

# Mediating the Electoral Connection: The Information Effects of Voter Signals on Legislative Behavior\*

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## Abstract

We develop and assess an elite-information account of representation. Accordingly, politicians face uncertainty about voter opinion, and use previous vote-margins to gauge future electoral outcomes. Losses in vote support elicit ideological moderation given new information about electorates. To test this account, we use rain around Election Day as a natural experiment in voting in U.S. House races from 1956 to 2008. We find each additional inch of rainfall exogenously dampens Democratic vote-margins by 1.4 to 2.0 percentage points, and shifts incumbents rightward in their roll-call positions in subsequent Congresses. We find responsiveness mainly in competitive districts with the greatest risk of defeat, and by Democrats rather than Republicans, suggesting an asymmetry in party representation. Overall, we highlight the importance of *elite information uncertainty* as a mechanism driving the electoral connection, and show that idiosyncratic electoral effects can meaningfully impact legislative behavior.

**Keywords:** representation, information, Congress, natural experiments, elections

Supplementary materials are available in an appendix published online. All data and replication materials are available on the *Journal of Politics* archive on Dataverse.

## Introduction

How do legislators represent their districts given uncertainty about voters' evolving policy demands? In this study, we develop and assess an account of elite learning as a driver of responsiveness to voter opinion.<sup>1</sup> Counter to the classical Downsian view, politicians possess imperfect information about voters, which can distort representation (Downs 1957; Enos and Hersh 2015; Hansen 1991). Citizens have few opportunities to clearly signal their preferences to politicians, and elites often fail to incorporate new information, especially when signals are noisy or biased (Butler and Dynes 2015). Nonetheless, we argue that politicians want to minimize the risk of electoral defeat, and therefore adapt to new and credible information signaling shifts in voter opinion.

We focus our account of elite learning on a particular source of reliable information: *prior election margins*. As a matter of survival, risk-averse politicians 'run scared,' investing scarce time and resources to gauge district opinion through a variety of information sources (Jacobson 1987; Hansen 1991). Yet, information varies in how well it captures voter attitudes or predicts performance in the next campaign. The latter consideration is paramount to election-motivated office-seekers. We expect elites place the most weight on signals that predict future voting with high reliability. Incumbents should pay particular attention to prior election returns, which offer the best predictions of outcomes in the next election (Gelman and King 1990). Though we focus on adaptation to prior win margins, we see this as a case of a broader theory of representation in which politicians learn voters' preferences and respond over time.

Responsiveness is mediated by the information incumbents have on hand and the many demands competing for their attention. When elites are well-informed, they can largely discount new information. Yet, if incumbents are unsure of their electoral standing, and their prior elections indicate vulnerability, they should alter their policy positions to shore

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<sup>1</sup>While constituents also demand casework and pork, we focus on a delegate-like model of responsiveness to voter policy preferences, similar to most work on representation.

up future support. In particular, we expect poor-performing incumbents subsequently *moderate* their roll-call voting to improve their electoral chances. That said, though all elites face uncertainty, some will be less willing to adjust. Incumbents in safe districts, for example, have less incentive to adapt (Griffin 2006). We also expect Republicans to be less responsiveness than Democrats, since the former typically have stronger policy-motivations and more ideological party supporters (Layman et al. 2010). Finally, we expect that more senior incumbents have accumulated information or expertise that minimizes their sensitivity to new election signals (e.g., Stratmann 2000).

We utilize over 50 years of data to evaluate this information theory of responsiveness. We test whether winning incumbents adapt following losses in reelection margins (Kousser, Lewis, and Masket 2007; Ladewig 2010), or are merely *selected* by like-minded electorates (Lo 2013; Poole 2007). Yet, assessing the extent of adaptation has proven inferentially challenging in prior research. Though much of this work has uncovered strong associations between election outcomes and roll-call positions, the strategic behavior of candidates makes it difficult to interpret this as evidence of adaptation. To address this intractable empirical problem, we exploit rainfall on *and* shortly before Election Day as a natural experiment in congressional voting.

Rainy elections randomly increase the cost of participation, especially diminishing Democratic turnout (Gomez, Hansford, and Krause 2007). In examining House races from 1956 to 2008, we find each additional inch of rain (above average) decreases Democratic vote-margins by 1.4 to 2.0 percentage points. Consequently, rain exogenously moves the participating electorate to the right on policy, signaling engaged voters are more conservative to incumbents. We then look beyond turnout to representation. Using rain as an instrument, we find conservative shifts in win-margins move incumbents rightward in their roll-call voting in the next Congress. Notably, the effect is due to meaningful adaptation to information, and not the defeat of incumbents in marginal districts. We find Democrats are responsive to win-margins, while Republicans are not, consistent with our information account and work on party asymmetry in representation (Ladewig

2010; Layman et al. 2010).<sup>2</sup> We also find greater responsiveness in competitive districts, confirming the strongest pressure to adapt persists where electoral security is weakest (Griffin 2006). Finally, incumbents appear less willing to adapt as they grow more senior.

Overall, we underscore a necessary condition for responsiveness in representation: uncertain politicians must observe credible information about voters. Our causal evidence from multiple election cycles indicates that (at least some) incumbents adapt to such information. Yet, our findings also suggest idiosyncratic signals can cascade into policy-making and electoral politics in modest, but meaningful and troubling ways (Achen and Bartels 2004). More generally, our study makes a significant contribution to the emerging debate about the role of elite uncertainty in mediating the electoral connection.

## Elite Uncertainty in Representation

Since at least Downs (1957), scholars have expected electoral competition will anchor strategic and well-informed candidates to voters. Subsequent research has investigated whether this anchoring is due to ‘delegates’ adapting to match constituents’ preferences, or voters’ re-electing or replacing unwavering ‘trustees’ (Miller and Stokes 1963). Many scholars do find that incumbents either adjust their positions or suffer the electoral consequences (Canes-Wrone, Brady, and Cogan 2002; Miller and Stokes 1963). Kousser, Lewis, and Masket (2007) examine the 2003 California recall, and show that Democratic incumbents witnessing large Republican shifts moderated their legislative behavior afterwards. In a randomized field experiment, Butler and Nickerson (2011) find that New Mexico legislators were more likely to vote in line with constituents after receiving survey results of district opinion on upcoming spending proposals. Yet, other research shows that politicians remain ideologically stable over time, suggesting selection rather than adaptation drives the electoral connection (Lee, Moretti, and Butler 2004; Poole 2007). Scholars also

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<sup>2</sup>Ladewig (2010) also studies elite adaptation to margins, but argues that Republicans are the *most responsive* because they are more ideologically motivated than Democrats.

have uncovered minimal adaptation following changes in incumbents' electoral incentives through redistricting, eyeing higher office, or choosing to retire (Grofman, Griffin, and Berry 1995; Lo 2013)

While such work advances our understanding of representation, it mainly addresses whether well-informed elites adapt. It rarely considers whether elite, as opposed to voter, uncertainty mediates responsiveness (Grofman 2004). We go beyond addressing *whether* politicians adapt by providing conditions for *when* and *how* it happens. Voters must credibly signal dissatisfaction to politicians who have reason to pay attention.

### **An Information Theory of Legislative Responsiveness**

Scholars typically posit that elites are well-informed (Jacobson 1987) and can gather new information easily (Enos and Hersh 2015). Yet, information might be biased or costly to collect, leaving politicians with imperfect perceptions of their constituents. Recent work has uncovered ample evidence of elite uncertainty. Incumbents often misjudge the policy views of their districts (Broockman and Skovron 2013), overestimate their chances of victory (Enos and Hersh 2015), and discount the consequences of controversial votes (Nyhan et al. 2012). Politicians also may incorporate information about their constituents in biased ways. They may dismiss the views of partisan opponents (Butler and Dynes 2015), rely too closely on allied interest groups or party leaders (Hansen 1991), or pay too much attention to core donors and vocal constituents (Broockman 2014; Fiorina 2009).

We argue that the difficulty voters face communicating policy attitudes to elected officials substantially contributes to elite uncertainty. Politicians infrequently experience off-cycle or recall elections that provide information about changing voter opinion. Polling may be unreliable, especially when voters lack strong or stable attitudes across issues. Attitudes may change with intervening events between elections (Achen and Bartels 2004), or become active only during campaigns (Rosenstone and Hansen 1993). Even in their direct communications with elected officials, constituents may send conflicting

information that only weakly predicts how they will vote. Thus, politicians may have distorted views of their districts, leading them to favor their own policy views or the demands of more intense interests, rather than those of their constituents.

Nevertheless, office-seeking politicians wish to avoid defeat, and use voter signals to reduce their uncertainty in future elections. In ‘running scared,’ candidates rely on a variety of information sources (Jacobson 1987). Yet, due to limited time and resources, they must satisfice, prioritizing some signals over others. In particular, they pay special attention to signals closely tied to their future job prospects. We expect that vote losses in previous elections are one of the best sources of such information. The only meaningful way constituents can punish candidates is by voting against them. Moreover, past elections are the most reliable predictors of future ones (Gelman and King 1990), and signal the approval of the portion of the electorate most likely to vote. In this sense, win margins demonstrate constituents’ revealed preferences, once they have paid the cost of voting. Thus, prior margins provide *credible* information about voter trends in incumbents’ districts. To be sure, incumbents pay attention to other information. However, if they fail to adapt to prior election signals, it seems unlikely they would adjust in response to weaker and more diffuse information.

When elites receive credible information indicating misalignment with constituents, we expect them to update their beliefs and adapt accordingly (e.g. Bullock 2009). As prior win-margins change, incumbents should adjust both their perceptions of voters and their roll-call votes. Incumbents may consider lower margins as negative evaluations of their records, with larger deviations signaling more dissatisfaction. We assume a basic spatial logic to voting: elites believe voters reward them, in part, for offering more proximate policy positions than their opponents.<sup>3</sup> In turn, at least some incumbents

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<sup>3</sup>While voters may reward extremism or vote non-spatially, we find incumbents moderate following vote losses, suggesting they *believe* voters reward moderation. Incumbents might also see low turnout as a negative evaluation, and moderate after after midterm

should moderate to reduce the risk of defeat.

Finally, we highlight two factors attenuating elites' sensitivity to new signals: strong policy-motivations and electoral security. Similar to the 'marginality hypothesis,' we expect safe incumbents to be unresponsive to new information (Griffin 2006). Unless vote shifts indicate risk, incumbents can update without changing course on policy. We also expect ideologically-driven incumbents resist adapting. Ideologues may prioritize more intense policy preferences, or experience pressure from extreme donors and primary voters. Evidence suggests Republicans are more ideologically rigid, and therefore should be less responsive than Democrats (Layman et al. 2010). A final implication stems from uncertainty and seniority. By spending more time in office, incumbents gain expertise and knowledge that may lessen their responsiveness (e.g., Stratmann 2000).

### **Alternative Accounts of Information and Elite Adaption to Vote Margins**

Notably, ours is not the only account of incumbent adaption to election returns. Somewhat similarly, Ladewig's (2010) innovative study theorizes that politicians adjust their voting to changes in prior win-margins. Yet, this is quite distinct from our information theory. Ladewig argues that expanded win-margins provide leeway for out-of-step incumbents to vote their own preferences, rather than those of their constituents, leading to greater polarization. This theory assumes elites are more ideologically extreme than their constituents, and thus is contingent on a feature derived from the current partisan period. In contrast, we make no such assumption. Our theory of elite learning is generalizable beyond contemporary and polarized Congresses.

A key implication of Ladewig's (2010) leeway mechanism is that more ideologically motivated (i.e., Republican) politicians exhibit *greater* responsiveness to win-margins. After voters provide leeway, incumbents can pull policies towards their preferred alternatives, with the most ideological exerting the greatest energy. We argue oppositely that

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elections, while polarizing after presidential elections. These patterns are not observed.



extreme incumbents are less likely to incorporate win margins or other signals into their representative behavior, instead prioritizing their strong policy commitments (Butler and Dynes 2015). We can empirically test these two competing theoretical mechanisms.

The most important difference, though, centers on the role of elite uncertainty. Ladewig (2010) maintains that politicians are well-informed, even as they rely on voters to provide them with information by communicating leeway.<sup>4</sup> This supposes some uncertainty on the part of politicians. Unfortunately, Ladewig does not explore this mechanism. Our account makes the important contribution that any adaptation to voter signals *necessitates* that elites face information uncertainty. At a minimal level (e.g., Ladewig 2010), elites may be uncertain about the security afforded by voters. Yet, we develop a more extensive theory, with vote margins being just one of many sources that under-informed and over-extended incumbents use to update their perceptions of district attitudes.

## Rainfall as a Natural Experiment for Party Vote Returns

A major challenge in interpreting the prior research on representation is that much of it relies on strong assumptions about the strategic behavior of politicians. Our question is whether incumbents change positions given new information about shifts in opinion once in office. Scholars often point to the *cross-sectional* association between voter attitudes and congressional behavior as evidence that they do (Canes-Wrone, Brady, and Cogan 2002; Griffin 2006). Yet, these associations clearly could result from candidates' decisions about whether to retire, which race to enter, and how to campaign, and not willingness to adapt (Kousser, Lewis, and Masket 2007). If liberal (conservative) candidates only contest races in predominantly Democratic (Republican) districts, then a robust association between vote margins and extremity will emerge without evidencing any adaptation.

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<sup>4</sup>Notably, Ladewig (2010) never links roll call retrospection to elite uncertainty. Oppositely, he describes incumbents as “information-rich,” and unlikely to polarize due to “errors” or “inaccurate estimations” of their reelection chances (Ladewig 2010, p. 501).

To account for district sorting, scholars often estimate the effect that *changes* in margins have on trends in roll-call positions through panel studies. Yet, strategic behavior also can bias these analyses. Once elected, well-matched incumbents may increasingly deter the entrance of strong challengers over time. In representing safe districts, incumbents may take more extreme positions to ward off possible primary challenges. Incumbency alone could produce trends in both win margins and roll-call extremity, upwardly biasing estimates of their association through deterrence.<sup>5</sup> Even the most sophisticated panel studies, which include random or fixed effects, face these concerns (e.g., Ladewig 2010; Stratmann 2000). While unit-level (fixed or random) parameters can control for unobserved variation across units, they are valid only under strong assumptions about strategic behavior. In modeling elections, unit-effects will be a function not only of omitted district variables, but also of the calculated behavior of incumbents and challengers. If some excluded factor (e.g., incumbent weakness) influences both roll-call positions and challenger behavior, these models can be biased.<sup>6</sup>

Generally, many strategic choices are difficult to observe, and potentially bias observational studies of the electoral connection. To properly account for the influence vote margins have on elite behavior, we require election variation that is independent of the types of candidates running, the level of competition, the matching between incumbents and districts, and many other things. While field experiments offer a solution to this problem, these unfortunately are rare and usually limited in scope. Such studies can also

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<sup>5</sup>This provides a different explanation for the finding reported in Ladewig (2010) that incumbents take more extreme positions when granted greater electoral leeway.

<sup>6</sup>For example, strong challengers may run only if incumbents are weak, anticipating vote losses in the next election. These incumbents may moderate their campaign positions to neutralize losses, which they advance in the next Congress. Unless ‘vulnerability’ is included in a regression, unit-level parameters will be confounded since these depend on omitted variation that influences both subsequent margins and legislative positions.

be difficult to replicate and extend, especially as elites grow increasingly aware of them.

### **Election Rain as an Instrument**

While it is impossible to randomize vote margins in congressional elections, we adopt the next best approach: using rain around Election Day as a natural experiment in voting. Rainy elections increase voting costs, making it sufficiently unrewarding for some to participate (Gatrell and Bierly 2002; Knack 1994). Democratic voters, in particular, are sensitive to such costs, since they lack many of the participation-relevant resources of their wealthier Republican counterparts (Gomez, Hansford, and Krause 2007; Hansford and Gomez 2010). In studying rain in presidential elections, Gomez, Hansford, and Krause (2007) find each inch of rain reduces overall participation by about 1%. Republican candidates are the main beneficiaries, receiving an additional 2.5% of the overall vote on average. In a follow-up study, Hansford and Gomez (2010) use rainfall as an instrument for turnout, again finding rain dampens Democratic voting in presidential elections.

In being determined by nature, rainfall induces exogenous variation in voting that cannot be influenced by prior voter attitudes, incumbent positions or candidate strategy. Indeed, a central motivation in using rain as a natural experiment is that politicians will be unable to incorporate Election Day weather into their strategic behavior unless they can predict it in advance. Similar to research on rain in presidential elections, we show that election rainfall significantly dampens Democratic turnout in congressional races. As a result, at least some of the shift in win margins is ‘as-if’ randomized, and thus independent. This feature allows us to use election rain as an instrumental variable (IV) to estimate the effects of rightward shifts in district opinion on incumbents’ subsequent voting decisions. In doing so, we can uncover causal evidence evaluating whether legislators adapt their roll-call voting in response to information signaled through win margins.

In our research design, we use two separate rain instruments: (a) rain on Election Day and the day before,  $Z^{(ED)}$ , and (b) rain averaged over the prior weekend,  $Z^{(PW)}$ . We

include weather occurring a few days before elections in the  $Z^{(PW)}$  instrument, since this could influence voting. Rain several days before an election may dampen the willingness to make plans, arrange transportation, and schedule time off work to go to the polls. Further, rain can have a negative impact on people’s mood and happiness, especially when it pours consistently over multiple days (Klimstra et al. 2011). These effects may subsequently reduce turnout (Healy, Malhotra, and Mo 2010). Rain just prior to the election also could remove a portion of voters who otherwise would have opted out due to rain on Election Day, weakening the effect of the  $Z^{(ED)}$  measure.<sup>7</sup> We also utilize rain in the *current election*, at time  $t$ , and the *previous election*, at  $t - 1$ , as instruments across our models. Incorporating previous rain as a control or additional instrument can help strengthen the instrumental estimates, by accounting for any variation over a two-year span not captured by removing trends over the entire period.<sup>8</sup>

To measure incumbent responsiveness to shifts in vote margins, we estimate the following models in a standard two-stage IV approach:

$$D_{it,d} = \rho_0 + \rho_1 Z_{it,d}^{(j)} + \rho_2 Y_{it-1,d} + \rho_3 D_{it-1,d} + \kappa X_{it,d} + \eta_{i,d} + \nu \quad (1)$$

$$Y_{it,d} = \beta_0 + \beta_1 D_{it,d} + \beta_2 Y_{it-1,d} + \beta_3 D_{it-1,d} + \theta X_{it,d} + \delta_{i,d} + \epsilon. \quad (2)$$

Incumbent  $i$ ’s positions (ideal points) at year  $t$  and decade  $d$  are denoted as  $Y_{it,d}$ , and prior positions at  $t - 1$  as  $Y_{it-1,d}$ . Democratic vote margins are indicated for year  $t$  and  $t - 1$  as  $D_{it,d}$  and  $D_{it-1,d}$ , respectively. The rain instruments are denoted  $Z_{it,d}^{(j)}$ , where  $j$  indicates prior weekend ( $j = PW$ ) or election-day ( $j = ED$ ) rain. The models simultaneously include relevant controls in  $X_{it,d}$ , and unit-level fixed effects.

Due to redistricting, we focus on two units of analysis: *District*  $\times$  *Decade* and *Incum-*

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<sup>7</sup>Station readings also have sampling error since these are snapshots of daily volume.

Averaging over two ( $Z^{(ED)}$ ) or four days ( $Z^{(PW)}$ ) reduces attenuation from this error.

<sup>8</sup>Rain at  $t$  is sufficiently predictive of voting, and excluding rain at  $t - 1$  does not alter our results. A concern in including additional rain instruments or expanding the window for measuring rain is that this could induce bias. We reject this through a placebo.

*bent*. Each specification is implemented separately, including either *District*  $\times$  *Decade* ( $\delta_{i,d}, \eta_{i,d}$ ) or *Incumbent* ( $\delta_i, \eta_i$ ) fixed-effects parameters. The *District*  $\times$  *Decade* analysis captures variation for the *same* geographies represented by the same incumbent, while the *Incumbent* analysis focuses on variation for each incumbent over (possibly) *different* district geographies. We break up the analysis in this way to isolate the possible ‘selection’ effects of rain on incumbent reelection at the district level, from its influence on the types of signals incumbents incorporate about changing vote margins.

In words, Equation (1) models the first-stage effects of rain on Democratic voting, controlling for prior ideal points, prior margins, covariates, and fixed effects. Equation (2) models the independent effect of Democratic vote margins on ideal point positions (identified by exogenous variation in margins), with the same controls and fixed effects. Under the standard IV assumptions, we interpret  $\beta_1$  as the causal effect of observed election margins on ideal points.<sup>9</sup> We estimate  $\beta_1$  through Two-Stage Least Squares (2SLS), and cluster standard errors at the *District*  $\times$  *Decade* or *Incumbent* level as appropriate.

## Data and Research Design

We examine aggregate rainfall and election margins in all contested House races between 1956 and 2008 where the sitting incumbent runs, excluding Alaska and Hawaii. The rain measures come from precipitation readings from the 36,568 National Climatic Data Center (NCDC) weather stations periodically in operation from the 1950s to the 2000s. The NCDC data provide the county, but not district location of each station. Further, congressional districts can cross county boundaries, subsume multiple counties, or wholly reside in a single county. Thus, to produce rain measures for each district, we first use census county-to-district matching to link each county to all of the congressional districts containing parts of that county. We then average rain across all county stations

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<sup>9</sup>We provide tests of *exogeneity* and *instrument strength*, and discuss the *exclusion restriction* assumption in our results below.

within each district, weighting by county population.

As described above, we create two rain measures: rain on Election Day and the day before ( $Z^{(ED)}$ ), and rain over the prior weekend through Election Day ( $Z^{(PW)}$ ). After linking county rainfall to districts, we deviate and normalize each district-level precipitation measure. We use both average and standard-deviation measures of district rainfall for a two (Monday and Tuesday) and four-day (Saturday – Tuesday) window preceding, and including Election Day for all years in the study. Standardizing measures in this way removes systematic trends in rain variation that could correlate with district factors.<sup>10</sup> To ensure this approach is reliable, we compare the rain instrument used by Gomez, Hansford, and Krause (2007) to an analogous rain measure using our approach. We recover a correlation of 0.84, indicating a high degree of similarity.<sup>11</sup>

The data on incumbent vote margins originates from Congressional Quarterly (CQ), which has comprehensive election returns for most of the post-war period (Congressional Quarterly 2014). We exclude elections in which incumbents lack opponents and receive more than 99% of the vote, ultimately removing 12.5% of the cases. For races just following each redistricting cycle, we link an incumbent’s pre-redistricting jurisdiction to her post-redistricting geography, even if these do not perfectly overlap.<sup>12</sup>

Our responsiveness measure comes from an ideal-point scaling of House roll-call votes.

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<sup>10</sup>See Hansford and Gomez (2010) for a similar, though distinct standardization approach.

We also vary the size of the window around elections when standardizing, which alters the variability of our measures, but not our results. Figure III in Section V.1 of the Online Appendix presents histograms of the election rain measures.

<sup>11</sup>Some difference may be due to ‘kriging’ used by Gomez, Hansford, and Krause (2007) to impute county rain. Instead of averaging readings, kriging models the spatial correlation between nearby stations to predict rain in areas that possess few or no stations.

<sup>12</sup>We recover identical results excluding *all* post-redistricting years. See Section VII of the Online Appendix.

Ideal points are a standard way of representing the policy positions of legislators (Poole and Rosenthal 1997). Drawn from spatial voting theory, an incumbent’s ideal point indicates the location of her most-preferred policy, which in turn determines her probability of voting *yea* or *nay* on a roll call item, given its spatial location relative to the status quo. We use ‘MCMCPack’ in **R** to estimate ideal points, taking advantage of the flexibility in modeling afforded by Bayesian posterior inference (Clinton, Jackman, and Rivers 2004). In particular, we use a one-dimensional model of legislative position-taking to estimate ideal points separately for each Congress (Martin, Quinn, and Park 2011).<sup>13</sup>

We control for many important factors when estimating instrumental effects, including prior-vote margins, roll-call positions, district-party voting, party control of offices, president’s party membership, and various socioeconomic and demographic factors.<sup>14</sup> We also control for midterm elections across all models, due to systematic differences in turnout. Further, we control for election competitiveness and district ideology. Fraga and Hersh (2010) show that presidential campaigns may counter the demobilizing effects of

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<sup>13</sup>We estimate separate ideal point models to avoid making structural assumptions about *trends* in legislative voting. There is no inferential loss in modeling Congresses unbridged since election rain across districts does not depend on previous ideal point distributions. However, the scale of our estimates is not fixed across all years, and is drawn from a Bayesian standard normal prior. Given legislator fixed-effects, we are estimating the difference in incumbents’ ideological positions caused by rain, given expected behavior in the absence of rain, after controlling for prior ideal point estimates, and other important district or incumbent factors. We assess the robustness of our results to alternative ideal point models, and find virtually identical results using both *bridged* and *unbridged* NOMINATE scores (Poole and Rosenthal 1997). Ultimately, we use Bayesian estimation since it better facilitates interpretation of substantive effects through simulations.

<sup>14</sup>See Table VII in the Online Appendix for the full list of controls. These mostly originate from Caughey and Sekhon (2011) and Adler (2012).

rain by ramping up their get-out-the-vote efforts in closely contested places. Controlling for competitiveness is essential, since candidate countermeasures could influence turnout. We use CQ’s competitiveness measure that predicts the closeness of each House election on a scale from 1 (likely Democratic win) to 7 (likely Republican win), with scores in the middle indicating toss-ups. It is also essential to control for aggregate voter preferences, since these provide incumbents with baseline electoral expectations. Here, we transform prior presidential vote into a normally distributed measure of district attitudes.

Though extensively collected, some covariate data are missing. We impute these data through Bayesian multiple chained equations (MICE) using the ‘mice’ package in **R** (van Buuren and Groothuis-Oudshoorn 2011). In doing so, we assign values for less than 0.1% of the items on seven covariates, and 3.8% for prior presidential vote. However, we impute a greater proportion (21.0%) of district competitiveness, which is wholly missing for six cycles. This imputation assumes missingness is essentially random given information in  $X_{it,d}$ , which is a relatively weak assumption in this case.<sup>15</sup> Excepting competitiveness, the amount of imputation is nominal. Further, drawn from whole years, missingness on competitiveness *cannot* correlate with any unobserved district characteristics.<sup>16</sup>

## Results and Discussion

For rain to be a valid instrument, it must be *exogenous* to factors that predict elections and roll-call positions, after controlling for important covariates and fixed effects.<sup>17</sup> Though drawn from a random (exogenous) process, weather may not be equally proba-

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<sup>15</sup>We rerun our analysis without imputing *any* data, and imputing *all* missing items, and recover virtually identical results. See Sections III and VII in the Online Appendix.

<sup>16</sup>We impute ideal points for the 484 defeated incumbents using their estimates from the previous Congress. See Section III in the Online Appendix for more details.

<sup>17</sup>Specifically, we assume  $E[Z_{it,d}^{(j)}\nu] = 0$ , which holds only if no factor omitted from Equation (1) influences both vote margins  $D_{it,d}$  and rainfall  $Z_{it,d}^{(j)}$ .



ble across districts, and could potentially correlate with partisan voting. For example, Democrats cluster in the Northwest where it rains frequently, but not in the dry (and Republican) Southwest. Residential sorting could bias estimates absent controls for district attitudes. As described above, we address these concerns by de-meaning and normalizing our rain measures, eliminating potential confounding from long-run trends in rain. We also control for important within-year and within-district factors ( $X_{it,d}$ ), which correlate with elections and roll-call voting. And we include district or incumbent fixed effects to account for additional unobserved factors orthogonal to election rain, which differ across jurisdictions. Consequently, our analysis assumes that rain is independent of omitted factors (including candidate strategy), once we include these controls.

Table 1: Placebo Test: Effect of Election Rainfall on *Previous* Democratic Vote Margin and Incumbent Roll Call Positioning

|                                 | ORDINARY LEAST SQUARES                 |  |  |  |
|---------------------------------|--|--|--|--|
|                                 | Dem. Vote Margin <sub>t-1</sub><br>(1) | Inc. Ideal Point <sub>t-1</sub><br>(2) | Inc. Ideal Point <sub>t-1</sub><br>(3) | Inc. Ideal Point <sub>t-1</sub><br>(4) |
| Election Day Rain <sub>t</sub>  | 0.003<br>(0.004)                       |  | -0.012<br>(0.009)                      |  |
| Prior Weekend Rain <sub>t</sub> |  | 0.003<br>(0.004)                       |  | -0.009<br>(0.010)                      |
| Observations                    | 7139                                   | 7139                                   | 7056                                   | 7056                                   |
| Clusters                        | 1726                                   | 1726                                   | 1700                                   | 1700                                   |
| R <sup>2</sup>                  | 0.882                                  | 0.882                                  | 0.930                                  | 0.930                                  |

Specifications are OLS with *Incumbent* fixed effects, and additional state, year, and district controls. *Incumbent* cluster standard errors are in parentheses.

\*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.1$ .

We implement a series of balance and placebo tests to assess whether this exogeneity assumption is likely to hold, ensuring that rain is a valid instrument for Democratic voting. In placebo tests presented in Table 1, we regress *prior* incumbent ideal points and Democratic vote margins on each rain instrument, including the standard battery

of controls and *Incumbent* fixed effects.<sup>18</sup> By construction, the coefficients in these tests should be zero, since rain today cannot impact past elections or incumbent legislative decisions. Significant effects would suggest that rain is confounded by omitted factors correlated with vote margins or roll positions. In models (1) and (3), we regress prior outcomes on Election-Day Rain, and in models (2) and (4) on Prior Weekend Rain. Across the tests, we consistently find that the election rain instruments are uncorrelated with prior Democratic voting and incumbent positioning. Notably, we include *Incumbent* fixed effects (and cluster errors) to verify that our full model is unconfounded. Yet, normalized rain is also uncorrelated with prior Democratic vote and incumbent ideology *without* these covariate and modeling assumptions. Placebo results are similar for Bivariate OLS excluding covariates, fixed effects, and cluster standard errors:  $p$ -values are 0.874, 0.788, 0.381 and 0.940 for models analogous to (1)-(4) in Table 1.

The rain instruments are uncorrelated with prior election outcomes and incumbent legislative behavior. Yet, rain may be associated with other district factors not captured in the placebos that influence elections or incumbent positions. To assess this possibility, we extend the above analysis to a series of balance tests to observe if rain correlates with any of a large array of district factors. We implement these tests by regressing each instrument simultaneously on an elaborate model of 62 covariates, taken over the last three election periods ( $t - 2$  to  $t$ ).<sup>19</sup> We also include (un)deviated *prior* rain measures in the model to assess if prior rain correlates with future rain. Confirming the above, the vast majority of covariates are uncorrelated with both instruments, including prior election rain, at the  $p < 0.05$  level.<sup>20</sup> In combination, these balance and placebo tests strengthen the plausibility that rain is an exogenous instrument.

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<sup>18</sup>Placebo tests with *District*  $\times$  *Decade* effects in Table IV, and a Sargan over-identification test also affirm instrument exogeneity. See Section IV.1 in the Online Appendix.

<sup>19</sup>A balance plot is presented in Figure I in Section IV.1 of the Online Appendix.

<sup>20</sup>Over 80% of covariates are balanced. This is lower than if rain were fully randomized.

We make the weaker assumption that election rain is exogenous conditional on district-

## Voter Signals or Incumbent ‘Selection’

We recover a robust causal relationship between rain and Democratic returns in the House, providing the first-ever comprehensive evidence Republicans indeed should “pray for rain” in *congressional* elections. We present these results in Table 2 for both (1)–(2) *Incumbent* and (3)–(4) *District*  $\times$  *Decade* fixed effects and cluster errors. We break apart our analysis in this way to ensure that our findings do not depend on how we isolate district variation. As seen in models (1) and (3), Election-Day rain shrinks Democratic vote margins by 1.4 to 1.6 percentage points, controlling for prior-vote margins, competitiveness, and other factors. In comparison, rain over the prior weekend dampens Democratic margins by roughly 1.7 to 2.0 points, for (2) and (4) respectively.<sup>21</sup>

While relatively modest, such shifts could have important implications for moderate incumbents and the marginal composition of Congress. Between 1956 and 2008, 229 incumbents lost by less than 1.4% of the vote, while 332 lost by under 2.0%. Rain dampens Democratic turnout, making the participating electorate more conservative. This can impose especially substantial costs on politicians in marginal districts.

Though influential, we further test whether the effect of rain on Democratic margins is sufficiently informative to be useful in an IV analysis.<sup>22</sup> The IV estimator is a ratio of rain’s effect on roll-call voting proportioned by rain’s effect on vote margins. If the

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level factors, which is plausible given the idiosyncratic pattern of association here.

<sup>21</sup>Each of these estimates obtains statistical significance at the  $p < 0.01$  level. We also find that normalized rain at  $t - 1$  has a weaker, but negative impact on Democratic voting at  $t$ . This is due to our use of common mean and variance moments to normalize rain at  $t$  and  $t - 1$ . Unnormalized rain at  $t - 1$  *does not influence* voting at  $t$ , indicating the exclusion restriction is likely to hold. We rerun the analysis excluding the prior rain instrument, and using prior rain as a control rather than instrument, and find virtually identical results. See Section IV.3 in the Online Appendix.

<sup>22</sup>See Keele and Morgan (2013) for a discussion of using rain as an instrument in elections.

Table 2: Main Effect of Election Rainfall on Democratic Vote Margin and Incumbent Reelection

|                                   | DEMOCRATIC VOTE MARGIN <sub>t</sub> |                                |                              |                      | INCUMBENT REELECTION <sub>t</sub> |                   |
|-----------------------------------|-------------------------------------|--------------------------------|------------------------------|----------------------|-----------------------------------|-------------------|
|                                   | <i>Incumbent FEs</i>                |                                | <i>District × Decade FEs</i> |                      | <i>District × Decade FEs</i>      |                   |
|                                   | (1)                                 | (2)                            | (3)                          | (4)                  | (5)                               | (6)               |
| Election Day Rain <sub>t</sub>    | -0.014<br>(0.005)**                 |                                | -0.016<br>(0.006)*           |                      | 0.001<br>(0.002)                  |                   |
| Prior Weekend Rain <sub>t</sub>   |                                     | -0.017<br>(0.006)**            |                              | -0.020<br>(0.007)**  |                                   | -0.000<br>(0.003) |
| Election Day Rain <sub>t-1</sub>  | -0.012<br>(0.005)*                  |                                | -0.016<br>(0.007)*           |                      | -0.002<br>(0.002)                 |                   |
| Prior Weekend Rain <sub>t-1</sub> |                                     | -0.009<br>(0.005) <sup>+</sup> |                              | -0.016<br>(0.007)*   |                                   | -0.002<br>(0.002) |
| Dem. Vote Margin <sub>t-1</sub>   | -0.008<br>(0.026)                   | -0.008<br>(0.026)              | -0.167<br>(0.029)***         | -0.167<br>(0.029)*** | 0.003<br>(0.014)                  | 0.003<br>(0.014)  |
| Inc. Ideal Point <sub>t-1</sub>   | -0.007<br>(0.010)                   | -0.007<br>(0.010)              | 0.002<br>(0.011)             | 0.001<br>(0.011)     | 0.002<br>(0.004)                  | 0.002<br>(0.004)  |
| Dem. Incumbent <sub>t</sub>       | 0.084<br>(0.037)*                   | 0.083<br>(0.035)*              | 0.042<br>(0.098)             | 0.038<br>(0.095)     | -0.352<br>(0.481)                 | -0.353<br>(0.481) |
| District Ideology <sub>t-1</sub>  | -0.043<br>(0.019)*                  | -0.036<br>(0.019)*             | -0.109<br>(0.023)***         | -0.104<br>(0.023)*** | 0.010<br>(0.008)                  | 0.010<br>(0.008)  |
| Competitiveness <sub>t</sub>      | -0.062<br>(0.005)***                | -0.062<br>(0.005)***           | -0.052<br>(0.005)***         | -0.052<br>(0.005)*** | -0.004<br>(0.003)                 | -0.004<br>(0.003) |
| Observations                      | 4177                                | 4177                           | 4177                         | 4177                 | 4560                              | 4560              |
| Clusters                          | 1328                                | 1328                           | 1960                         | 1960                 | 2109                              | 2109              |
| R <sup>2</sup>                    | 0.928                               | 0.928                          | 0.942                        | 0.942                | 0.463                             | 0.463             |

Specifications are OLS with *Incumbent* [(1)-(2)] or *District × Decade* [(3)-(6)] fixed effects, and additional state, year, and district controls. *Incumbent* [(1)-(2)] or *District × Decade* [(3)-(6)] cluster standard errors are in parentheses.

\*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.1$ .

latter is too small, and the instrument is *weak*, there will be little exogenous variation (i.e., information) in election margins. A practical consequence of weak instruments is IV estimates are too large, and measures of uncertainty too small. Stock and Yogo (2005) develop standard tests for weak instruments, focusing on the upper bound of bias tolerated in an IV estimate. In particular, the authors identify critical values for  $F$ -statistics at which the false positive rate is less than 10% when a significance level of  $\alpha = 0.05$  is used to interpret coefficients under the no-effect null hypothesis. The critical value for this test is 19.93 for two instruments (rain at  $t$  and  $t - 1$ ) and one endogenous regressor (Democratic margins at  $t$ ). The test is interpreted such that first-stage models

with  $F > 19.93$  indicate sufficiently strong instruments for IV analysis.

According to the test, normalized election rain is sufficiently influential to generate informative variation in Democratic voting. The cluster  $F$ -statistics for our models in Table 2, with *Incumbent* fixed-effects and cluster errors, are 23.216 for (1) Election Day, and 24.465 for (2) Prior Election Rain instruments.<sup>23</sup> Cluster  $F$ -statistics for models (3) and (4), with *District*  $\times$  *Decade* units are 19.172 and 24.116, respectively. All but one of these models yield first-stage  $F$ -tests greater than 19.93, and the exception is just at the threshold. We are interested in isolating the information effects of vote margins, thus we mainly interpret the *Incumbent* models, which surpass standard thresholds. Overall, these provide strong evidence that our instruments are sufficiently informative to recover unbiased IV estimates of the effect of vote margins on roll-call positions.

In contrast, we intriguingly find that election rain does not have a direct effect on *incumbent reelection* for either Democrats or Republicans. Much of the prior work on rain in elections focuses on the potential impact of lower Democratic turnout on party control in government (Gatrell and Bierly 2002; Gomez, Hansford, and Krause 2007; Hansford and Gomez 2010). Under certain conditions, very rainy elections could influence the partisan composition of Congress by defeating marginal Democrats. Yet, we find little evidence of a ‘selection’ effect from rain in our data. We present tests of this in Table 2, regressing incumbent reelection on (5) Election Day and (6) Prior Weekend Rain, alongside standard controls and fixed effects. We focus on *District*  $\times$  *Decade* variation to isolate the selection effect of rain across districts, rather than for particular incumbents. As shown in the models, neither instrument significantly influences incumbents’ reelection rates. Though rain has little effect, competitiveness and redistricting hurt reelection, though both just miss standard levels of significance.

Inferentially, the lack of a selection effect is helpful since it precludes that our find-

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<sup>23</sup>Cluster  $F$ -statistics are Kleibergen-Paap. See Section IV.2 in the Online Appendix for details on this and additional tests of instrument strength.

ings are driven by rain defeating relative extremists in marginal districts. Nevertheless, this may seem surprising given the theoretical argument that politicians adapt to lower margins by moderating out of fear of defeat. Incumbent behavior helps explain our result. Relatively few House incumbents (4.6%) ever lose their reelection campaigns. This security is likely the product of a number of strategic choices made well in advance of Election Day, including whether to adapt to voter opinion or retire rather than run. Incumbents cannot predict the weather, but may retire when they anticipate a tough race. Retirements are uncorrelated with rain, and therefore do not bias our estimates. If adaptive behavior is heterogenous, though, retirement may change the population for whom we can estimate causal effects. That said, we might not witness a ‘selection’ effect among incumbents who choose to run, since these are the types who are willing to strategically adapt their roll-call voting to bolster their re-election odds in the first place. Ultimately, our analysis shows that rain appears to signal vulnerabilities to incumbents without actually contributing to their defeat.

### Representational Roll-Call Findings

We turn to the main focus of our analysis: evaluating if changes in vote returns signal new information to incumbents, causing them to shift their roll-call votes. Table 3 presents instrumental estimates of the effects of Democratic voting on incumbent positioning from Equation (2) at the *Incumbent* and *District*  $\times$  *Decade* level. Using the Election-Day Rain instrument, with *Incumbent* effects, we find increases in Democratic voting correspond to a negative and statistically significant ideal-point shift (-1.298,  $p = 0.015$ ). We find similar results (-1.144,  $p = 0.022$ ) with the Prior-Weekend Rain instrument. Further, in columns (3) and (4) in Table 3, we report virtually identical estimates (-1.373, -1.129) for the *District*  $\times$  *Decade* models. Democratic gains (losses) in election win-margins consistently yield subsequent liberal (conservative) adaptation in incumbent policy positions. Politicians indeed adapt to information from reelection

margins, consistent with the account of elite uncertainty in representation.

Table 3: Instrumented Effect of Democratic Vote Margin on Subsequent Incumbent Roll Call Positioning

|                               | <i>Incumbent FEs</i>             |                                   | <i>District × Decade FEs</i>     |                                   |
|-------------------------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|
|                               | Election Day <sub>t</sub><br>(1) | Prior Weekend <sub>t</sub><br>(2) | Election Day <sub>t</sub><br>(3) | Prior Weekend <sub>t</sub><br>(4) |
| Dem. Vote Margin <sub>t</sub> | -1.298<br>(0.531)*               | -1.144<br>(0.499)*                | -1.373<br>(0.571)*               | -1.129<br>(0.500)*                |
| <i>F</i> -statistic           | 23.216                           | 24.465                            | 19.172                           | 24.116                            |
| Observations                  | 6237                             | 6237                              | 6237                             | 6237                              |
| Clusters                      | 2639                             | 2639                              | 1609                             | 1609                              |
| R <sup>2</sup>                | 0.915                            | 0.918                             | 0.927                            | 0.932                             |

Specifications are 2SLS with *Incumbent* [(1)-(2)] or *District × Decade* [(3)-(4)] fixed effects and additional state, year, and district controls. *Incumbent* [(1)-(2)] or *District × Decade* [(3)-(4)] cluster standard errors are in parentheses. *F*-statistics are Kleibergen-Paap for cluster standard errors.

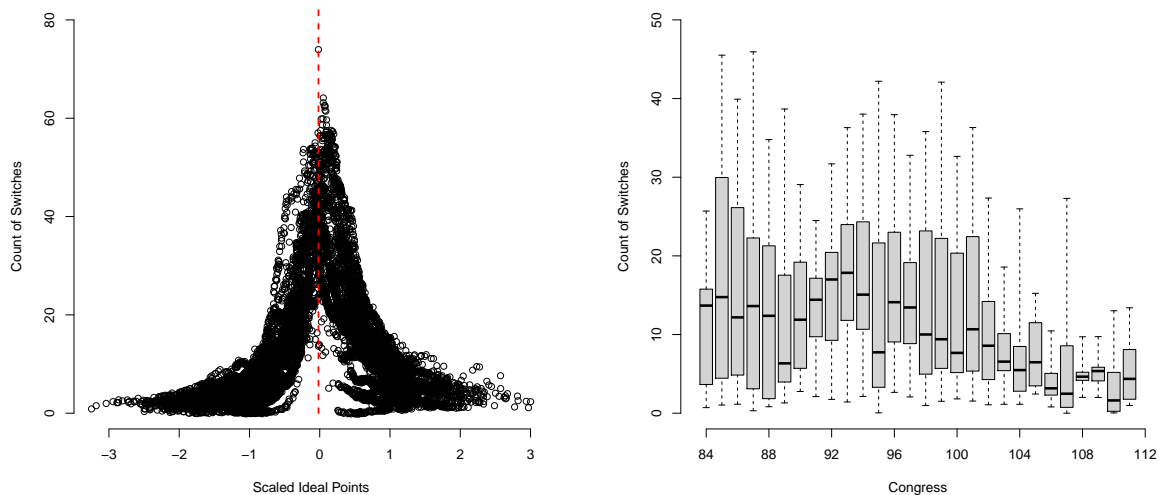
\*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.1$ .

Each rain-induced percentage point loss in Democratic voting causes incumbents to move rightward by a factor of between 0.011 and 0.013 on the ideal-point scale. This is roughly equivalent to altering David Price’s (D-NC) record to resemble Gregory Meeks’ (D-NY), or pushing Deborah Pryce (R-OH) to vote like Mark Kirk (R-IL). To provide a behavioral interpretation of this finding, we conduct simulations of the hypothetical impact of losses in Democratic votes on roll-call *switches*. A roll-call switch is when an incumbent would have voted differently had she previously won by a contrasting electoral margin of some magnitude, under an ideal-point model. First, we use actual legislative choices to estimate ideal points. Then, we simulate probabilities legislators will support or oppose each roll call, given an exogenous uniform Democratic vote-loss of 2.5%, generating a 0.033 average rightward ideal-point shift.<sup>24</sup> We count the number of times each incumbent would have switched her vote in probability (by crossing the 0.5

<sup>24</sup>Simulations incorporate estimator and posterior uncertainty. We take 1,000 random draws from  $\beta_{IV} \sim N(1.298, 0.531^2)$ , and transform these into a distribution of conservative ideal point shifts. We incorporate the  $k$ th shift into the  $k$ th posterior from

threshold) under a simulated Congress holding 1,000 floor votes.<sup>25</sup> The simulations show a 2.5% Democratic loss results in an average 12.8 switches per incumbent.

Figure 1: Estimated Number of Roll Call Switches From 2.5% Loss in Democratic Vote



(a) Switches Given Ideological Placement

(b) Switches Over Time

Of course, some politicians are more likely than others to switch given electoral shifts. Figure 1(a) plots the expected number of switches as a function of ideology. We find extreme incumbents are much less likely to take new positions in response to downturns in reelection margins, while moderates may switch on as many as 50 to 60 votes due to their proximity to more roll-call cutpoints. There also is a decline in the expected number of switches over time, as displayed in Figure 1(b), largely due to increasing polarization in Congress. This finding provides causal evidence incumbents pay attention to information

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the ideal-point model to estimate  $k$  roll call probability matrices. We summarize over these  $k$  probabilities to estimate the variance and expectation of the count of roll-call switches. See Section V of the Online Appendix for additional simulations.

<sup>25</sup>These shifts in Democratic voting are reasonable counterfactuals given rain variation and expected Democratic losses. These are smaller than, but comparable to losses found elsewhere, e.g., 5.5% in the Gray Davis recall (Kousser, Lewis, and Masket 2007).



from vote margins and adapt following electoral downturns. Further, we show even modest Democratic losses can have substantial effects on subsequent representational behavior, especially for centrist incumbents and in less polarized settings.

### Electoral Risk and Adaptation

Our information account predicts that incumbents will adapt to new information from voters. We find evidence of this in our above analysis. Additionally, we expect that incumbents with the greatest risk of defeat will be the most responsive, consistent with the ‘marginality hypothesis’ (Griffin 2006). To test this prediction, we rerun our analysis separately for safe and competitive districts. We define a competitive district as one decided by less than 7.5% (or 15% margin) of the Democratic vote in the last Presidential election.<sup>26</sup> We find consistent and strong repositioning effects in competitive districts for both the Election-Day (-1.751,  $p = 0.046$ ) and Prior-Weekend (-1.575,  $p = 0.035$ ) rain instruments. The estimates are much smaller (-0.714, -0.787) and not statistically significant in safe districts. Thus, politicians in marginal districts are the most responsive to information from election margins. Notably, rain’s effect on Democratic margins does *not* drive this result. Counter to Fraga and Hersh (2010), we find rain has quite similar effects on election returns in both competitive and safe House races. Apparently, legislators do not counter-mobilize *in districts* the way presidential candidates do *in counties*.

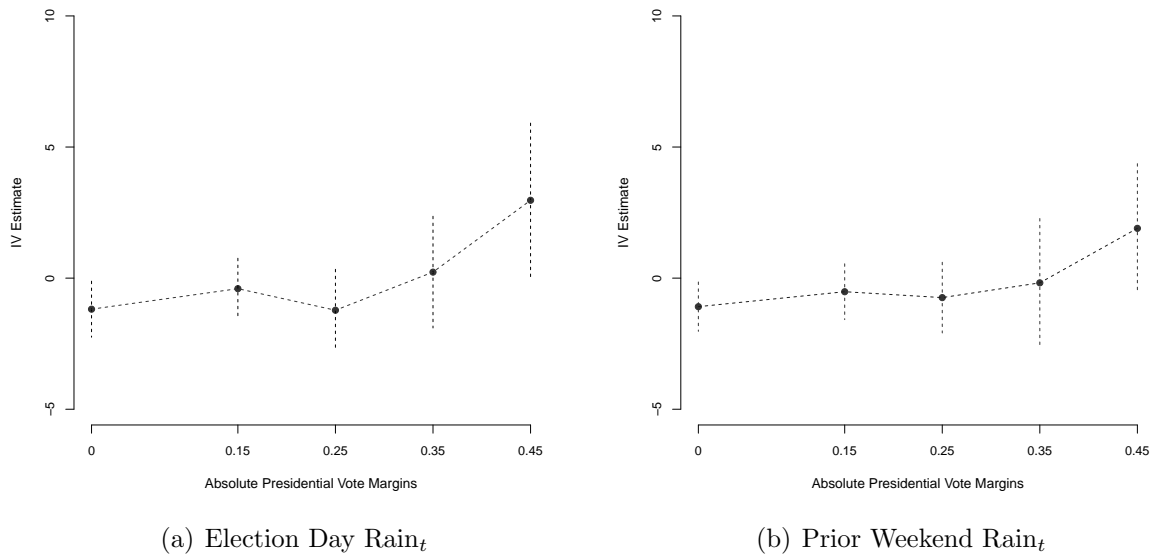
As an additional test, we expand our analysis to explore how incumbents adapt at different levels of competitiveness. We stratify our models using prior presidential vote, and assess effects as we increasingly expand the margin of presidential victory in districts. Results from this analysis are presented in Figure 2, with 95% confidence bounds for IV estimates indicated by (vertical) dashed lines.<sup>27</sup> Using both (a) Election-Day and (b)

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<sup>26</sup>Results using *Incumbent* fixed-effects are in Table I of the Online Appendix.

<sup>27</sup>The  $x$ -axis in Figure 2 indicates ranges of prior presidential vote margins  $v$  included in the stratications, e.g., ‘0’  $\equiv v \in abs(0, 0.15)$ ; ‘0.25’  $\equiv v \in abs(0.15, 0.25)$ , and so on.

Figure 2: Effect of Democratic Vote Margins on Incumbent Roll Call Positioning as District Competitiveness Changes



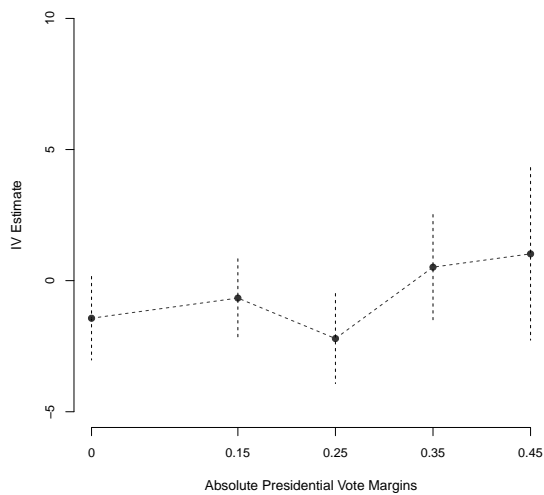
Prior-Weekend rain, we confirm that incumbents respond to voter signals when presidential elections are more competitive. As margins grow large, we observe less responsiveness. Estimates are always statistically indistinguishable from zero as Presidential vote margins exceed 0.15, and but appear to reverse sign at high levels of electoral security. In summary, at-risk incumbents are more responsive to new information than those representing safe districts, and this responsiveness may depend on the extent of electoral security.

### Party Asymmetry in Responsiveness

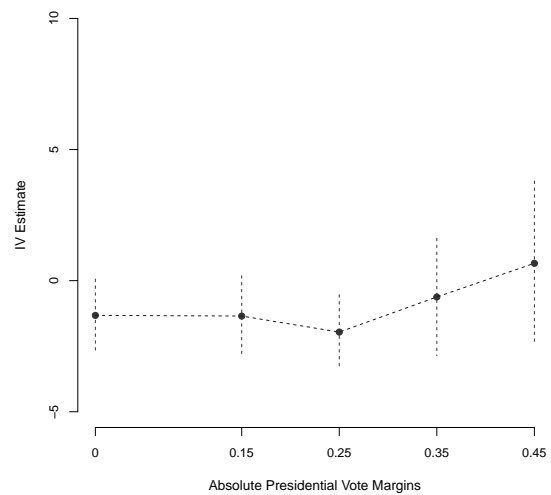
Our account also predicts that ideologically-driven incumbents will be less responsive to new information about voter attitudes. This may be because they have inflated confidences in their security or weight their own policy views above those of their constituents. Recent research has shown an asymmetry in representation between the parties, in which Republicans are the main source of polarization in Congress. Republicans appear more ideologically consistent across issues and more attached to their party than Democrats

(e.g., Layman et al. 2010). Beyond competitiveness, we assess whether Republicans are indeed less responsive than Democrats to vote margin signals.

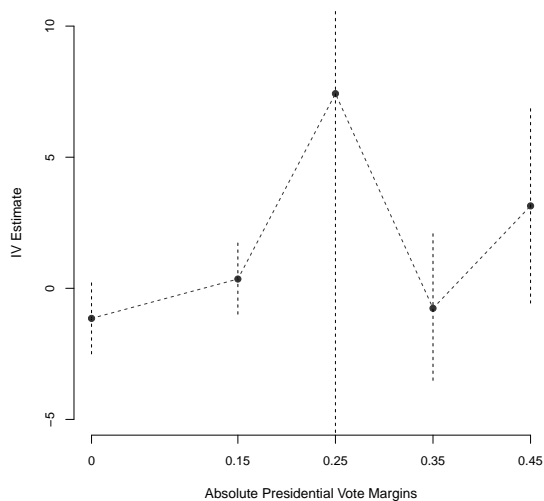
Figure 3: Effect of Democratic Vote Margins on Incumbent Roll Call Positioning as District Competitiveness Changes, by Incumbent Party



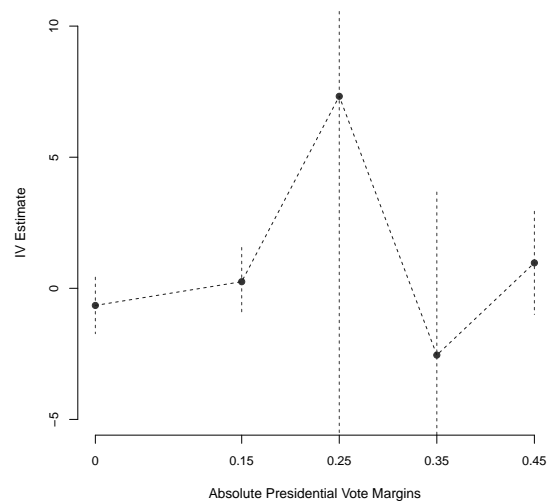
(a) Democrats – Election Day  $Rain_t$



(b) Democrats – Prior Weekend  $Rain_t$



(c) Republicans – Election Day  $Rain_t$



(d) Republicans – Prior Weekend  $Rain_t$

We stratify our analysis by Democratic or Republican incumbency, again using *Incum-*

*bent* fixed-effects and cluster errors.<sup>28</sup> The results confirm our prediction that Democrats rather than Republicans respond to information transmitted through changes in vote margins. Democrats shift significantly in response to conservative signals induced by Election-Day (-1.101,  $p = 0.037$ ) and Prior-Weekend rain (-1.235,  $p = 0.022$ ). While we observe a conservative shift (-1.559, -0.393) amongst Republicans, it is small and statistically insignificant.

An alternative explanation for this asymmetry is that adaptation depends on electoral security, and Republicans may simply represent less competitive districts. To assess whether Republicans adapt when marginal, similar to Figure 2 above, we again stratify our estimates by level of competitiveness broken down by party. These results are presented in Figure 3. Democrats again exhibit evidence of adaptation, particularly as their districts become more competitive, as instrumented by (a) Election Day and (b) Prior Weekend rain. As electoral security increases, Democratic incumbents become less responsive, closely mirroring the pattern overall displayed in Figure 2. In stark contrast, Republicans generally are unresponsive, even when they represent marginal districts. Leveraging both (c) Election-Day and (d) Prior-Weekend instruments, we find that Republicans in competitive districts (i.e., presidential margins less than 0.15), do not adapt following new voter signals. Unlike our findings for Democrats, neither of these stratified estimates are statistically different from zero. As presidential margins increase, we consistently find that Republicans are unresponsive to their districts' demands.

We argue that this finding, consistent with other work on party asymmetry, is due to Republicans' ideological rigidity relative to Democrats. In moderating, Democrats aim to improve their future win-margins. In contrast, Republicans fail to take advantage of additional the leeway offered by rain, and also do not moderate in response to dry weather. Notably, this result stands in stark contrast to Ladewig (2010), who argues that Republicans should be the most responsive to additional leeway. An alternative

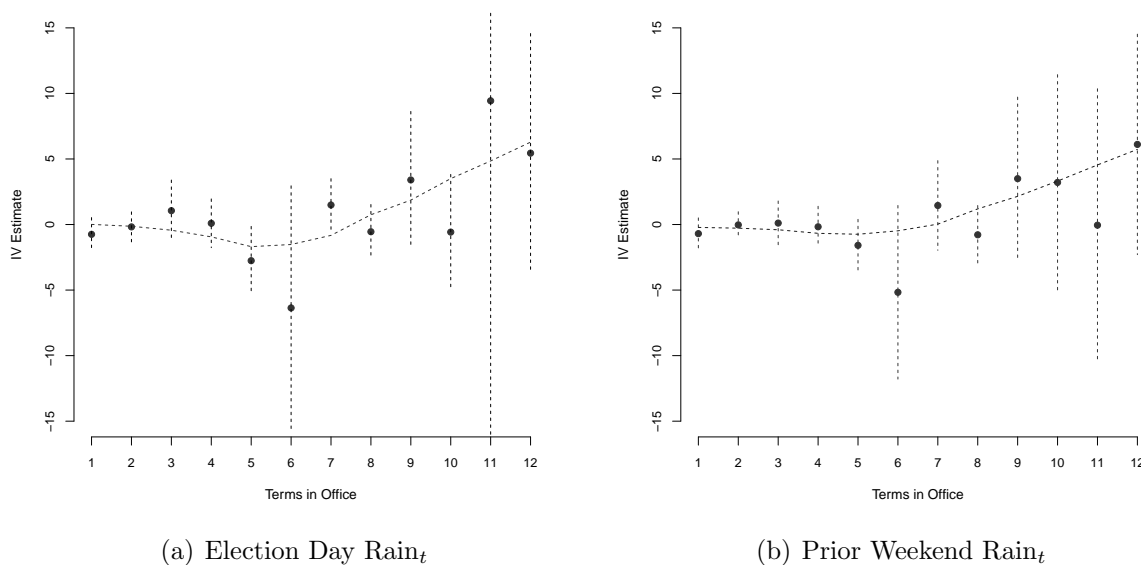
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<sup>28</sup>The full table of results is in Table II of the Online Appendix.

interpretation, however, is that rain imposes asymmetric costs on incumbents, presenting risks to Democrats, but insurance to Republicans. Republicans might view their increased support as signals of voter approval, and decide to maintain the same positions, rather than drift rightward. Winning Republicans may also be unwilling to give on policy when electorally unnecessary. Conversely, rain imposes costs for Democrats. Risk-averse Democrats may respond by positioning themselves closer to the political center. They also may be unwilling to take on additional risk by moving left following dry elections. Under either interpretation, our evidence indicates Democrats moderate following electoral losses, providing additional insight into how politicians respond to voter signals.

### Seniority and Standing Pat

Figure 4: Effect of Democratic Vote Margins on Incumbent Roll Call Positioning as District Competitiveness Changes, by Number of Terms in Office



Finally, we assess our theoretical prediction that incumbents grow less responsive to information over multiple terms in office. This expectation stems from a possible benefit afforded by seniority. Time in office allows politicians to accumulate greater knowledge

and expertise about their constituents, which may reduce their uncertainty when staking out policy positions, making them less sensitive to new signals. To test this prediction, we follow a similar line of analysis above. We stratify our estimates by the number of terms in office, focusing on incumbents with six or fewer terms (EARLY INCUMBENCY), and those serving for longer periods (LATE INCUMBENCY).<sup>29</sup> We then stratify our analysis by each term in office, presented in Figure 4. Pooling over early incumbency, we show that less senior politicians are more responsive ( $-1.018, p = 0.016$ ;  $-0.775, p = 0.028$ ) than their more senior colleagues ( $0.115, p = 0.917$ ;  $-1.220, p = 0.438$ ). In Figure 4, we find that incumbent-responsiveness decreases with additional time in office. Yet, this evidence is weak relative to our other results, and the nature of the effect is also less clear. Intriguingly, we find that incumbents are most consistently responsive to voter signals in their first, fifth and sixth terms, while adaptation tapers off after 12 years in office. The effects also appear to depend non-linearly on seniority, especially in early incumbency.

## What Can Incumbents Learn from Rainy Elections?

An important challenge to this study is that strategic politicians should discount ‘noise’ or other variation in election outcomes. Repeated ‘flipflops’ might displease voters and alienate core supporters. Incumbents also might be better off focusing on slow-moving trends rather than attending to periodic swings in district support. This critique may be especially sharp in the context of results driven by irrelevant or idiosyncratic events like weather. If these shifts do not reflect real changes in opinion or are likely to be temporary, incumbents may risk electoral losses in adapting to, rather than ignoring such ‘information.’ Adaptation might evince extreme uncertainty or foolishness.

One way to view this critique is as a potential violation of the *exclusion restriction* assumption made in the IV analysis. We assume rain only influences incumbent voting *through* its impact on electoral margins, and thus does not directly affect representation.

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<sup>29</sup>Results are in Table III of the Online Appendix.

That assumption is violated if incumbents rationalize their election margins, discounting changes in vote support that occur alongside rainy elections, attenuating responsiveness to signals from win margins. Notably, this alternative is consistent with elite uncertainty over voter attitudes, while also being entirely informed about rain's turnout effects. Yet, this view is also consistent with politicians being sufficiently well-informed to ignore any changes in margins, regardless of whether they are induced by weather.

We take this as the most serious critique of the theory and evidence. Besides this concern, we think the exclusion restriction is likely to hold. Election rain impacts vote margins immediately. Beyond that, though, rain is unlikely to influence any other district-factors driving representation. It is an open empirical question whether politicians consider or discount variation in win-margins in their strategic calculations, even when derived by rain. We provide causal evidence that elites do adapt, and do not wholly discount information signaled through rainy elections. In spite of any tendency to rationalize elections or ignore noisy signals, we still observe rightward shifts in roll-call votes following rain-induced Democratic vote losses. Further, it is possible politicians tend to engage in some discounting, muting even greater adaptive behavior, or that we mainly observe responsiveness when discounting is weak, as in marginal elections. Nevertheless, we take a willingness to adapt as evidence elites face at least some uncertainty about voters. Given this evidence, what exactly do incumbents learn about their districts from election rain?

An extreme view is that politicians are so poorly informed they respond to any signals, including random weather, tying their policies to the whims of nature. We think this is unlikely given the degree of stability in elite positioning, and the difficulty previous research has had finding evidence of adaptation. In contrast, we argue that incumbents possess some information about voters, but also are uncertain about the next election. As a result, incumbents are attentive to signals that communicate vulnerability, particularly when they provide plausible information about future vote support. We see rain as an opportunity to shed light on this learning process as it mediates representation. However, this view does require that elites, at least in part, have difficulty disentangling rain's effect

on voting from other information signaled through win margins.

There are several reasons why this is likely. Politicians may find it difficult to distinguish signals from noise during campaigns. Being risk-averse, they also may overcorrect to noisy signals, especially during competitive races (Jacobson 1987). Alternatively, incumbents might learn about the magnitude of rain's effect while campaigning. Elites may be uncertain about their levels of 'soft' versus 'hard' support. Rain may transmit this information by indicating the proportion of supporters who will not turn out when voting is increasingly costly. Lower vote margins could combine with election rain to signal important information about the difficulty of mobilizing 'soft' voters who are especially pivotal in close elections.<sup>30</sup> Accordingly, incumbents moderate to mobilize support after learning about their vulnerability to electoral shocks.

Finally, even noisy processes can have systematic consequences. Following a rainy election, stronger opponents might decide to run or raise more money to challenge weaker-than-expected incumbents. Politicians could adapt to stem these challenges. Rain may also have a long-run impact on voter turnout and district partisanship. If voting is habit-forming, being deterred by rain in this election may reduce Democratic participation in the future, permanently shifting electorates to the right. Consequently, even if losses are idiosyncratic, elites have meaningful reasons to adapt to the information signaled to them and their opponents, to shore up future electoral support.

We raise these alternatives, not to adjudicate between them, but to highlight elite uncertainty and adaption to vote margins does not mean politicians are irrational or foolish. Quite oppositely, we maintain that elites are rational, but have imperfect beliefs about electoral realities. We see this uncertainty as a fundamental feature of representation. Elites strategically incorporate signals they perceive as credible indicators of future voting. More research is necessary to determine which, if any, of the above information

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<sup>30</sup>This account is spatial and has an enthusiasm component: the closer an incumbent is to a voter's policy views, the greater rain's must be to deter participation.



mechanisms can explain the adaptation we uncover. Yet, each of these views underscores that responsive representation is contingent on voters' abilities to send information to politicians (e.g., Butler and Nickerson 2011; Kousser, Lewis, and Masket 2007), and the ability of politicians to take notice and respond accordingly.

## Conclusion

A central debate in the study of representation is whether elites act mainly as delegates adapting to voters' demands (Butler and Nickerson 2011; Miller and Stokes 1963), or as trustees standing pat until they are electorally replaced (Lee, Moretti, and Butler 2004; Poole 2007). We maintain that politicians *are* willing to adapt to voters' preferences to win elections, and do not exclusively operate as Burkean trustees. However, unlike traditional accounts of representation (e.g., Downs 1957; Jacobson 1987), we argue that incumbents, much like voters, face systematic shortfalls in information. Elites are imperfectly informed about the policy demands of constituents, which constrains their ability to adapt to changes in attitudes. Importantly, this uncertainty may contribute to continued polarization and a disconnect in representation, especially as incumbents pay more attention to louder and more extreme policy demanders (Fiorina 2009).

Our study joins a growing body of research on elite uncertainty, and makes a new contribution to understanding how democratic representation aggregates voter opinions into policies. Elites pay attention to many different kinds of information in their scramble to address voter concerns, yet are most sensitive to credible signals predicting the next election. We argue that shifts in prior electoral support provide one of the clearest indicators of voter demands used by elites. Furthermore, these shifts allow for a strong empirical test of our theory. If imperfectly informed politicians adapt to new information, they should pay attention to changes in their previous win-margins, and be willing to adjust their roll-call behavior accordingly. Yet, we do not expect all incumbents to adapt similarly. Better informed incumbents, and those with greater electoral security or

stronger policy motives will be less sensitive to new signals.

We utilize five decades of data to assess this account. Our study offers a major improvement in research design by using rain as a natural experiment. Research on representation has faced considerable difficulty in interpreting the association between incumbent positions and voter attitudes as evidence of adaptation. Unlike many factors influencing elections, rain is essentially random. It shifts electorates to the right on policy by imposing participation costs that dissuade some Democrats from voting. We exploit this to test if legislators then adjust their roll-call positions rightward. The results confirm this prediction. Through a placebo, we show that responsiveness is not likely confounded by any unobserved differences across districts associated with voting or candidate entry. Further, rain does not significantly contribute to incumbents' losses, but instead meaningfully influences legislative behavior.

Unlike much prior research, including Ladewig (2010), we find the most adaptation in marginal races, where incumbents have the strongest incentives to pay attention to new information about their re-election chances. This suggests a key role for elite information in the 'marginality hypothesis.' We also uncover evidence of asymmetrical responsiveness: Democrats shift, but Republicans largely do not. This points to important differences in the ways parties represent voters. Yet, rain's asymmetric costs also might contribute to this result. To disentangle these alternatives, future work should examine other shocks imposing symmetrical costs for the parties (e.g., anti-incumbency shocks), or instruments working in the opposite partisan direction as rain. We uncover weaker evidence that responsiveness diminishes over a legislative career (e.g., Stratmann 2000). Additional research is needed to clarify the precise way in which seniority mediates adaptation, as well as the more general conditions under which elites are responsive to voters.

Though our evidence indicates that elites respond to clear signals from voters, and are not merely subject to replacement, rain-induced adaptation may offer a flimsy link in the representational chain. Weather itself provides limited information about voter opinion. Our study joins a growing body of research showing that idiosyncratic factors

can systematically influence representation. Like similar ‘irrelevant’ events, rain-induced signals may pose a challenge for democracy (Achen and Bartels 2004; Healy, Malhotra, and Mo 2010). Though rain’s impact is modest, representation might improve if politicians ignored it. Also troubling, rain could have a lasting impact on voter participation, permanently altering the electoral landscape.

In addition to vote margins, politicians use other signals to update their beliefs, such as polls, news coverage or interest group lobbying. These sources are likely biased given the forces (e.g., intrinsic efficacy, campaign mobilization) that differentially motivate citizens to be engaged (Broockman 2014; Hansen 1991). While imperfect in isolation, however, these signals may be more informative in the aggregate.<sup>31</sup> Further work should examine the myriad channels by which imperfectly informed elites learn about about voters, as well as how they weight information given variation in its accuracy, credibility and cost. While we mainly focus on elite uncertainty over voter attitudes, incumbents might also face other information shortfalls, such as over the effectiveness of their or their opponents’ campaign organizations. Much is still unknown about how politicians’ limited information affects representation. Greater scholarly attention to elite uncertainty will improve our understanding of how elections link citizens to the policymaking process. Nonetheless, while the electoral connection is imperfect, we underscore an important information mechanism explaining how elections tether representatives to their constituents.

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<sup>31</sup>The priorities of pollsters or news organizations, for example, might favor some groups’ demands over others, but in opposing directions.

## References

- Achen, Christopher H., and Larry M. Bartels. 2004. "Musical Chairs: Pocketbook Voting and the Limits of Democratic Accountability." American Political Science Association Annual Meeting, September 2004.
- Adler, E. Scott. 2012. "Congressional District Data File." [Computer File].
- Broockman, David. 2014. "Distorted Communication, Unequal Representation: Constituents Communicate Less to Representatives Not of Their Race." *American Journal of Political Science* 58 (2): 307–321.
- Broockman, David, and Christopher Skovron. 2013. "What Politicians Believe About Their Constituents." Vanderbilt Conference on Political Representation, March 2013.
- Bullock, John G. 2009. "Partisan Bias and the Bayesian Ideal in the Study of Public Opinion." *Journal of Politics* 71 (3): 1109–1124.
- Butler, Daniel M., and Adam M. Dynes. 2015. "How Politicians Discount the Opinions of Constituents with Whom They Disagree." *American Journal of Political Science*.
- Butler, Daniel M., and David W. Nickerson. 2011. "Can Learning Constituency Opinion Affect How Legislators Vote? Results from a Field Experiment." *Quarterly Journal of Political Science* 6 (1): 55–83.
- Canes-Wrone, Brandice, David W. Brady, and John F. Cogan. 2002. "Out of Step, Out of Office: Electoral Accountability and House Members' Voting." *American Political Science Review* 96 (1): 127–140.
- Caughey, Devin, and Jas Sekhon. 2011. "Elections and the Regression-Discontinuity Design: Lessons from Close U.S. House Races, 1942–2008." *Political Analysis* 19: 385–408.
- Clinton, Joshua D., Simon Jackman, and Doug Rivers. 2004. "The Statistical Analysis of Roll Call Data." *American Political Science Review* 98 (2): 355–370.

- Congressional Quarterly. 2014. "CQ Congress Collection." Accessed Online at: <http://library.cqpress.com/congress/>.
- Downs, Anthony. 1957. *An Economic Theory of Democracy*. New York, NY: Harper & Row.
- Enos, Ryan D., and Eitan D. Hersh. 2015. "Campaign Perceptions of Electoral Closeness: Uncertainty, Fear and Over-Confidence." *British Journal of Political Science*: 1–19.
- Fiorina, Morris P. 2009. *Disconnect: The Breakdown of Representation in American Politics*. Norman, OK: The University of Oklahoma Press.
- Fraga, Bernard, and Eitan Hersh. 2010. "Voting Costs and Voter Turnout in Competitive Elections." *Quarterly Journal of Political Science* 5 (4): 339–356.
- Gatrell, Jay D., and Gregory D. Bierly. 2002. "Weather and Voter Turnout: Kentucky Primary and General Elections, 1990-2000." *Southeastern Geographer* 42: 114–134.
- Gelman, Andrew, and Gary King. 1990. "Estimating Incumbency Advantage without Bias." *American Journal of Political Science* 34 (4): 1142–1164.
- Gomez, Brad T., Thomas G. Hansford, and George A. Krause. 2007. "The Republicans Should Pray for Rain: Weather, Turnout, and Voting in U.S. Presidential Elections." *Journal of Politics* 69 (3): 649–663.
- Griffin, John D. 2006. "Electoral Competition and Democratic Responsiveness: A Defense of the Marginality Hypothesis." *Journal of Politics*, 68 (4): 911–921.
- Grofman, Bernard. 2004. "Downs and Two-Party Convergence." *Annual Review of Political Science* 7: 25–46.
- Grofman, Bernard, Robert Griffin, and Gregory Berry. 1995. "House Members Who Become Senators: Learning from a Natural Experiment in Representation." *Legislative Studies Quarterly* 20 (4): 513–29.

- Hansen, John Mark. 1991. *Gaining Access: Congress and the Farm Lobby, 1919–1981*. Chicago: University of Chicago Press.
- Hansford, Thomas G., and Brad T. Gomez. 2010. “Estimating the Electoral Effects of Turnout.” *American Political Science Review* 104 (2): 268–288.
- Healy, Andrew J., Neil Malhotra, and Cecilia Hyunjung Mo. 2010. “Irrelevant Events Affect Voters’ Evaluations of Government Performance.” *Proceedings of the National Academy of Sciences* 107 (29): 12804–12809.
- Jacobson, Gary C. 1987. “Running Scared: Elections and Congressional Politics in the 1980s.” In *Running Scared: Elections and Congressional Politics in the 1980s*, ed. Mathew D. McCubbins and Terry Sullivan. New York, NY: Cambridge University Press.
- Keele, Luke, and Jason Morgan. 2013. “Stronger Instruments By Design.” American Political Science Association Annual Meeting, September 2013.
- Klimstra, Theo, Tom Frijns, Loes Keijsers, Jaap Denissen, Quinten Raaijmakers, Marcel van Aken, Hans Koot, Pol van Lier, and Wim Meeus. 2011. “Come Rain or Come Shine: Individual Differences in How Weather Affects Mood.” *Emotion* 11 (6): 1495–1499.
- Knack, Steve. 1994. “Does Rain Help the Republicans? Theory and Evidence on Turnout and the Vote.” *Public Choice* 79 (1): 187–209.
- Kousser, Thad, Jeffrey B. Lewis, and Seth E. Masket. 2007. “Ideological Adaptation? The Survival Instinct of Threatened Legislators.” *Journal of Politics* 69 (3): 828–843.
- Ladewig, Jeffrey W. 2010. “Ideological Polarization and the Vanishing of Marginals: Retrospective Roll-Call Voting in the U.S. Congress.” *The Journal of Politics* 72 (2): 499–512.
- Layman, Geoffrey C., Thomas M. Carsey, John C. Green, Richard Herrera, and Rosalyn Cooperman. 2010. “Activists and Conflict Extension in American Party Politics.” *American Political Science Review* 104 (2): 324–346.

- Lee, David S., Enrico Moretti, and Matthew J. Butler. 2004. "Do Voters Affect or Elect Policies?" *Quarterly Journal of Economics* 119 (3): 807–859.
- Lo, James. 2013. "Legislative Responsiveness to Gerrymandering: Evidence from the 2003 Texas Redistricting." *Quarterly Journal of Political Science* 8 (1): 75–92.
- Martin, Andrew, Kevin M. Quinn, and Jong Hee Park. 2011. "MCMCpack: Markov Chain Monte Carlo in **R**." *Journal of Statistical Software* 42 (9).
- Miller, Warren E., and Donald E. Stokes. 1963. "Constituency Influence in Congress." *American Political Science Review* 57 (1): 45–56.
- Nyhan, Brendan, Eric McGhee, John Sides, Seth Masket, and Steven Greene. 2012. "One Vote Out of Step? The Effects of Salient Roll Call Votes in the 2010 Election." *American Politics Research* 40 (5): 844–879.
- Poole, Keith T. 2007. "Changing Minds? Not in Congress!" *Public Choice* 131 (3-4): 435–451.
- Poole, Keith T., and Howard Rosenthal. 1997. *Congress: A Political-economic History of Roll Call Voting*. New York, NY: Oxford University Press.
- Rosenstone, Steven J., and John Mark Hansen. 1993. *Mobilization, Participation, and Democracy in America*. New York, NY: Macmillan Publishing.
- Stock, James H., and Motohiro Yogo. 2005. "Testing for Weak Instruments in Linear IV Regression." In *Identification and Inference for Econometric Models*, ed. James H. Stock and Donald W.K. Andrews. Cambridge, UK: Cambridge University Press.
- Stratmann, Thomas. 2000. "Congressional Voting over Legislative Careers: Shifting Positions and Changing Constraints." *American Political Science Review* 94 (3): 665–676.
- van Buuren, Stef, and Karin Groothuis-Oudshoorn. 2011. "MICE: Multivariate Imputation by Chained Equations in **R**." *Journal of Statistical Software* 45 (3).