</i>			
	OLS	OLS	OLS	IV
	(1)	(2)	(3)	(4)
$p_{i,t}$	0.760*** (0.029)	0.734*** (0.029)	0.734*** (0.029)	0.734*** (0.029)
$x_{i,t}$	-7.205*** (2.759)	-5.621* (2.891)	-5.757** (2.889)	-5.757** (2.903)
$x_{i,t}^2$	-2.579 (1.727)	-1.960 (1.821)	-2.044 (1.811)	-2.044 (1.820)
$x_{i,t} \times \text{republican}$	6.482 (5.363)	2.755 (5.613)	3.162 (5.547)	3.162 (5.575)
$x_{i,t} \times \text{presrep. margin}$	17.584*** (4.923)	21.064*** (5.027)	20.600*** (5.081)	20.600*** (5.106)
$\sqrt{e_{i,t}}$	0.026*** (0.007)	0.026*** (0.007)	0.021** (0.010)	0.021** (0.010)
$\sqrt{e_{i,t}^{chall}}$	-0.043*** (0.008)	-0.043*** (0.008)	-0.042*** (0.008)	-0.042*** (0.008)
First-stage F-statistic ( $e_{it}$ )				19.178***
First-stage F-statistic (tv-ads(challenger))				9.809***
<b>Congress FE</b>	No	Yes	Yes	Yes
<b>Time FE</b>	No	Yes	Yes	Yes
Observations	1,056	1,056	1,056	1,056
Adjusted R <sup>2</sup>	0.757	0.756	0.749	0.769

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

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



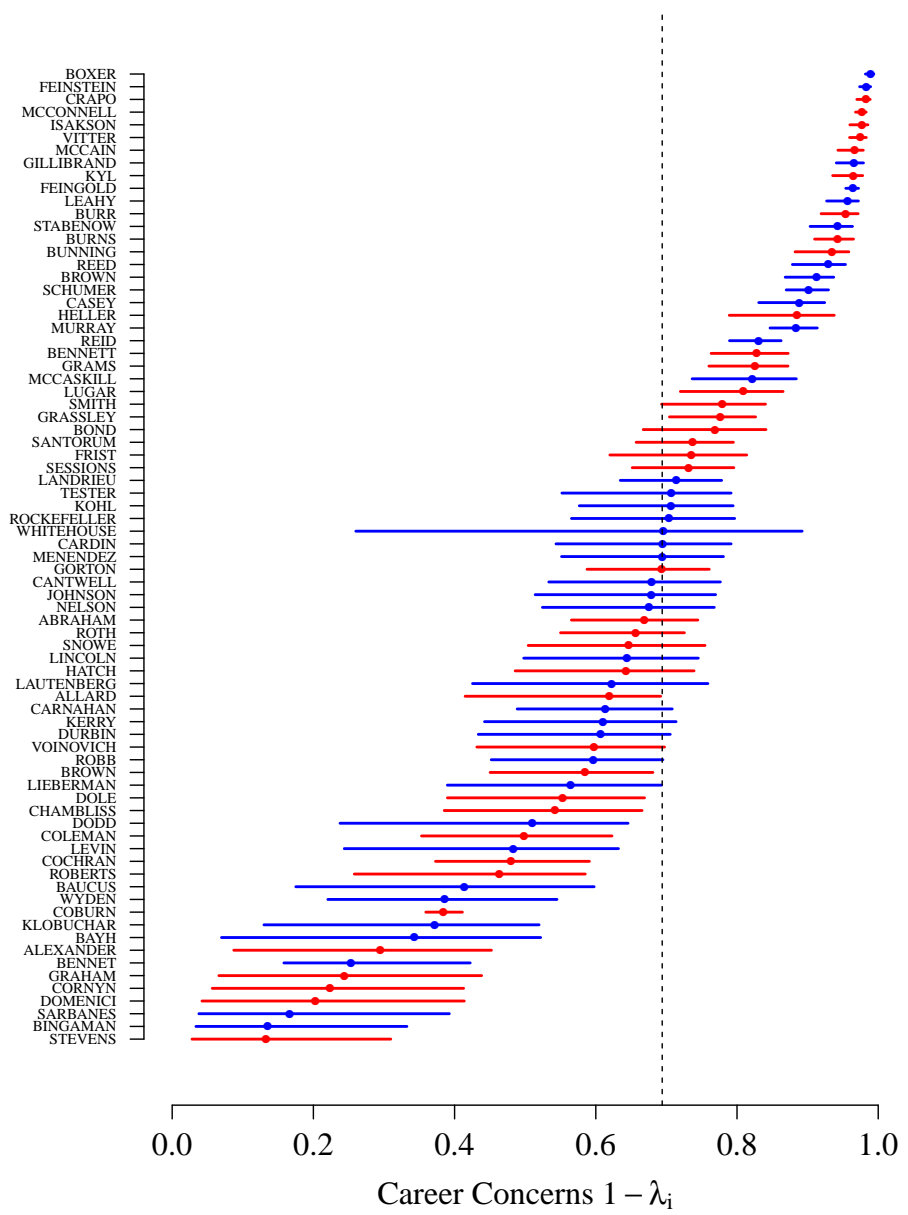
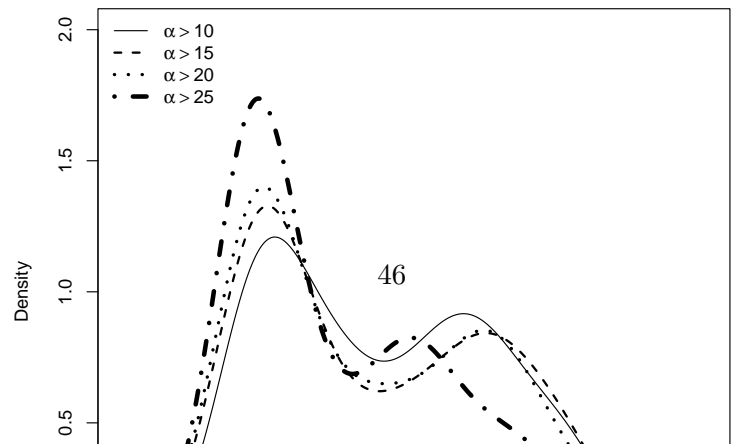


Figure A.2: Career Concerns (Solid lines plot 90% bootstrap confidence intervals)



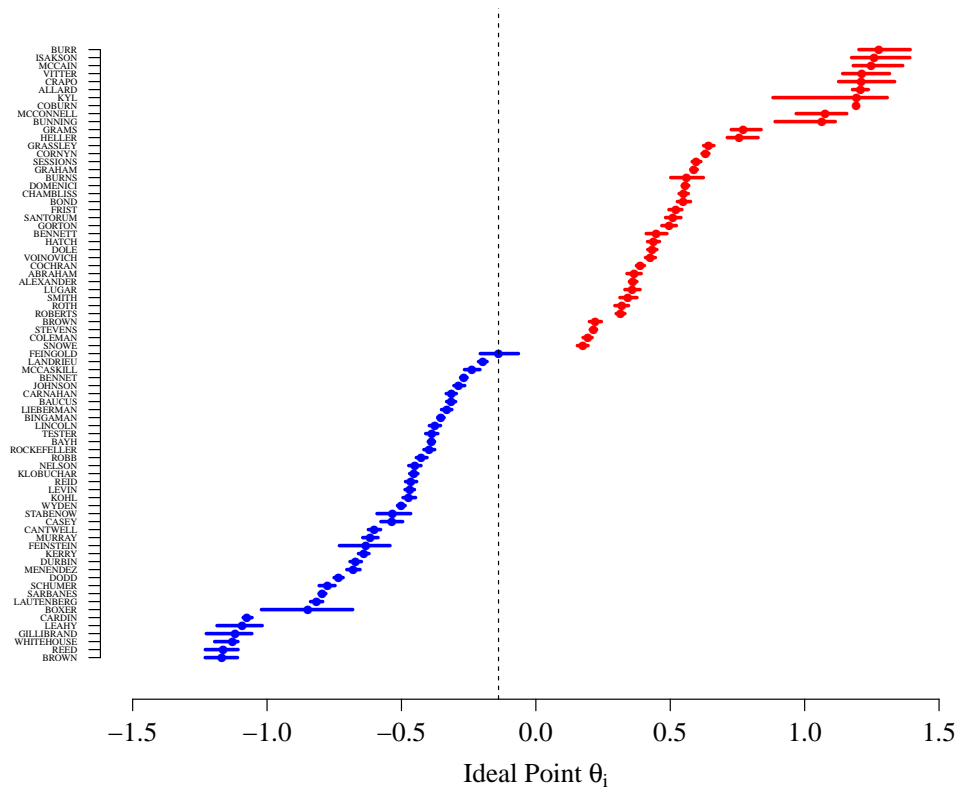


Figure A.5: Ideal Point Estimates (Solid lines plot 90% bootstrap confidence intervals)



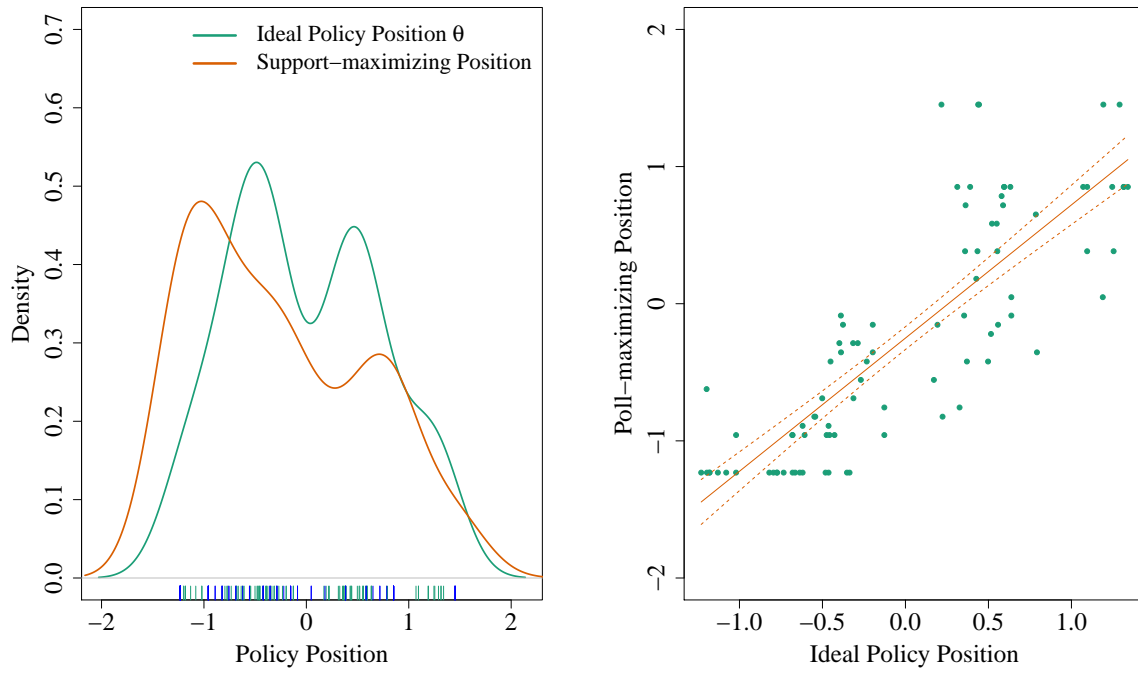


Figure A.6: Ideal Policy and Poll-maximizing Position

## B Strategic Challenger: Appendix

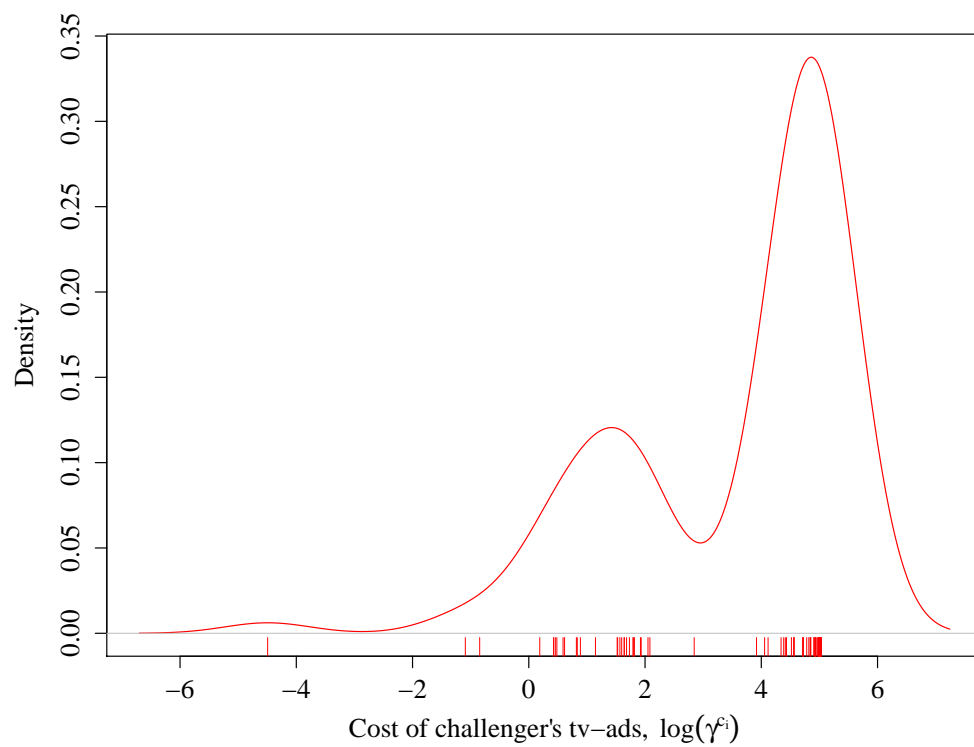


Figure B.1: Challenger's Cost of Spending ( $\gamma^c$ )

Table B.1: Incumbent's Best Response: Accountability

<i>Dependent variable: Electoral Accountability Index</i>				
	(1)	(2)	(3)	(4)
$p_{i,t}$	-0.100***	-0.100***	-0.100***	-0.100***
$e_{it}^c$	0.00002*		-0.00001	
Medium $e^c$		0.104***		-0.138**
High $e^c$		0.558**		-0.454
$\omega$	53.184***	53.184***	52.507***	52.411***
$\alpha$	66.610***	66.610***	66.303***	66.150***
$\gamma$	0.049	0.049	0.049	0.049
$\gamma^c$	0.025	0.025	0.025	0.025
Time to Election	-1.898***	-1.898***	-1.898***	-1.898***
$e_{it}^c \times \omega$			0.0001**	
$e_{it}^c \times \alpha$			0.00003	
Medium $e^c \times \omega$				0.318***
Medium $e^c \times \alpha$				0.372**
High $e^c \times \omega$				1.995**
High $e^c \times \alpha$				1.009
Constant	-16.854**	-16.888**	-16.523**	-16.468**
Observations	22,057	22,057	22,057	22,057
Adjusted R <sup>2</sup>	0.332	0.332	0.332	0.332

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

Robust standard errors clustered at the senator-congress level.

Table B.2: Incumbent's Best Response: Tv-ads

	<i>Dependent variable: tv-ads</i>			
	(1)	(2)	(3)	(4)
$p_{i,t}$	-67.7***	-67.7***	-67.7***	-67.7***
$e_{it}^c$	0.02***		0.01	
Medium $e^c$		49.9***		23.4
High $e^c$		594.8***		231.6
$\omega$	988.4	988.4	678.7	685.7
$\alpha$	2,538.4*	2,538.4*	2,456.6**	2,446.1**
$\gamma$	-90.8	-90.8	-90.8	-90.8
$\gamma^c$	-26.6***	-26.6***	-26.6***	-26.6***
Time to Election	-1,561.1***	-1,561.1***	-1,560.9***	-1,560.9***
$e_{it}^c \times \omega$			0.03**	
$e_{it}^c \times \alpha$			0.01	
Medium $e^c \times \omega$				40.5
Medium $e^c \times \alpha$				36.3
High $e^c \times \omega$				864.8**
High $e^c \times \alpha$				241.0
Constant	11,514.6***	11,508.5***	11,643.3***	11,638.9***
Observations	22,057	22,057	22,057	22,057
Adjusted R <sup>2</sup>	0.3	0.3	0.3	0.3

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

Robust standard errors clustered at the senator-congress level.

## C First Period Effort in Simplified Model

Now, by the envelope theorem, letting  $\hat{p}_3(p_2) \equiv \eta_p p_2 + \eta_x x_2^*(p_2) + \eta_e e_2^*(p_2)$ ,

$$W_2'(p_2) = [\phi(1/2 - \hat{p}_3(p_2))\omega + \phi(\bar{p} - \hat{p}_3(p_2))\alpha] \eta_p \quad (\text{C.1})$$

Substituting (C.1) in (3.12) and (3.13) and simplifying we obtain

$$\omega \int \phi(1/2 - \hat{p}_3(\eta z_1 + \varepsilon))\phi(\varepsilon)d\varepsilon + \alpha \int \phi(\bar{p} - \hat{p}_3(\eta z_1 + \varepsilon))\phi(\varepsilon)d\varepsilon = \frac{\gamma}{\eta_e \eta_p} e_1 \quad (\text{C.2})$$

$$-\omega \int \phi(1/2 - \hat{p}_3(\eta z_1 + \varepsilon))\phi(\varepsilon)d\varepsilon - \alpha \int \phi(\bar{p} - \hat{p}_3(\eta z_1 + \varepsilon))\phi(\varepsilon)d\varepsilon \begin{cases} = \frac{\lambda}{\eta_x \eta_p} (\theta - x_1^*) & \text{if } x_1^* \in (0, \theta], \\ \geq \frac{\lambda}{\eta_x \eta_p} \theta & \text{if } x_1^* = 0. \end{cases} \quad (\text{C.3})$$

Each of the integrals on the LHS's of either first period FOC have the form: for some  $p' \in \{\frac{1}{2}, \bar{p}\}$

$$\frac{1}{2\pi} \int \exp\left(\frac{-(p' - \eta z_1 - \varepsilon)^2}{2}\right) \exp\left(\frac{-\varepsilon^2}{2}\right) d\varepsilon \quad (\text{C.4})$$

This simplifies to

$$\frac{1}{2\pi^{\frac{1}{2}}} \exp\left(\frac{-(p' - \eta z_1)^2}{4}\right) \quad (\text{C.5})$$

The LHS of the first period FOC's is a sum of terms of this form and the RHS corresponds to the RHS of the second period FOC scaled by a constant. Given this the optimization problem in each period is 1-dimensional, (selecting  $x_t^*$ ). We write  $\eta z(p_t, x_t^*) = \eta_p p_t + \eta_x x_t^* + \eta_e \frac{\eta_e}{-\eta_x} \frac{\lambda}{\gamma} (\theta - x_t^*)$ . Combining these insights, we may rewrite the first and second period conditions for an interior solution respectively as

$$\omega \exp\left(\frac{-(\frac{1}{2} - \eta z(p_1, x_1^*))^2}{4}\right) + \alpha \exp\left(\frac{-(\bar{p} - \eta z(p_1, x_1^*))^2}{4}\right) = \frac{2^{\frac{1}{2}} \gamma \frac{\eta_e}{-\eta_x} \frac{\lambda}{\gamma} (2\pi)^{\frac{1}{2}} (\theta - x_1^*)}{\eta_p \eta_e} \quad (\text{C.6})$$

$$\omega \exp\left(\frac{-\left(\frac{1}{2} - \eta z(p_2, x_2^*)\right)^2}{2}\right) + \alpha \exp\left(\frac{-(\bar{p} - \eta z(p_2, x_2^*))^2}{2}\right) = \frac{\gamma \frac{\eta_e}{-\eta_x} \frac{\lambda}{\gamma} (2\pi)^{\frac{1}{2}} (\theta - x_2^*)}{\eta_e} \quad (\text{C.7})$$

When  $\eta_p > 2^{\frac{1}{2}}$  the RHS is larger in magnitude and steeper in the first period equation. Moreover the RHS of the first equation is arbitrarily steep for small values of  $\eta_p$ . Because the LHS terms are bounded by  $\omega \exp(0) + \alpha \exp(0) = \omega + \alpha$  for values of  $\eta_p$  small  $\theta - x_1^* < \theta - x_2^*$ . Thus when there is not much poll persistence, Senators adjust policy positions to maximize support less in the first period than in the second period. Since  $e_t^*$  and policy moderation are complements this means that in the first period there is also less spending at any particular level of poll support.

## D Diagnostics for Balanced Panel Data in First Stage Estimation

The first stage model (4.2) is estimated on a balanced panel dataset, with polls at every month within a year before election. To fill remaining missing values on senate races, which are usually intermittently measured over an electoral cycle, we implement a multiple imputation technique via the EM algorithm (Honaker and King (2010)), which is a commonly applied method to efficiently analyze unbalanced opinion survey data in American politics. This method uses the information on all other variables in the observed portion of the data to impute multiple values for each missing value of electoral support, where the imputations vary depending on the estimated uncertainty in predicting each missing value. In particular, we construct five completed datasets and estimate the parameters of the first stage for each dataset. Next, we combine the estimated coefficients following Rubin (2004), where we average point estimates and standard errors across datasets while incorporating the variation across imputed values into the latter.

Figures D.1, D.2 and D.3 show diagnostics for the multiple imputations as suggested in Abayomi, Gelman, and Levy (2008), as well as the estimation of the transition distribution for the observed unbalanced panel data set that does not include the lagged value of electoral support. Overall, we find that without including all the information in the observed data -brought about by the covariates other than support- and in the lagged effect of electoral support, the effects of `stance` and `tv-ads` go in the same direction as in the balanced panel dataset, but with a larger magnitude for both variables.

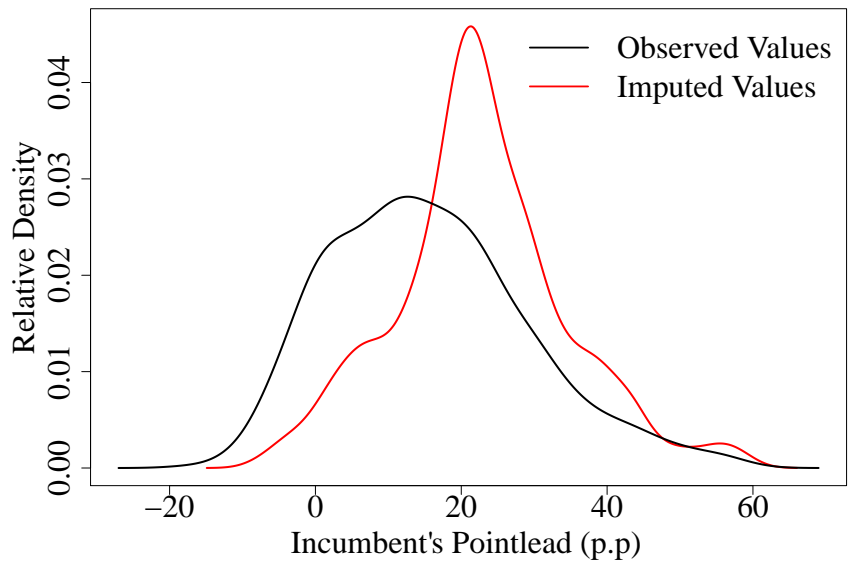


Figure D.1: Incumbent's Observed *vs* Imputed Pointlead

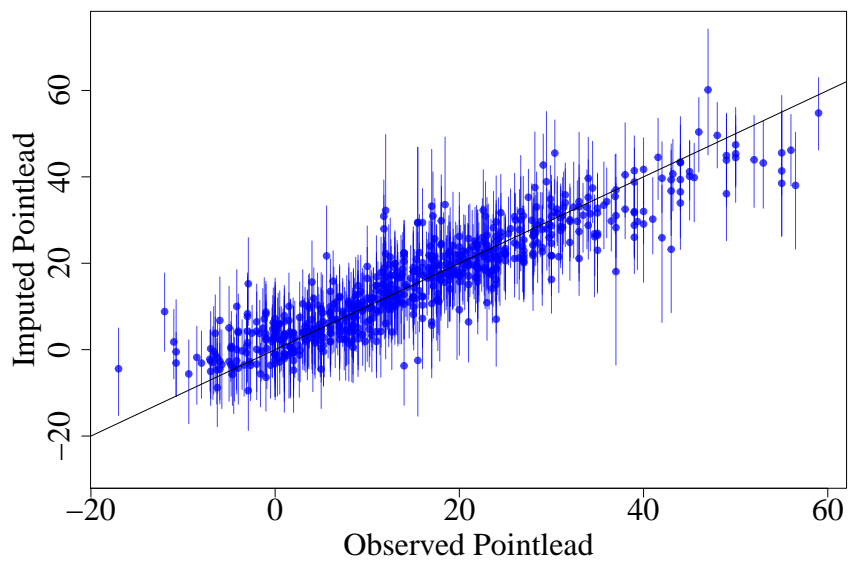


Figure D.2: Validation of Multiple Imputation on Observed Pointlead

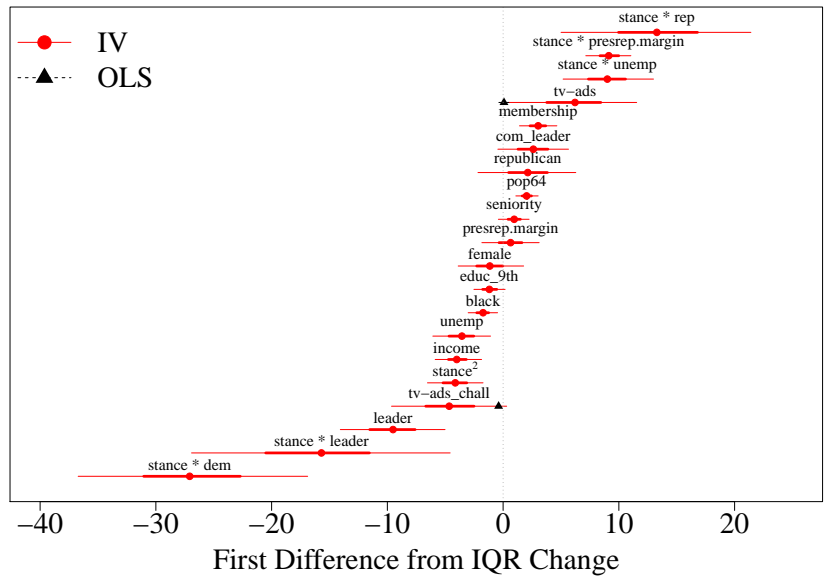


Figure D.3: Transition parameters with unbalanced panel and no lagged dependent variable