

Geography, Uncertainty, and Polarization*

Nolan McCarty[†], Jonathan Rodden[‡], Boris Shor[§]
Chris Tausanovitch,[¶] and Christopher Warshaw^{||}

October 9, 2014

Abstract

Using new data on roll-call votes of U.S. state legislators and measures of public opinion in their districts, we explain how ideological polarization of voters within districts can lead to legislative polarization. Many of the so-called “moderate” districts that switch hands between Democrats and Republicans are internally polarized. The ideological distance between Democrats and Republicans within these districts is often greater than the distance between liberal cities and conservative rural areas. We present a theoretical model in which intra-district ideological polarization causes candidates to be uncertain about the ideological location of the median voter, thereby reducing their incentives to moderate their policy positions. We then demonstrate that in districts with similar median voter ideologies, the difference in roll-call voting behavior between Democratic and Republican state legislators is greater when there is more within-district ideological heterogeneity. Our findings suggest that accounting for the subtleties of political geography can help explain the coexistence of a polarized legislature and a moderate mass public.

*Earlier versions of this paper were presented at the 2013 Annual Meetings of the American Political Science Association, the 2014 Conference on the Causes and Consequences of Policy Uncertainty at Princeton University, and the 2014 European Political Science Association. We thank Project Votesmart for access to NPAT survey data. The roll call data collection has been supported financially by the Russell Sage Foundation, the Princeton University Woodrow Wilson School, the Robert Wood Johnson Scholar in Health Policy program, and NSF Grants SES-1059716 and SES-1060092. Special thanks are due to Michelle Anderson and Peter Koppstein for running the roll-call data collection effort. We also thank the following for exemplary research assistance: Steve Rogers, Michael Barber, and Chad Levinson.

[†]Professor, Department of Politics and the Woodrow Wilson School, Princeton University, nmccarty@princeton.edu

[‡]Professor, Department of Political Science and Senior Fellow, Hoover Institution, Stanford University, jrodden@stanford.edu

[§]Visiting Assistant Professor, Department of Government, Georgetown University, boris@bshor.com

[¶]Assistant Professor, Department of Political Science, UCLA, ctausanovitch@ucla.edu

^{||}Assistant Professor, Department of Political Science, Massachusetts Institute of Technology, cwarshaw@mit.edu

Introduction

One of the central puzzles in the study of American politics is the coexistence of an increasingly polarized Congress with a stable and centrist electorate (Fiorina 2010). Because it has been difficult to find a reliable link between polarization in Congress and the polarization of voter policy preferences in national surveys, researchers have generally abandoned explanations of congressional polarization that rely on changes in the ideology of the mass public, looking instead at institutional features like primaries, agenda control in the legislature, and redistricting that may have led to increased Congressional polarization (Fiorina and Abrams 2008; Barber and McCarty 2013).¹

This paper brings attention back to the distribution of ideology in the mass public with new data and an alternative theoretical approach. Previous explanations for polarization focus, quite naturally, on variation across the nation as a whole, or on the average traits of citizens in each district (e.g., Clinton 2006; McCarty, Poole and Rosenthal 2006; Jacobson 2004; Levendusky 2009). This work follows from a long literature on representation that builds on Anthony Downs's (Downs 1957) argument that two candidate competition should lead to platforms that converge on the preferences of the median voter. The great majority of scholarship on this question, however, finds that the median voter is an inadequate predictor of candidate or legislator positions (Ansolabehere, Snyder and Stewart 2001; Bafumi and Herron 2010; Clinton 2006; Miller and Stokes 1963). Moreover, as McCarty, Poole and Rosenthal (2006) and McCarty, Poole and Rosenthal (2009) have shown, polarization in Congress over the past four decades has been primarily a reflection of the increased differences

¹Scholars have generally recognized that the policy positions of partisan identifiers have diverged over the past several decades, but that this is due to better ideological sorting of voters into partisan camps. But rather than driving elite polarization, such sorting may be caused by it (see (Levendusky 2009)).

in the way Republicans and Democrats represent otherwise similar districts.². Consequently, it is unlikely that variation in the position of the median voter, either cross-sectionally or across-time, causes polarization.

We take a different approach. We build on a nascent literature that focuses on the distribution of preferences across voters *within* districts rather than the distributions of voter medians or means across districts (Gerber and Lewis 2004; Levendusky and Pope 2010). Our theory builds on the work of Calvert (1985) and Wittman (1983) who argue that policy-motivated candidates might adopt divergent positions in the face of uncertainty about voter preferences. Specifically, our argument is based on a model in which candidates with ideological preferences must choose platforms in the presence of uncertainty over the median voter. When candidates are uncertain about the ideological location of the median voter, they shade their platforms toward their or their party's more extreme ideological preferences. Our key insight is that uncertainty about the median voter is driven in part by the ideological distribution of preferences in the district. The intuition is that when there is a large mass of voters around the district median, even volatile turnout and substantial preference shocks will result in a median voter on election day close to the expected median. Consequently, candidates deviate from the expected median at their peril. In contrast, when voters are more evenly or bimodally distributed throughout the ideological spectrum, there is more uncertainty about the identity of the median position of those who show up on Election Day. This implies weaker incentives for the candidates to strategically suppress their ideological leanings in pursuit of victory.

After presenting our argument, we turn to an empirical analysis of the roll call voting

²State legislative polarization exhibits a similar pattern (Shor and McCarty 2011)

behavior of state legislators. Existing research on polarization in the United States focuses primarily on attempting to explain the dramatic growth of polarization in the United States Congress (Poole and Rosenthal 1997). Unfortunately, Congressional polarization has moved in tandem with many potential explanatory variables. Thus, the exclusive focus on Congress undermines efforts to test competing hypotheses. Moreover, most of the increase in polarization occurred prior to the years for which reliable estimates of voter ideology can be created at the district level. Drawing on the data collection efforts of Shor and McCarty (2011), we turn away from the traditional analysis of change over time in the U.S. Congress, focusing instead on the considerable cross-sectional variation in state legislative polarization.

Building on the work of McCarty, Poole and Rosenthal (2009), we match districts that are as similar as possible on all dimensions but partisan control, showing that 1) as in the U.S. Congress, there is considerable divergence in roll-call voting across otherwise identical districts controlled by Democrats and Republicans, and 2) this inter-district divergence is a function of within-district ideological polarization as well as more direct proxies for uncertainty over the identity of the district median voter.

We conclude with a discussion of the implications of these findings for the polarization literature. Based on our findings, we find it quite plausible that the rise of polarization in the U.S. Congress has been driven in part by increasing within-district polarization associated with demographic and residential sorting in recent decades. Moreover, our results suggest skepticism about redistricting reforms aimed at creating more ideologically heterogeneous districts as a cure for legislative polarization (McCarty, Poole and Rosenthal 2009; McGhee et al. 2014; Kousser, Phillips and Shor 2013). Finally, the utility of these results for explaining polarization suggests that future research on representation should take seriously the idea

that other features of the distribution of preferences within districts may be important for determining legislator positions. Legislators do not answer to a single principle or compete with a fixed challenger (Besley 2007). They must balance competing strategic considerations as well as their own preferences in deciding what policy positions to uphold (Fiorina 1974).

Polarization in the Mass Public and State Legislatures

We begin by reviewing some of the stylized facts and research findings that motivate the remainder of the paper. First, we examine the geographic distribution of ideology within states. One of the obstacles to previous research on this topic is that we have lacked good measures of the mass public's ideology at the individual level in each state. However, Tausanovitch and Warshaw (2013) illustrated that scholars can estimate the ideal points of survey respondents from many surveys and project them onto a common scale. Based on this approach, we bridge together the ideal points of survey respondents from eight recent large-sample surveys using survey responses on a battery of policy questions. The resulting dataset has a measure of the ideological preferences of over 350,000 respondents on a common scale. This data enables us to dramatically increase the size of survey samples within small geographic areas, which makes it possible to characterize not only the mean or median position, but also the nature of the overall distribution of ideological preferences within states and legislative districts.

These data enable a new approach to what is becoming a classic question in American politics: does ideological polarization in the mass public correspond to ideological polarization in legislatures? The current literature answers with a tentative “no,” based on time

series analysis of the U.S. Congress, where legislative polarization has grown but the ideological distance between Democrats and Republicans began growing much later and has not grown at the same rate.

As discussed above, Shor and McCarty (2011) have estimated ideal points of members of state legislatures from a large data set of roll-call votes covering several years. Combining the data on ideological distributions of voters and positions of state legislators provides the opportunity to take a first look at the relationship between district heterogeneity and legislative polarization. If legislative polarization is a function of ideological polarization of voters across districts, we might expect to see the familiar bimodal distribution of legislator ideal points mirrored in the distribution of ideology across districts.

Figure 1: Distributions of roll-call votes and district ideology



Figure 1 displays kernel densities of both measures across all state upper chambers: there is sharp divergence between the roll-call votes of Democrats and Republicans, but the distribution of ideology across districts has a single peak. The disjuncture is even more

extreme when one examines these distributions separately for each state. Thus Fiorina's (2010) puzzle reappears at the district level: there is a large density of moderate districts, but in many states the middle of the ideological distribution is not well represented in state legislatures.

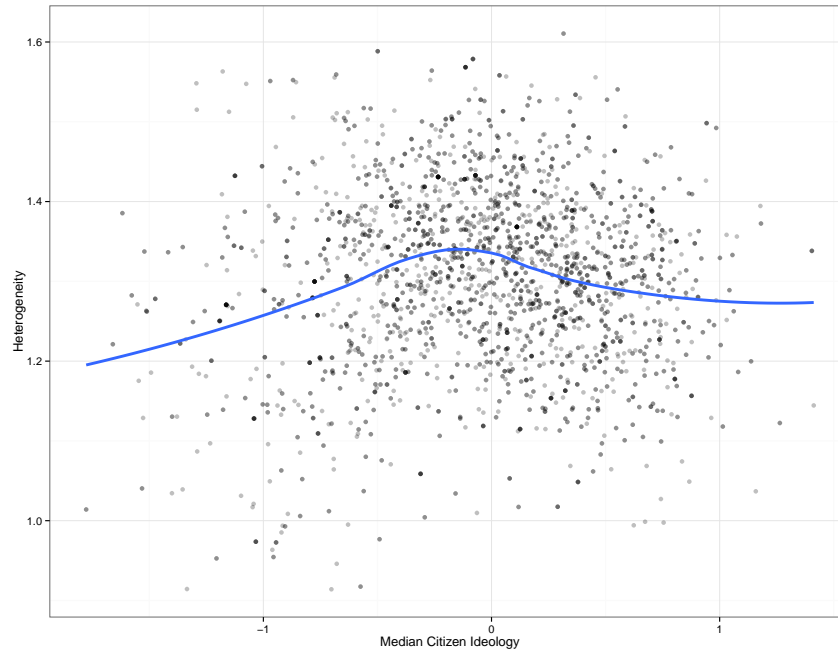
Next, we examine cross-state variation in the polarization of legislatures that we measure as the distance in ideal point estimates between state legislative Democratic and Republican medians (averaged across chambers). A commonly held view of polarization is that it reflects the way in which voters are allocated across districts. If this were the case, we would expect to see our measure of legislative polarization correlate strongly with the variation of district medians within each state. In the top panel of Figure 2, we consider this hypothesis by plotting the degree of legislative polarization against across-district ideological polarization in the mass public for each state. Indeed, we find a correspondence between across-district polarization and the polarization of the legislature. This relationship, however, leaves a large portion of variance unexplained. In the bottom panel of Figure 2 we test a different proposition—that polarization *within* districts correlates legislative polarization. Again we find a systematic relationship. Not only is legislative polarization correlated with across-district ideological polarization, but the states with the highest levels of within-district polarization, like California, Colorado, and Washington, are also clearly those with the highest levels of legislative polarization. In the states like West Virginia and Louisiana—where public opinion is not very polarized within districts—the parties in the legislature are much more alike.

Which districts are heterogeneous? More specifically, what is the relationship between ideology—how conservative or liberal a district is on average—and that district's heterogeneity?

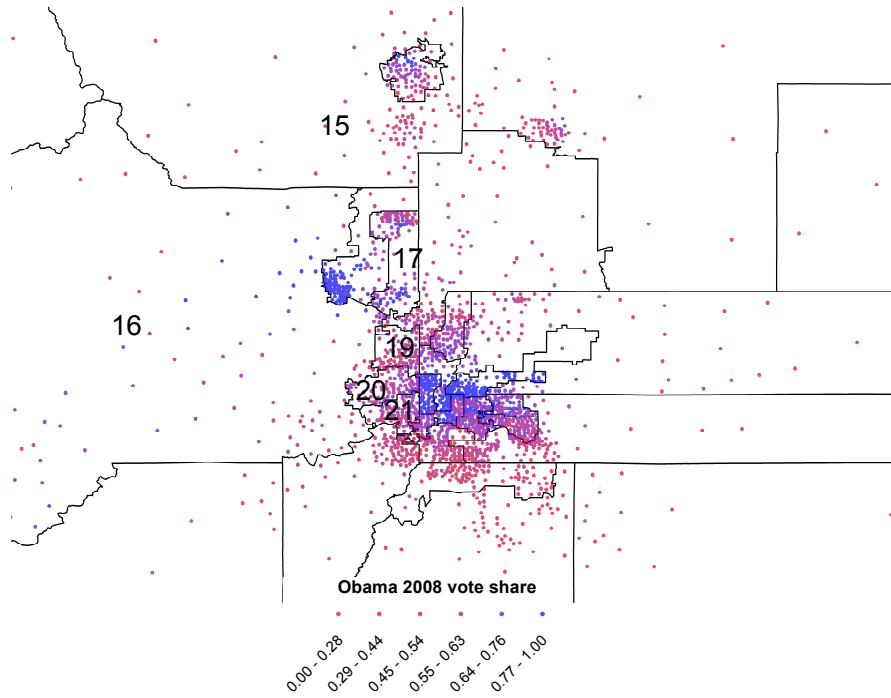
Figure 3 plots our measure of the standard deviation of public ideology for each state senate district on the vertical axis, and our estimate of mean ideology of the district on the horizontal axis. The left side of the inverted U shape of the lowess plot in Figure 3 shows that the far-left urban enclaves are ideologically relatively homogeneous. The same is true for the conservative exurban and suburban districts on the right side of the plot.

The most internally polarized districts are those in the middle of the ideological spectrum. In other words, the districts with the most moderate ideological means—the so-called “purple” districts where the presidential vote share is most evenly split—tend to be places where the electorate is most deeply polarized. These are the districts that switch back and forth between parties in close elections and determine which party controls the state legislature. Reformers often idealize such moderate districts because it is believed that they are most conducive to the political competition that produces moderate representation. But as we will show, the fact that such districts are more likely to be heterogeneous mitigates their ability to elect moderate legislators.

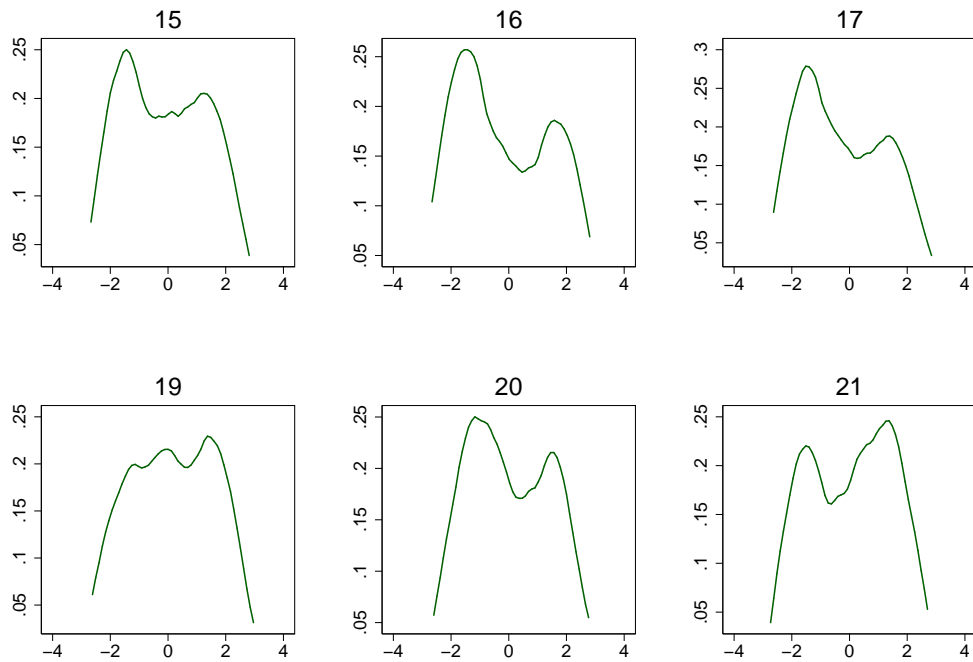
Figure 3: Average district ideology and within-district polarization



To better understand why moderate districts are usually heterogeneous districts, it is useful to take a closer look at the distribution of ideology in a highly polarized state. Figure 4 zooms in on the pivotal “purple” Denver-Boulder suburban corridor, representing the centroids of precincts with colored dots. The numbers of the districts with the most ideologically moderate means are displayed in Figure 4, and these match up with kernel densities, displayed in Figure 4, of the distribution of our ideological scale within each corresponding district. Clearly, these districts are purple primarily because red and blue precincts have been joined together to create heterogeneous mixtures of liberal and conservative voters.



(a) Precinct-level 2008 Obama vote share



(b) Within-district distribution of ideology, pivotal districts

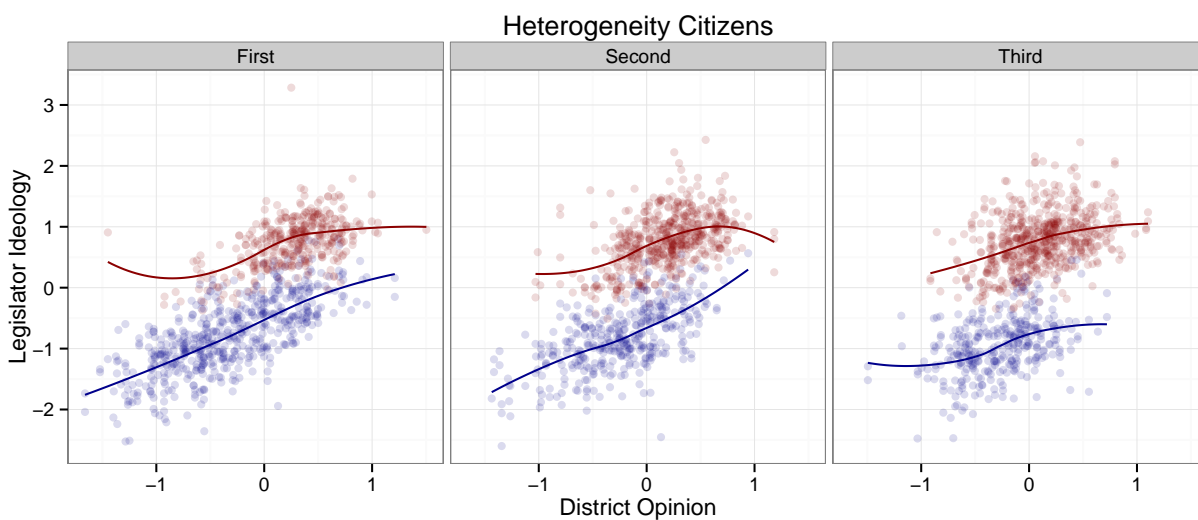
Figure 4: Within-district distributions of votes and ideology, selected Colorado Senate districts

These stylized facts motivate the remainder of the paper. In the middle of each states' distribution of districts lies a set of potentially pivotal districts that are ideologically moderate on average, but where voters are polarized within. Moreover, this within-district ideological polarization is a good predictor of polarization in state legislatures.

But given the logic of the median voter, why would electoral competition in these pivotal but polarized districts generate such polarized legislative representation? The remainder of the paper develops a simple intuition: a heterogeneous internal distribution of ideology creates uncertainty over the spatial location of the median voter. When a district is internally polarized, a moderate shift in voting or turnout—perhaps driven by national or statewide trends—can lead to a substantial shift in the location of the median voter. Relative to a district with a large density of moderates in the middle of the internal distribution, candidates in such polarized districts face weaker incentives for platform convergence.

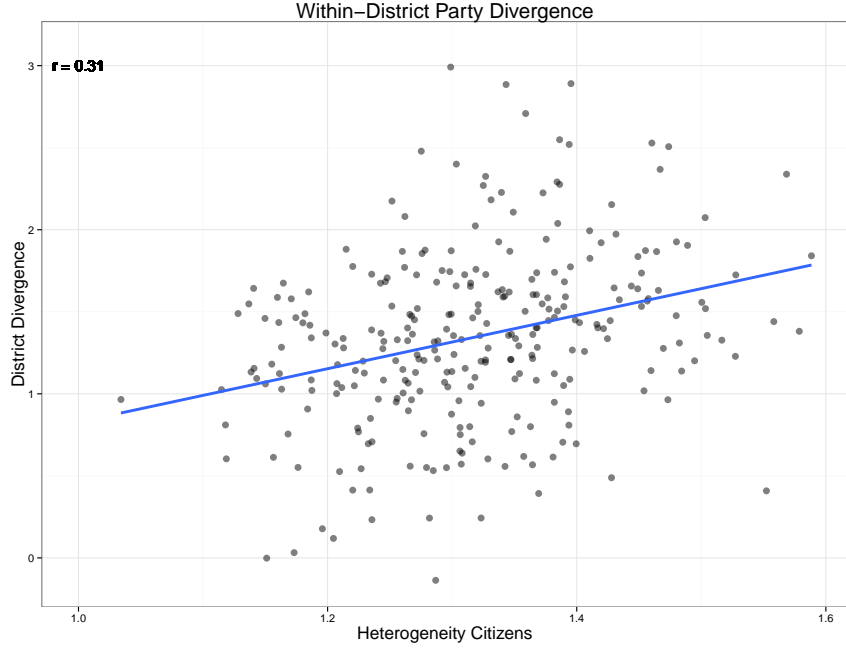
Before we describe the formal model and its empirical counterpart, we can take a quick look at the raw data to confirm the plausibility of our intuitions. Figure 5 shows how legislator ideology changes with district opinion. The three panels represent terciles of district heterogeneity, with the leftmost (or “1”) the least heterogeneous, and the rightmost (“3”) the most heterogeneous. Each dot represents a unique legislator serving some time between 2003 and 2012, colored red for Republicans and blue for Democrats. Both parties are responsive to district opinion, with more conservative districts being represented by more conservative legislators. Nevertheless, a distinct separation between the parties is quite evident. Even more central to our point, that divergence is largest for districts which are the most heterogeneous.

Figure 5: Scatterplot of Legislator Ideology and District Opinion, by Heterogeneity Tercile



We can also examine the subset of districts which have been represented by both parties at some point in this decade. We measure within-district party divergence as the difference in the average ideal point score of Democrats and Republicans who have served in the same district across the decade. Figure 6 shows plots this divergence as the function of district opinion heterogeneity. The results are quite obvious; district heterogeneity and legislator partisan divergence are quite strongly related.

Figure 6: Scatterplot of District Heterogeneity and Partisan Divergence



The Model

Following Wittman (1983) and Calvert (1985), we assume that there are two political parties who have preferences over a single policy dimension. Let $\theta_L < \theta_R$ be the ideal points of party L and R respectively. The preferences of party L are given by a concave utility function $u_L(x)$ where u_L is maximized at zero for $x = \theta_L$ and decreasing in $x > \theta_L$. Similarly, the utility of party R is given by $u_R(x)$ which is maximized at $x = \theta_R$ and increasing for $x < \theta_R$.³

We assume that the parties are uncertain about the distribution of voter preferences. But they share common beliefs that the ideal point of the median (and decisive) voter m is given by probability function F . We assume that the median voter has preferences that are single-peaked and symmetric around m .

³Outcomes outside the interval $[\theta_L, \theta_R]$ involve dominated strategies.

Prior to the election, parties L and R commit to platforms x_L and x_R .⁴ Voter m votes for the party with the closest platform. Therefore, party L wins if and only if $m \leq \frac{x_L + x_R}{2}$.

Therefore, we may write the payoffs for the parties as follows:

$$U_L(x_L, x_R) = F\left(\frac{x_L + x_R}{2}\right) u_L(x_L) + \left[1 - F\left(\frac{x_L + x_R}{2}\right)\right] u_L(x_R) \quad (1)$$

and

$$U_R(x_L, x_R) = F\left(\frac{x_L + x_R}{2}\right) u_R(x_L) + \left[1 - F\left(\frac{x_L + x_R}{2}\right)\right] u_R(x_R) \quad (2)$$

The first order conditions for optimal platforms are ⁵

$$F\left(\frac{x_L + x_R}{2}\right) u'_L(x_L) + \frac{1}{2} \left[F'\left(\frac{x_L + x_R}{2}\right) \right] (u_L(x_L) - u_L(x_R)) = 0 \quad (3)$$

$$\left[1 - F\left(\frac{x_L + x_R}{2}\right)\right] u'_R(x_R) + \frac{1}{2} \left[F'\left(\frac{x_L + x_R}{2}\right) \right] (u_R(x_L) - u_R(x_R)) = 0 \quad (4)$$

It is straightforward to establish that convergence is not an equilibrium. Suppose $x_L = x_R$, then the first-order conditions become

$$\frac{1}{2} u'_L(x) = 0 \quad (5)$$

$$\frac{1}{2} u'_R(x_R) = 0 \quad (6)$$

But since $\theta_L < \theta_R$, these equations cannot hold simultaneously. It is also easy to see that $x_L = \theta_L$ and $x_R = \theta_R$ is never an equilibrium. In this case, the first-order conditions would

⁴In equilibrium, it must be the case that $x_L \leq x_R$ otherwise each party would prefer to lose to the other.

⁵The second-order conditions will be met so long as F is not too convex.

become

$$-\frac{1}{2} \left[F' \left(\frac{\theta_L + \theta_R}{2} \right) \right] u_L(\theta_R) = 0 \quad (7)$$

$$\frac{1}{2} \left[F' \left(\frac{\theta_L + \theta_R}{2} \right) \right] u_R(\theta_L) = 0 \quad (8)$$

But these equations cannot hold as the left-hand side of the first expression is strictly positive and the left-hand side of the second is strictly negative. Thus, party L gains from moving its position to the right and party R gains by moving its position to the left.

The only candidate equilibrium is one where $\theta_L < x_L^* < x_R^* < \theta_R$. Thus, when there is uncertainty about the median voter, the candidates diverge in equilibrium. Conversely, if the median voter is known with certainty, then candidates converge as predicted by Downs.

Now, we can establish the direct relationship between uncertainty and polarization by re-writing the first-order conditions as:

$$\frac{F' \left(\frac{x_L + x_R}{2} \right)}{F \left(\frac{x_L + x_R}{2} \right)} = \frac{-2u'_L(x_L)}{u_L(x_L) - u_L(x_R)} \quad (9)$$

$$\frac{F' \left(\frac{x_L + x_R}{2} \right)}{1 - F \left(\frac{x_L + x_R}{2} \right)} = \frac{2u'_R(x_R)}{u_R(x_R) - u_R(x_L)} \quad (10)$$

The left-hand sides on both equations get larger as the candidates converge (as convergence reduces the denominator). So the level of divergence depends on two features of the distribution of m , $\frac{F'}{1-F}$, and $\frac{F'}{F}$ at the cutpoint between platforms. These ratios are the known as the hazard rate and the reverse hazard rate of the distribution, respectively. For a very large family of distributions, these hazard rates are decreasing in the variance of m at least when evaluated near the center of the distribution. For the uniform distribution, the hazard

rates are decreasing in the variance across the entire domain.⁶ For the normal distribution, the hazard rates are decreasing in the variance except in the extreme tails. This fact is illustrated in Figure 7 which plots the hazard and reverse hazard rates for a normal distribution with mean zero for two different values of the standard deviation s . Clearly, the hazard rates are higher for $s = 1$ than for $s = 2$ except for the region where the random variable has an absolute value greater than 1.5. So as long as the cutpoint between the platforms is not in the tail of the distribution, we can expect divergence to increase in the uncertainty about the median voter. Because we are primarily interested in the level of divergence in moderate districts, we expect this will be the case.

For more precise predictions about such moderate districts, we focus on a symmetric case where the expected median voter lies at the midpoint between the two party ideal points.

Proposition 1. *Let the parties have quadratic preferences with ideal points $-\theta$ and θ and F be a symmetric distribution function with mean and median 0. Then*

(a) *there exists a symmetric Nash equilibrium such that $x_L = -\theta + \epsilon$ and $x_R = \theta - \epsilon$*

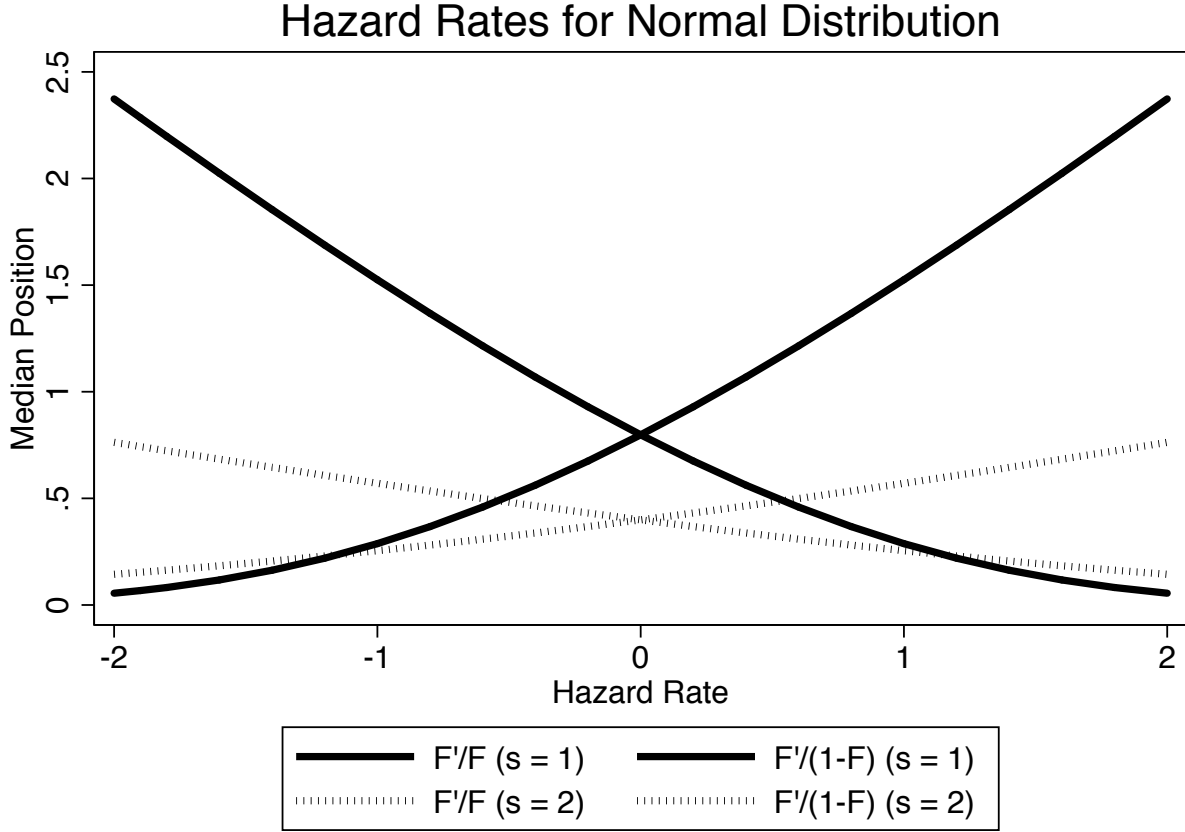
where

$$\epsilon = \frac{2F'(0)\theta^2}{1 + 2F'(0)\theta}$$

(b) *the level of divergence is $2\theta - 2\epsilon$ and is decreasing in $F'(0)$.*

⁶If m is distributed uniformly on the interval $[-a, a]$ then $\frac{F'}{1-F} = \frac{1}{a-m}$ and $\frac{F'}{F} = \frac{1}{a+m}$. Since the variance of m is $\frac{a^2}{3}$, the hazards are clearly decreasing in the variance.

Figure 7: Hazard Rates of Normal Distribution Function



Proof. If $x_L = -\theta + \epsilon$ and $x_R = \theta - \epsilon$, then both first-order conditions 9 and 10 become:

$$\frac{F'(0)}{F(0)} = \frac{4\epsilon}{(2\theta - \epsilon)^2 - \epsilon^2}$$

$$\frac{F'(0)}{1 - F(0)} = \frac{4\epsilon}{(2\theta - \epsilon)^2 - \epsilon^2}$$

Using algebra and the fact that the median of $F(0) = .5$, both of the conditions become

$$2F'(0) = \frac{4\epsilon}{\theta^2 - \theta\epsilon}$$

The desired result is obtained by solving for ϵ . Part (b) is can be verified through differentiating $2\theta - 2\epsilon$ with respect to $F'(0)$. \square

Corollary 1. *In the symmetric Nash equilibrium described in Proposition 1, the equilibrium level of divergence is increasing in the variance of m .*

Proof. From Proposition 1, we know that the level of divergences is decreasing in $F'(0)$. Since F is symmetric with mean and median 0, the variance of m is decreasing in $F'(0)$. \square

To illustrate the proposition and corollary, consider a couple of examples. First, assume that m is distributed normally with mean 0 and standard deviation s . In this case, $\epsilon = \frac{\sqrt{2}\theta^2}{\sqrt{2\theta+s\sqrt{\pi}}}$. Therefore, the equilibrium level of divergence is increasing in s . Similarly assume that m is distributed $u[-a, a]$, $\epsilon = \frac{\theta^2}{\theta+a}$. Therefore. divergence is increasing in a and therefore the variance of m .

Thus far, our results establish that uncertainty about the median voter can contribute to candidate divergence in moderate districts. The next step is to connect uncertainty about the median voter to the underlying preference heterogeneity of the district. To establish this connection, we focus on the role of uncertain turnout in generating uncertainty about the median voter.

Let $G(x)$ be the distribution function for voter ideal points. Let $x = 0$ be the median ideal point and σ^2 be the variance of ideal points – our measure of heterogeneity. If turnout is completely random and N voters participate, a standard result from sampling theory suggests that the variance of the median s^2 is given by

$$s^2 = \frac{1}{4(N+1)(G'(0))^2}$$

Therefore, the variance of the median ideal point on Election Day is a decreasing function of the density of median voter in the district. Thus, given enough data to precisely estimate the density of the median of each district, we could use those estimates as predictors of the level of divergence between the candidates in the district.

Unfortunately, while we have a relatively large number of observations per district, precise estimation of these densities remains formidable. But we can however, use the variance of the distribution in each district as a proxy. For example, if the distribution of voter ideal points is normal, we can directly relate the variance of the realized median to the variance of the overall median:

$$s^2 = \frac{\sigma^2 \pi}{2(N + 1)}$$

For other distributions, the relationship between $G'(0)$ and σ^2 is less direct. But there is a large class of parametric distributions for which the density at the median is lower when the variance is larger. Any symmetric distribution such as the t-distribution, uniform and others in the symmetric beta family must have this property. Non-symmetric distributions with this property include the log-normal, Pareto, exponential, and Weibull.

This leads to our main hypothesis that greater levels of district level heterogeneity in voter preferences will lead candidate positions to diverge.

Research Design

Our formal model suggests the following empirical strategy. We would like to estimate the model:

$$divergence_i = f(\beta varm_i + \gamma Z_i + \epsilon_i) \quad (11)$$

where $divergence_i$ is the distance between the two-candidates in district i , $varm_i$ is the variance of the median voter in district i , and Z_i is a set of control variables. The theoretical model suggests that $\beta > 0$. Unfortunately, we only observe the winning candidates of the elections. Therefore, we follow the approach of McCarty, Poole and Rosenthal (2009), who decompose partisan polarization into roughly two components. The first part, which they term *intradistrict divergence* is simply the difference between how Democratic and Republican legislators would represent the same district. The remainder, which they term *sorting*, is the result of the propensity for Democrats to represent liberal districts and for Republicans to represent conservative ones.⁷

To formalize the distinction between divergence and sorting, we can write the difference in party mean ideal points as

$$E(x|R) - E(x|D) = \int \left[E(x|R, z) \frac{p(z)}{\bar{p}} - E(x|D, z) \frac{1-p(z)}{1-\bar{p}} \right] f(z) dz$$

where x is an ideal point, R and D are indicators for the party of the representative, and z is a vector of district characteristics. We assume that z is distributed according to density function f and that $p(z)$ is the probability that a districts with characteristics z elects a

⁷This concept is closely related to what we refer to above as between-district polarization.

Republican. The term \bar{p} is the average probability of electing a Republican. The average difference between a Republican and Democrat representing a district with characteristics z , $E(x|R, z) - E(x|D, z)$, captures the intradistrict divergence, while variation in $p(z)$ captures the sorting effect.

Estimating the AIDD is analogous to estimating the average treatment effect of the non-random assignment of party affiliations to representatives. There is a large literature discussing alternative methods of estimation for this type of analysis. For now we assume that the assignment of party affiliations is based on observables in the vector z . If we assume linearity for the conditional mean functions, i.e., $E(x|R, z) = \beta_1 + \beta_2 R + \beta_3 x$, we can estimate the AIDD as the OLS estimate of β_2 .

Our claim is that the average intradistrict divergence (AIDD) is a function of uncertainty over the location of the median voter within districts which we have proxied by the variance of the voter’s ideal points.

We use two empirical strategies to examine whether the AIDD is greater when there in more heterogeneous districts. First, we use OLS-based regression models of the form:

$$x_i = \alpha + \beta_1 \text{var}m_i + \beta_2 \text{Party}_i + \beta_3 \text{var}m_i x \text{Party}_i + \gamma Z_i + \delta_{j[i]} + \epsilon_i \quad (12)$$

where x_i is the ideological position of the incumbent in district i , Party_i is an indicator that equals 1 if the incumbent is a Republican and -1 if she is a Democrat, γ is a vector of district-level covariates, and δ is a fixed or random effect for each census division or state. If $\text{var}m$ has a polarizing effect, $\beta_3 > 0$ as it moves Republicans to the right and Democrats to the left.

One complication is that there could be unobserved factors that lead to across-state variation in polarization (i.e., the distance between parties within each state). For instance, variation in primary type or other institutions could affect polarization. As a result, we subset the data and estimate the model separately for each party. This allows us to use census division and state-level random effects to account for any time invariant, unobserved factors that lead to across-state variation in polarization within parties. Thus, our regression models show the relationship between legislators’ ideal points and the position of the median voter and the amount of heterogeneity *within each state*. This specification also allows β and other coefficients to vary across parties.

Second, because the functional forms used in our OLS models are somewhat restrictive, we also use matching estimators to check the robustness of our main results. Intuitively, these estimators match observations from a control and treatment group that share similar characteristics z and then compute the average difference in roll-call voting behavior for the matched set. Ho et al. (2007) make the case that matching reduces model dependence and provides more accurate causal inferences compared to standard ordinary least squares methods. We use the bias-corrected estimator developed by Abadie and Imbens (2006) and implemented in R using the `Matching` package (Sekhon 2013). Unlike the regression models, however, we are not able to estimate the AIDD as continuous function of district heterogeneity. Therefore, following McCarty, Poole and Rosenthal (2009) and Shor and McCarty (2011) we use matching techniques to estimate the *average district divergence* for districts with different levels of $var m_i$. Specifically, we use matching to estimate the AIDD for districts with “high” and “low” levels of heterogeneity. We define districts with “high” levels of heterogeneity as those that are above the national median, and those with “low”

levels of heterogeneity as those that are below the national median.

Finally, we use two measures of ideological heterogeneity in our analyses. The first and most straightforward was already displayed in some of the graphs above: the standard deviation of preferences in the electorate (Gerber and Lewis 2004; Levendusky and Pope 2010). We estimate this measure for every state senate district in the country using the large dataset of citizens' ideal points from Tausanovitch and Warshaw (2013). As a robustness check, we also use a more direct measure of the uncertainty over the median voter in each district.⁸ However, we were only able to calculate this measure of uncertainty for districts where had more than 40 respondents in our data, which forced us to drop about 50% of state senate districts, and substantially reduces our statistical power. As a result, we use the standard deviation of preferences in the electorate in our main analysis, and the more direct measure of uncertainty as a robustness check.

Results

We present our empirical results in Table 1. The unit of analysis is the unique legislator in Shor and McCarty (2011)'s data that served at some point between 2003 and 2012. The two columns show results of a simple multilevel model with varying intercepts for census divisions. The results indicate that both Democratic and Republican state legislators take substantially more extreme positions in more ideologically heterogeneous districts.⁹ Aver-

⁸In order to measure uncertainty over the median, we bootstrapped 20 different samples from each district and fixed the number of respondents at 40 in each district. This allows us to hold variation in sampling error fixed across districts. In each simulation, we estimated the median ideal point in each district. Then, across all the simulations, we estimated the standard deviation of the median. This measure captures uncertainty over the median voter in each district.

⁹Running models with varying intercepts for states shows smaller, but still significant effects.

age intradistrict divergence (AIDD) is clearly a function of ideological heterogeneity in the district. Controlling for mean district ideology, the difference between the roll-call voting behavior of Democrats and Republicans within states is largest in districts that are most heterogeneous, and smallest in districts that have the most ideologically homogeneous.¹⁰ Suggestively, the effect for Republicans appears somewhat higher than that for Democrats (though the difference is not significant at conventional levels). We also find substantively similar results using the more direct measure of uncertainty over the median as our main independent variable.

Table 1: Heterogeneity - Legislator Score Models (Multilevel)

	<i>Dependent variable:</i>	
	Legislator Score	
	R	D
	(1)	(2)
Heterogeneity Citizens	0.45*** (0.10)	-0.29*** (0.10)
Citizen Ideology	0.82*** (0.06)	0.87*** (0.04)
Constant	0.04 (0.15)	-0.35** (0.15)
Observations	1,471	1,279
Log Likelihood	-587.41	-518.62
Akaike Inf. Crit.	1,184.81	1,047.25
Bayesian Inf. Crit.	1,211.28	1,073.02
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01	

To get a better idea of the size, of the effect, consider the first two columns of Table

¹⁰While the theoretical model suggests that we should control for the expected median, we instead use estimates of the mean voter position that we obtain from multilevel regression with poststratification estimates. Using presidential vote by district returns the same results.

1. A shift from the 25th percentile on our heterogeneity measure to the 75th percentile is associated with a shift by Republicans about .05 units to the right, and a shift by Democrats about .04 units to the left. This suggests that a shift from the 25th percentile to the 75th percentile on our heterogeneity measure is associated with an increase in AIDD of about .09. Figure 8 shows these effects more vividly. A district with heterogeneity less than 1.2 can expect to be represented by a moderate, regardless of party. In stark contrast, districts with heterogeneity of 1.4 can expect to be represented by a legislator who is from the extremes of their party.

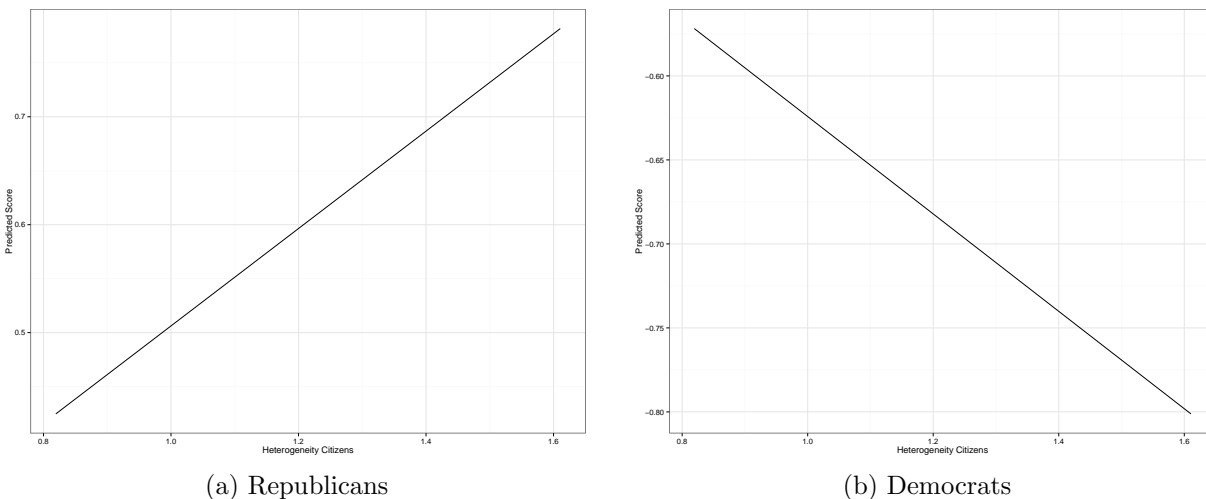


Figure 8: Predicted values of the gap between Democrats and Republicans as a Function of District Heterogeneity

Finally, as discussed above, we use matching estimators to check the robustness of our main results. The matching approach tells a similar story to the OLS models. Average intradistrict divergence is substantially greater among matched districts that are more heterogeneous than in those that contain more homogeneous electorates. Table 2 shows that the AIDD in heterogeneous districts is 0.3 greater than in more homogeneous districts.

One possible objection to our results is that the heterogeneity of the mass public's pref-

	N.Obs	N.Rep	AIDD	SE
Overall	3322	1753	1.28	0.02
High Heterogeneity Districts	1375	845	1.45	0.04
Low Heterogeneity Districts	1375	626	1.15	0.04

Table 2: Matching Estimates of the AIDD (Average Treatment Effect)

erences in a particular district may be endogenous. State legislators are themselves in charge of the districting process in many states. Perhaps more extreme legislators have more heterogeneous districts because they designed the districts this way. There is reason to doubt this alternative explanation for our results. If this were the case, then it seems that moderates are being relegated to unsafe districts—precisely the opposite of what you would expect if moderates are able to leverage their pivotal position in the legislative process. However, we cannot a priori rule out the idea that districting is playing a role in producing these results.

Discussion and Conclusion

Our key findings can be summarized as follows. Partisan polarization within state legislatures emerges in large part from the fact that Democrats and Republicans represent districts with similar mean characteristics very differently. We have discovered that these differences are especially large in districts that are most internally polarized. Further, we have discovered that these internally polarized districts are especially prevalent in the ideologically “centrist” places that most frequently change partisan hands in the course of electoral competition.

In other words, districts that are moderate on average often do not contain large densities of moderates. When candidates compete in these internally polarized districts in suburbs and outside of metropolitan areas, they face weak incentives to adopt moderate platforms

and build up moderate roll-call voting records. Aggregating up to the level of states, we have shown that the states with the highest levels of within-district ideological polarization are also those with the highest levels of partisan polarization in the legislature.

Our large-sample super-survey only covers recent years, and we are not in a position to examine the evolution of ideological polarization over time within U.S. Congressional districts. Yet our analysis may shed light on the paradox of a polarizing Congress representing a stable and centrist electorate. A possible explanation is that as cities and very rural areas have depopulated, ideological extremists from both sides have converged on suburbs and exurbs where jobs and housing are most plentiful, and the internal polarization of the pivotal Congressional districts has increased even though the overall distribution of ideology across individuals has been stable. In other words, ideological moderates may be distributed less efficiently across districts than in the past. In fact, some of the most internally polarized districts are those with the most rapidly growing and changing populations. Likewise, some of the most polarized states are those that have experienced the most rapid population growth and demographic change in recent decades, for example in the West and Sun Belt, and legislative polarization is growing most rapidly in these states. This is worthy of further analysis.

Finally, our analysis has implications for debates about redistricting reform. A common claim is that polarization emerges because districts have become too homogeneous, as like-minded Americans have moved into similar communities and politicians have drawn incumbent-protecting gerrymanders. Some reformers advocate the creation of more heterogeneous districts, like California's sprawling and diverse state senate districts, in order to enhance political competition and encourage the emergence of moderate candidates. This

paper turns this conventional wisdom on its head. When control of the legislature hinges on cutthroat competition within internally polarized winner-take-all districts, candidates and parties do not necessarily face incentives for policy moderation.

References

- Abadie, Alberto and Guido W Imbens. 2006. "Large Sample Properties of Matching Estimators for Average Treatment Effects." *Econometrica* 74(1):235–267.
- Ansolabehere, Stephen, James M. Snyder, Jr. and Charles Stewart, III. 2001. "Candidate Positioning in U.S. House Elections." *American Journal of Political Science* 45(1):136–159.
- Bafumi, Joseph and Michael C Herron. 2010. "Leapfrog Representation and Extremism: A Study of American Voters and their Members in Congress." *American Political Science Review* 104(3):519–542.
- Barber, Michael and Nolan McCarty. 2013. "Causes and Consequences of Polarization." *Negotiating Agreement in Politics* p. 19.
- Besley, Timothy. 2007. *Principled Agents?: The Political Economy of Good Government*. Oxford University Press.
- Calvert, Randall L. 1985. "Robustness of the Multidimensional Voting Model: Candidate Motivations, Uncertainty, and Convergence." *American Journal of Political Science* 29(1):69–95.
- Clinton, Joshua D. 2006. "Representation in Congress: Constituents and Roll Calls in the 106th House." *Journal of Politics* 68(2):397–409.
- Downs, Anthony. 1957. "An Economic Theory of Democracy."
- Fiorina, Morris P. 1974. *Representatives, Roll Calls, and Constituencies*. Lexington Books Lexington, MA.
- Fiorina, Morris P and Samuel J Abrams. 2008. "Political polarization in the American public." *Annual Review of Political Science* 11:563–588.
- Gerber, Elisabeth R and Jeffrey B Lewis. 2004. "Beyond the Median: Voter Preferences, District Heterogeneity, and Political Representation." *Journal of Political Economy* 112(6):1364–1383.
- Ho, Daniel E, Kosuke Imai, Gary King and Elizabeth A Stuart. 2007. "Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference." *Political Analysis* 15(3):199–236.
- Jacobson, Gary. 2004. "Explaining the Ideological Polarization of the Congressional Parties since the 1970s." Working Paper.
- Kousser, Thad, Justin H. Phillips and Boris Shor. 2013. "Reform and Representation: Assessing Californias Top-Two Primary and Redistricting Commission." Working Paper.
- Levendusky, Matthew. 2009. *The Partisan Sort: How Liberals Became Democrats and Conservatives Became Republicans*. University of Chicago Press.

- Levendusky, Matthew S and Jeremy C Pope. 2010. "Measuring Aggregate-Level Ideological Heterogeneity." *Legislative Studies Quarterly* 35(2):259–282.
- McCarty, Nolan, Keith Poole and Howard Rosenthal. 2006. *Polarized America: The Dance of Ideology and Unequal Riches*. MIT Press.
- McCarty, Nolan, Keith Poole and Howard Rosenthal. 2009. "Does Gerrymandering Cause Polarization?" *American Journal of Political Science* 53(3):666–680.
- McGhee, Eric, Seth E. Masket, Boris Shor, Steven Rogers and Nolan M. McCarty. 2014. "A Primary Cause of Partisanship? Nomination Systems and Legislator Ideology." *American Journal of Political Science* 58(2):337–351.
- Miller, Warren E. and Donald E. Stokes. 1963. "Constituency Influence in Congress." *American Political Science Review* 57(1):45–56.
- Poole, Keith T and Howard Rosenthal. 1997. *Congress: A Political-Economic History of Roll Call Voting*. Oxford University Press.
- Shor, Boris and Nolan McCarty. 2011. "The Ideological Mapping of American Legislatures." *American Political Science Review* 105(3):530–551.
- Tausanovitch, Chris and Christopher Warshaw. 2013. "Measuring Constituent Policy Preferences in Congress, State Legislatures, and Cities." *Journal of Politics* 75(2):330–342.
- Wittman, Donald. 1983. "Candidate Motivation: A Synthesis of Alternative Theories." *The American Political Science Review* 77(1):142–157.