

Components of party polarization in the US House of Representatives

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Abstract

We specify the level of polarization in a two-party legislature as an explicit function of three factors: (1) the ideological heterogeneity of district median voters, (2) the distance between candidates of different parties in the same or ideologically comparable districts, and (3) partisan bias in choosing between candidates equidistant from the median voter. Our key empirical finding, reinforced by two alternative methods of calculation, is that, while changes in each factor have contributed to the present day extremely high level polarization in the US House of Representatives, at least 80% of the growth in that polarization from 1956 through 2008 can be attributed to a dramatic increase in the second of these factors: party differentiation at the district level.

Keywords

House of Representatives; ideological heterogeneity; partisan bias; party polarization

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I. Introduction

In the more than five decades after Downs (1957), there has been a huge amount of literature looking at the determinants of the degree to which candidates in two-party competition theoretically should and/or empirically do converge to the preferences of the median voter in the district (see, e.g., reviews in Butler, 2009; Fiorina, 2006; Grofman, 2004; Theriault, 2008). The consensus of the most plausible theoretical models (e.g. Adams et al., 2005; Aldrich, 1983; Aldrich and McGinnis, 1989) and of empirical work on the United States (e.g. Bafumi and Herron, 2010; Poole and Rosenthal, 1984) is that, at the district level, we should expect some degree of divergence from the median voter location, with (in one-dimension) Democrats to the left of that position and Republicans to the right.

A change in the party that represents a given district currently generates a huge difference in the voting behavior of the representative. Consider Congressman Parker Griffith, a Democrat from Alabama, who was replaced by Congressman Mo Brooks in the 2010 election. While Griffith was conservative for a Democrat, his DW-NOMINATE score was -0.013 ; he looked moderate compared to the Republican who replaced him – Brooks' DW-NOMINATE score is 0.797 . This district was relatively politically divided with a vote for Obama in 2008 of nearly 40 percent.

We know that divergence of candidates from the position of the median voter in the district is nothing new, but we also know that the magnitude of the differentiation has varied over time. Looking at the latter part of the twentieth century, Ansolabehere et al. (2001: 136) first conclude that congressional candidates '... primarily espoused the ideology associated with the national party, moderating very little to accommodate local ideological conditions.' But they also assert: 'District-by-district competition exerts some pressure on candidates to fit with their constituents, and there have been times in American history when this pressure has been more acute than others. From the 1940s to 1970s candidates became much more responsive to district interests, but that degree of responsiveness waned in the 1980s and 1990s'. As we will see, party differentiation – which we specify as the ideological gap between Democrats and Republican elected from the same or ideologically similar districts – is around its all time high. Rescaling DW-NOMINATE scores on a scale from 0 to 100, we estimate below that this gap is about 40 points.

Now let us consider *legislative polarization*, where by *legislative polarization* we mean the difference in ideology between the mean Democrat and the mean Republican in the legislature. Just as there has been variation in the extent to which Democrats and Republican elected from the same or similar districts have espoused similar ideologies to one another, if we move from the constituency level to the level of the legislature as a whole, we can look at changes in *legislative polarization*. While the volume of work on polarization in Congress is not as large as the work on party/candidate divergence at the district level, there is still a large literature. We know from the work of Poole and Rosenthal (1997) that there has been great historical variation in the degree to which there is an ideological gap between the two party delegations in the House or in the Senate (see esp. McCarty et al., 2006).¹

One extreme of party differentiation occurred around 1900 but then diminished in size, so that the two parties were most nearly convergent a little past mid-twentieth century. Today we once again have extreme polarization, at a level not seen since the turn of the 19th century. Indeed, ideological polarization and accompanying partisan enmity is arguably the driving force of the past several decades of US electoral history. The current gap we estimate between the mean Republican legislator in the House and the mean Democratic legislator in the House is close to 50 points (again, on a 0 to 100 scale), above the level of mean party differentiation in the districts.²

The goal of this paper is to understand *legislative polarization* in terms of its electoral roots. How can we relate the level of legislative polarization to the level of district divergence? Why are the two parameters not identical? How do changes in the former affect changes in the latter and/or vice versa?

Contemporary neo-Downsian theory, which acknowledges both centrifugal and centripetal forces in party competition, can help us to make sense of party differentiation at the district level, but unfortunately, however, most theoretical work on two-party competition in the Downsian tradition remains relatively ahistoric. Standard neo-Downsian theories are not well equipped to deal with changes in party differentiation over time. Models either predict convergence at the district level, or they predict some level of divergence, or they predict instability, but they are not well oriented to telling us when candidates might diverge and when they might converge from the median voter in the district. Moreover, even when neo-Downsian models allow for divergence, they usually generate an equilibrium in which candidates are symmetrically located around the constituency median with equal chances of being elected, a result that does not seem realistic since it cannot explain why the vast majority of congressional districts remain in the hands of a single party over the course of a decade, even when there is an open seat.

There are theories proposed as to why we might expect changes in polarization in the US Congress over time. McCarty et al. (2006: 5–10) note that polarization in the US Congress has correlated closely with increased income inequality and immigration. Fiorina (2006) emphasizes that recent increases in legislative polarization can be linked to the ideological sorting of partisans in the electorate generated both by geographic mobility and by changes in the regional bases of the parties. He argues that explaining polarization does not require us to posit a growing policy extremism on the part of voters. Theriault (2008) agrees that polarization in Congress is in part due to geographical sorting of the electorate, but argues that there are also important changes at the elite level, such as institutional and procedural changes in Congress that affect the ability of party leaders to motivate party members via incentives such as campaign financing and committee assignments. Lebo et al. (2007) and Koger and Lebo (2012) emphasize reciprocal strategic calculations by party leaders and office holders on both sides of the aisle in scheduling votes where members from vulnerable districts must balance the need to pass/block legislation to improve their party's image with concerns about their own reelectability.

However, none of the models of polarization above do what we want to do in this essay, namely link what we see at the district level to what is happening in the legislature as a whole. McCarty et al. (2009), and Merrill et al. (2014), however, take an approach that we can build on. In particular, the latter propose a model that relates congressional polarization with constraints on district candidates' ability to locate at positions far from the national party stance that may be imposed by voter perceptions of credible locations and by activist involvement in the candidate selection process. The Merrill–Grofman–Brunell model suggests that the divergence between the mean Democratic and Republican locations in Congress is correlated with the tightness of the tether that constrains district candidates to the stance of their national party. This model implies, furthermore, that the tightness of this tether is also correlated with the intraparty homogeneity of a party delegation. The effects on polarization in the legislature of ideological sorting of the electorate into parties that match more closely the voter's own ideology and of changes in heterogeneity of the districts themselves is treated in Brunell et al. (forthcoming), as each party picks off the more moderate members of the other party's delegation.

Often polarization in the legislature and divergence from the median voter in the constituency are conflated. But polarization can arise in the legislature without divergence in party positions at the district level (see Figure 1(a)). This can occur if within a district, voters give more credibility to and favor the candidate whose policy platform better reflects the national position of the candidate's party, even if both parties' candidates present identical platforms.³ If districts differ in their median location then candidates of the two parties will be elected from different types of districts in ideological terms, thus giving rise to polarization between the party delegations in the legislature.⁴ On the other hand, differentiation can occur at the district level without polarization at the legislative level (see Figure 1(b)) if the likelihood that a candidate of a given party wins in the district is uncorrelated with the location of the median voter in the district.

While the examples above show that *legislative polarization* is clearly conceptually distinct from *district-specific party differentiation* (divergence from the views of the median voter in the district), we can show how the two are empirically and theoretically linked when we view the latter as but one component of a fully specified model of party polarization. Drawing on ideas in the recent work by Merrill, Grofman, and Brunell summarized above, and on McCarty et al. (2009), we express in this paper the difference between the mean locations of the party delegations in the legislature in terms of within district party divergence and the probability that a district with given characteristics will vote Republican or Democratic in House elections. We derive new explicit formulas involving the basic components of party polarization – formulas that employ the variance of the district medians and a measure of partisan bias, as well as within-district party divergence. These results are intended to help dissect the underpinnings of legislative polarization and to help explain the historical patterns in polarization identified in McCarty et al. (2009).

Our key results rest on a mathematical identity that encompasses the three (potentially interrelated) factors that jointly determine the level of legislative polarization: (1) *district heterogeneity*, i.e. the distribution over districts of the

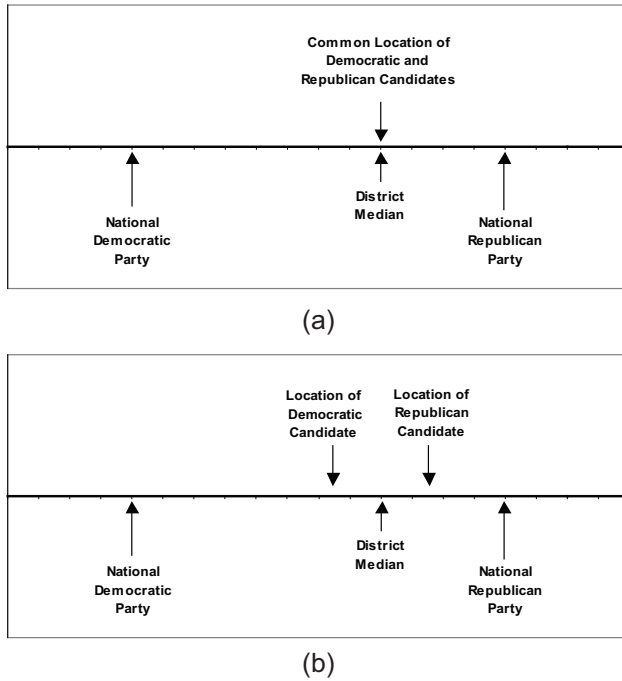


Figure 1. Interplay of partisan factors and legislative polarization for a hypothetical district whose median voter is closer to the national position of the Republican party than to the national position of the Democratic party.

(a) Democratic and Republican district candidates both take positions at the district median.

Suppose that the district median voter is nearer the national Republican position. Suppose that the candidates of the two parties are identically located at the district median as in case 1(a) above. Suppose the median voter resolves the tie in proximity to the candidates by voting Republican, namely for the party whose national position is closer to her own. And oppositely for the case where the Democratic national party position is closer to the median voter. Under these assumptions a party will win each seat for which the district median is nearer its national party position. It follows that, as long as district medians are distributed over some range, given the districts that Republicans are winning and that Democrats are winning, Republican members of the legislature will be to the right of Democratic members, and polarization will result, even though in any district the candidates of the two parties are both located at the district median.

(b) Democratic and Republican district candidates take positions symmetrically placed about the district median.

Suppose the party candidates are equidistant from the constituency median but clearly differentiated from each other, with one to the left and one to the right of that median, as in case 1(b) above. Now suppose the decisive median voter is equally likely to choose either candidate, the usual Downsian assumption. Under these assumptions, each party is equally likely to win a seat regardless of the district's ideology, since they are always equidistant from the constituency median. Now the two party delegations in the legislature overlap, without strong polarization, even though in every district the parties are differentiated.

ideological locations of median voters, (2) the (mean) difference between the candidates of the two parties in a district or in ideologically comparable districts, which we label *district-specific party differentiation*, and (3) how likely a constituency with

a given median will, *ceteris paribus*, elect a Republican rather than a Democrat (or vice versa) – a concept we refer to as *partisan asymmetry*. Defining ideological polarization in the legislature (which we have labeled *legislative polarization*) as the difference between the mean (ideological) location of Democrats and the mean location of Republicans, we can specify *legislative polarization* as a specific function of the three basic variables identified above, and thus separate the national and local factors which affect it.

Our theoretical work differs from much of the neo-Downsian literature on party convergence in three key ways. First, rather than assuming convergence to the views of the median voter in the constituency, we model party positions as involving only partial convergence to the constituency median. Second, unlike most previous models with a non-convergent equilibrium (Aranson and Ordeshook, 1972; Coleman, 1972; Owen and Grofman, 2006; Palfrey, 1984; cf. Austen-Smith, 1984), we allow for the possibility that candidates locate asymmetrically with respect to that median (see below). Third, we posit that the likelihood that a district will be won by a given party is a function of not just candidate positions and the location of the median voter in the constituency, but also the national party position.

While very similar in spirit to McCarty et al. (2009), our work also differs from most of the other previous work on models of legislative polarization in important ways. Most earlier work looks at broad-gauge changes that affect polarization such as demographic changes, economic forces, or changes in congressional organization. Here we look at the electoral roots of polarization – the specific electoral mechanisms in terms of district level competition that, in composite, determine polarization.

In the empirical section of the paper, after first operationalizing each of the three factors identified above, and tracing changes in each in recent decades, we calculate the relative contribution of each factor to contemporary legislative polarization. Our key empirical finding, reinforced by two alternative methods of calculation, is that, while changes in each factor have contributed to the present day extraordinary level of polarization, at least 80% of the growth in legislative polarization in the US House of Representatives from 1956 through 2008 can be attributed to growing differentiation between the parties at the constituency level. Holding constituency characteristics constant, a winning candidate of one party is expected to be further apart ideologically from a winning candidate of the other party now more than at any point in the recent past.

2. Modeling changes in legislative polarization tied to party differentiation at the district level: the three factor model

2.1. Modeling considerations

The formal theory of polarization dynamics we offer builds on three stylized facts:

1. Constituencies differ in the location of their median voter (*district heterogeneity*).

2. Candidate convergence in the constituency is typically not complete (*district-specific party differentiation*).
3. Under assumptions to be specified below, *ceteris paribus*, some constituencies are more likely to elect Republicans than Democrats, and vice versa (*partisan asymmetry*).

To justify assumption (1), we simply note that, in any given election year, the ideological composition of the district varies substantially across congressional districts, as can be proxied by, e.g. vote shares for the Democratic presidential nominee, since party and ideology are linked (Noel, 2013).

To justify assumption (2), we note the limitations of the classic Downsian (1957) model. Recent formal modeling of parties' election strategies shows that full convergence in two-party competition is extremely unlikely. Platform divergence can result from centrifugal incentives caused by many different factors: voter loyalties that change vote maximizing dynamics by making it easier for parties to capture the votes of their past supporters (see, e.g., Adams, 2001; Adams et al., 2005; Merrill and Adams, 2002), the involvement of party activists who force candidates to toe an ideological line lest they be denied financial support or be confronted by a well-funded challenger in the party primary (see, e.g., Cameron and Enelow, 1992), candidate self-selection into parties in terms of ideological propinquity combined with candidate insistence on promoting their own policy goals (see esp. Wittman, 1973, 1977, 1983), multidimensional issues (see, e.g., Miller and Schofield, 2003), threats of third party entry (Gerber and Morton, 1998; Palfrey, 1984), projection by candidates including both the perception that the position of the median voter is closer to the candidate's position and the perception that the district opponent is more extreme (Cioroianu, 2013), or 'spillover effects' of multiple simultaneous elections in constituencies with different characteristics (Austen-Smith, 1984).⁵

To motivate assumption (3), we note that absent special circumstances – such as the dead hand of Civil War induced loyalties, or other factors that foster a second dimension to political competition – it will be harder for Republicans than for Democrats to win 'liberal' districts and harder for Democrats than for Republicans to win 'conservative' ones, even if both candidates are at or equidistant from the constituency median (Grofman et al., 2000). That is because (a) more liberal (conservative) positions by Republican (Democratic) candidates may not be credible if they are too far away from the positions espoused by national party leaders, (b) party choice can affect partisan control of Congress, which has important policy consequences, of which at least some voters are aware, (c) partisan identification can act to bias choice in favor of the party to which one is attached (Adams, 2001; Adams et al., 2005; cf. Bafumi and Herron, 2010) and, as noted earlier, we expect a relationship between party attachments and party platforms and ideological preferences (see, e.g., Noel, 2013).

2.2. Deriving the three-factor decomposition

In the definitions that follow, we assume throughout that ideology is measured on a scale from 0 to 100.

Definition 1: Legislative *polarization* is the gap between the mean locations of the elected party delegations, i.e.

$$\text{legislative polarization} = |\mu_R - \mu_D|, \quad (1)$$

where μ_D and μ_R are the Democratic and Republican mean ideological locations in the legislature, respectively.

Definition 2: We denote by $f(m)$ the density function for the distribution of median voters over districts. This distribution is *symmetric* if $f(50 - m) = f(50 + m)$, $0 \leq m \leq 50$.

Definition 3: The *effective median*, m' , is given by $m' = wm + (1 - w)m_0$, where m denotes the district median, m_0 denotes the national median of the overall electorate, and w denotes a weighting factor.⁶

Definition 4: The district-specific *party differentiation*, denoted by k , is the mean distance between winning Democratic and Republican candidates from ideologically comparable districts.⁷

Definition 5: For each party, the constituency-level *partisan asymmetry* is the probability function $P_D(m)$ (for the Democrats) or $P_R(m)$ (for the Republicans) that that party wins in a district with median voter at m , if each party offers either identical policy platforms at the location of the effective median m' [= $wm + (1 - w)m_0$], where w is a weighting factor, or platforms at equal distance to the left and right, respectively, from m' —a likelihood which may differ across constituencies depending upon the location of the median voter in the district. Note that $P_D(m) = 1 - P_R(m)$.

Definition 6: As a measure of the level of partisan asymmetry, we define the *mean partisan bias* as

$$\text{mean partisan bias} = \frac{2}{100} \int_0^{100} |P_R(m) - 0.5| dm. \quad (2)$$

Definition 7: The partisan asymmetry function P_R is *linear* on the interval $[0, 100]$ if

$$P_R(m) = 0.5 + d^*(m - 50).$$

for some d , $0 \leq d \leq 0.01$, and the partisan asymmetry functions for the two parties are *complementary* if

$$P_D(50 - m) = P_R(50 + m), 0 \leq m \leq 50.$$

We can readily see that μ_D (μ_R) is the weighted average (over district medians m) of the expected ideological locations of Democratic (Republican) legislators for a given m , weighted by the density of the distribution of district medians and the

propensity of districts with a given median to elect a Democrat (Republican). It follows that, more formally, using the definitions above, we can represent the relationship between μ_D and μ_R , legislative polarization, and our three factors in terms of a simple identity, as given by Proposition 1:

Proposition 1. The delegation means, μ_D and μ_R , are given by

$$\mu_D = \frac{\int_0^{100} (m' - k/2)P_D(m)f(m) dm}{\int_0^{100} P_D(m)f(m) dm} = \frac{\int_0^{100} m'P_D(m)f(m) dm}{\int_0^{100} P_D(m)f(m) dm} - k/2$$

and

$$\mu_R = \frac{\int_0^{100} (m' + k/2)P_R(m)f(m) dm}{\int_0^{100} P_R(m)f(m) dm} = \frac{\int_0^{100} m'P_R(m)f(m) dm}{\int_0^{100} P_R(m)f(m) dm} + k/2$$

so that legislative polarization is given by

$$|\mu_R - \mu_D| = \left| \frac{\int_0^{100} m'P_R(m)f(m) dm}{\int_0^{100} P_R(m)f(m) dm} - \frac{\int_0^{100} m'P_D(m)f(m) dm}{\int_0^{100} P_D(m)f(m) dm} \right| + k. \quad (3)$$

Suppose, as a simple example, that f is uniform and that P_R is the step function for which $P_R(m) = 1$ for $m \geq 50$ and $P_R(m) = 0$ for $m < 50$ (i.e. districts with a median voter to the right of 50 always elect the Republican, while districts with median to the left always elect the Democrat). Assume further that $m = m'$, i.e. the candidate locations straddle the district median symmetrically (ignoring the national median), 10 units on either side, so that $k = 20$. In this case,

$$|\mu_R - \mu_D| = \left| \frac{75/2}{1/2} - \frac{25/2}{1/2} \right| + 20 = 70,$$

resulting in a highly polarized legislature, with Democratic lawmakers centered around 15 and Republican legislators centered round 85, on a 0 to 100 scale.

We next develop a proposition that relates our three factors explicitly to polarization in the legislature.

Proposition 2. If the partisan asymmetry functions are linear and complementary on the interval $[0, 100]$ and the distribution of district medians is symmetric, then legislative polarization is given by

$$\text{Legislative polarization} = 0.08 \times (\text{mean partisan bias}) \times w\sigma_M^2 + k. \quad (4)$$

where σ_M^2 is the variance of the distribution of district medians and w is the weighting factor of the effective median, specified by $m' = wm + (1 - w)m_0$.

See Appendix A (available online at <http://course.wilkes.edu/Merrill/>) for the proof. Thus, for linear partisan asymmetry functions, legislative polarization has an additive component equal to district-level party differentiation. Furthermore, the remaining component of polarization in the legislature is proportional to the

mean partisan bias (for a fixed distribution of district medians) and proportional to the square of the standard deviation of the distribution of district medians (for a fixed partisan asymmetry function). In particular, aside from the effect of district-level party differentiation, when the standard deviation of the district-median distribution doubles, the partisan polarization in the legislature increases by a factor of four. As voters become more ideologically sorted along geographical lines, constituencies of MCs become more ideologically divergent from one another. Because of the squared term in equation (4), Proposition 2 suggests that increased variance in district ideological heterogeneity can have a strong effect on partisan polarization in the legislature.

Proposition 3 summarizes the relation of our three factors to legislative polarization (see Appendix A for the proof).

Proposition 3: Assuming that the partisan asymmetry functions are complementary and the distribution of district medians is symmetric, *ceteris paribus*, the mean polarization in the legislature *increases* with:

- (a) *district heterogeneity*, i.e. the variance of the distribution of constituency medians, provided the partisan-asymmetry function is linear,
- (b) *district-specific party differentiation*, i.e., the (mean) ideological difference, k , between Republicans and Democrats elected to the legislature from ideologically comparable districts, and
- (c) *partisan asymmetry*, i.e.

$$\text{if } P_{R1}(m) \geq P_{R2}(m) \text{ for all } m, 50 \leq m \leq 100, \text{ then } \mu_{R1} \geq \mu_{R2}, \quad (5a)$$

where P_{R1} and P_{R2} are two partisan asymmetry functions for the Republicans and, similarly,

$$\text{if } P_{D1}(m) \geq P_{D2}(m) \text{ for all } m, 0 \leq m \leq 50, \text{ then } \mu_{D1} \geq \mu_{D2}, \quad (5b)$$

where P_{D1} and P_{D2} are two partisan asymmetry functions for the Democrats.

2.3. Robustness of assumptions

To investigate the robustness of the results in Proposition 2 and Proposition 3, we relax the symmetry assumption on the district median distribution and the linearity assumption on the partisan asymmetry function. First, we consider district medians that follow beta distributions that vary in concentration and are not necessarily symmetric. Second, we specify a family of non-linear partisan asymmetry functions in the form of cumulative normal distribution functions, which are roughly intermediate between linear and step functions (see Figure 2). Such functions can be specified by $\Phi((m - 50)/\sigma)$, where Φ is the standard normal cumulative distribution function, σ is the standard deviation, and m is truncated to the interval from 0 to 100. For relatively high values of σ , this function resemble a linear function; whereas for very low values, it approaches a step function. In

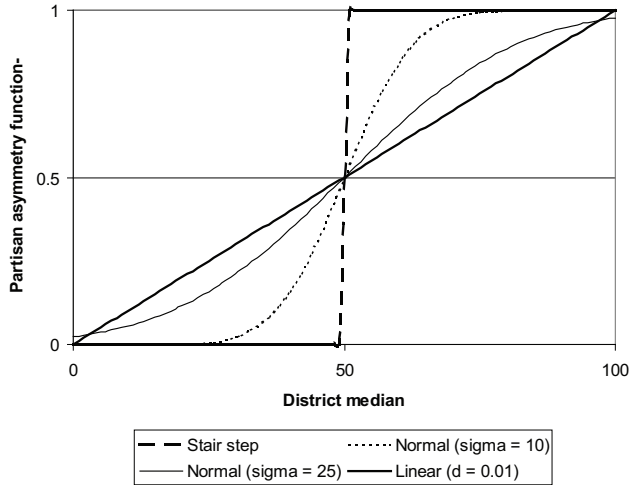


Figure 2. Examples of partisan asymmetry functions.
 Note: The plots represent several possible forms for the partisan asymmetry function, $P_R(m)$.

Appendix B (available online at <http://course.wilkes.edu/Merrill/>), we show that if the partisan asymmetry function is a step function, then the variance of the district median distribution is replaced by the mean absolute deviation of that distribution in equation (4) in Proposition 2.

Table 1 indicates that, when the district median distribution and partisan asymmetry function are varied, numerically calculated values for legislative polarization are roughly equivalent to corresponding values computed from Proposition 2, (in these calculations the weighting factor w is set equal to 1 and the district-specific party differentiation k set equal to 0). Ten of 16 of the Proposition 2 estimates in the table are within 10 percent of the exact values. The most significant deviations occur for the uniform median distribution when the partisan asymmetry is close to a step function and for the beta(4,2) district median distribution. The latter deviations suggest that for asymmetric district-median distributions, the estimates from equation (4) can substantially underestimate the actual polarization. We expect that intermediate values of σ and of parameters specifying a beta distribution representing moderate concentration of district medians are most realistic and for these cases equation (4) provides a reasonable fit.

The distributions in Table 1 are listed in descending order of the variance of the distribution. Note that the legislative polarization decreases as we move down the table, as expected from Proposition 3, except for a couple of cases in the last two columns, where the partisan asymmetry functions diverge from the assumptions of that proposition. Similarly, as we move across the table from left to right, the partisan asymmetry functions increase (for $m > 50$) and decrease for $m < 50$ (for almost all values of m ; see Figure 2), and the legislative polarization also increases, in accord with Proposition 3.

Table 1. Assessing the accuracy of Proposition 2 under relaxation of assumptions.

District median distribution	Partisan asymmetry function			Step function
	Linear ($d = 0.01$)	Normal ($\sigma = 25$)	Normal ($\sigma = 10$)	
Uniform	33.3 (33.3)	38.5 (40.6)	48.0 (56.0)	50.0 (66.7)
Beta(2,2)	20.0 (20.0)	25.2 (24.4)	34.7 (33.6)	37.5 (40.0)
Beta(3,2)	16.7 (16.0)	21.4 (19.5)	31.5 (26.9)	35.1 (32.0)
Beta(3,3)	14.3 (14.3)	18.8 (17.4)	27.9 (24.0)	31.3 (28.6)
Beta(4,2)	14.3 (12.7)	18.6 (15.5)	29.9 (21.3)	34.2 (25.4)

Note: Table entries are numerically calculated values for legislative polarization for the indicated district median distribution and partisan asymmetry function. Values in parentheses are the estimates of legislative polarization from formula (4) in Proposition 2, given by $Mean\ polarization = 0.08 \times (mean\ partisan\ bias) \times \sigma_M^2$ (with the weighting factor w set equal to 1 and the district-specific party differentiation k set equal to 0). Note the rough equivalence between the two sets of values, with most Proposition 2 estimates within ten percent of the correct value (the cells indicated in bold). The most significant deviations occur for the uniform median distribution when the partisan asymmetry is close to a step function and for (the asymmetrical) beta(4,2) district median distribution.

Further analysis of the relation of alternative district-median distributions to legislative polarization is presented in Appendix B (available online at <http://course.wilkes.edu/Merrill/>).

3. Changes in legislative polarization: estimating the effects of each of the three factors in the model

3.1. Measuring the three factors identified in equation (4) that affect legislative polarization

We now present empirical measures for the three factors that we have identified as the foundational factors affecting the level of legislative polarization:

1. *district heterogeneity*, the variation in the locations of the district medians. To measure district heterogeneity we note that generally the higher the vote for the Democratic presidential candidate the more to the left is the district median. Accordingly, we may approximate the distribution of district medians with the normalized distribution of two-party presidential vote shares.¹⁰ Our approximation to district heterogeneity is the standard deviation of two-party presidential vote shares across congressional districts.
2. *district-specific party differentiation*, the ideological difference between Republicans and Democrats elected from ideologically comparable constituencies. To measure this party differentiation, we regress, separately for the winners of each party, the first dimension of DW-NOMINATE scores against the two-party presidential vote share in different epochs (see, e.g., Hussey and Zaller, 2011). The difference between the intercepts for the two

parties is used as a measure of district-specific party differentiation. For this difference to be well-specified, the gap between winning candidates of different parties in ideologically comparable districts must be essentially invariant across districts, i.e. the regressions for the DW-NOMINATE scores¹¹ must have at least approximately a common slope over the parties. In our empirical analyses we will check the accuracy of this common-slope assumption.

3. *partisan asymmetry*, the likelihood that a constituency with given ideological characteristics would elect a Republican as opposed to a Democrat. To measure *partisan asymmetry*, we estimate mean partisan bias, defined as

$$\frac{2}{100} \int_0^{100} |P_R(m) - 0.5| dm,$$

from the data by first partitioning the districts in each election into 20 five-percentage-point bins according to the normalized presidential vote. For the i th bin, aggregated for each 10-year period and separately for the entire period of study, we determine the number n_i of districts and the proportion $P_R(i)$ electing a Republican. For each time period, the quantity

$$\left(\frac{2}{\sum_i n_i} \right) \sum_i (n_i |P_R(i) - 0.5|) \quad (6)$$

is used to estimate the *mean partisan bias*.¹²

3.2. Measurement methodology

We now consider in detail the empirical evidence about changes in legislative polarization since the 1950s.

3.2.1. District heterogeneity. To provide evidence of changes in district heterogeneity over time, we track the standard deviation in normalized presidential two-party vote shares in House districts over elections from 1956 to 2008. This standard deviation is somewhat stable between 1956 and 1992, staying mostly between 0.110 and 0.125. Since that time, however, there has been a marked increase in the standard deviation of the distribution of presidential vote shares with an average increase each presidential year of about 0.007. So the variance over the last twenty years or so has increased noticeably. As judged by presidential vote share, there are more districts that are ideologically extreme.¹³

3.2.2. District-specific party differentiation. Our second factor that helps us explain changes in legislative polarization is the ideological difference between Republicans and Democrats elected from the same or ideologically comparable constituencies. In this section we provide evidence that (except for what can be considered random variation) this difference between Republicans and Democrats is essentially constant as a function of the district-median m , and that this difference can be estimated from available aggregate level data.

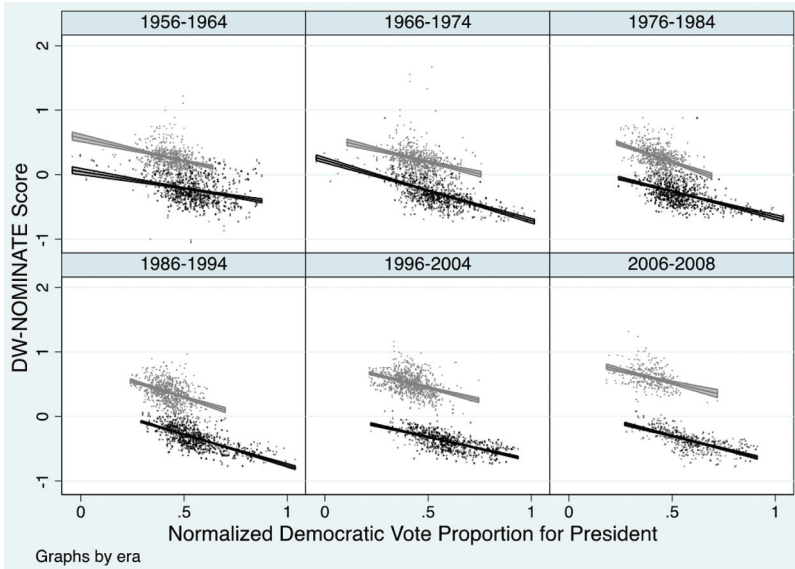


Figure 3. Presidential vote share and ideology for US House members in different time periods with regression lines for Democrats and Republican fitted separately.

First, we note that this effect is dramatically highlighted when an MC of one party is replaced by an MC of the opposite party in the *same* district. Focusing on Democrats (Republicans) who were replaced by Republicans (Democrats) in the next Congress over the period 1982 to 2004, Brunell et al. (forthcoming) find that the mean change in DW-NOMINATE scores for the 103 Democrats replaced by Republicans was 0.671 (on a scale with a range of 2.0) and the mean change for the 54 Republicans replaced by Democrats was -0.669 , on the same scale.¹⁴ Thus the average change in districts with partisan replacement during this period was approximately one third of the entire width of the scale.

We wish, however, to relate the winners in all districts to the partisan-makeup of the district for the full period from 1956 to 2008 and to rely on data that is free from respondent projection. At the same time, in order to estimate the mean position of each party delegation in the House, we only need data from the *winners* of House elections, not the losers. Separately for the winners of each party, we plot the first dimension of DW-NOMINATE scores as a function of two-party presidential vote share in different epochs.¹⁵ Figure 3 shows this data, together with separate regression lines for each party.

For the time periods we investigate, we model these relationships as simple linear functions in which DW-NOMINATE scores (y_D and y_R) and support (x) for the Democratic presidential candidate can be written as

$$y_D = \alpha_D + \beta x + \varepsilon \quad (7)$$

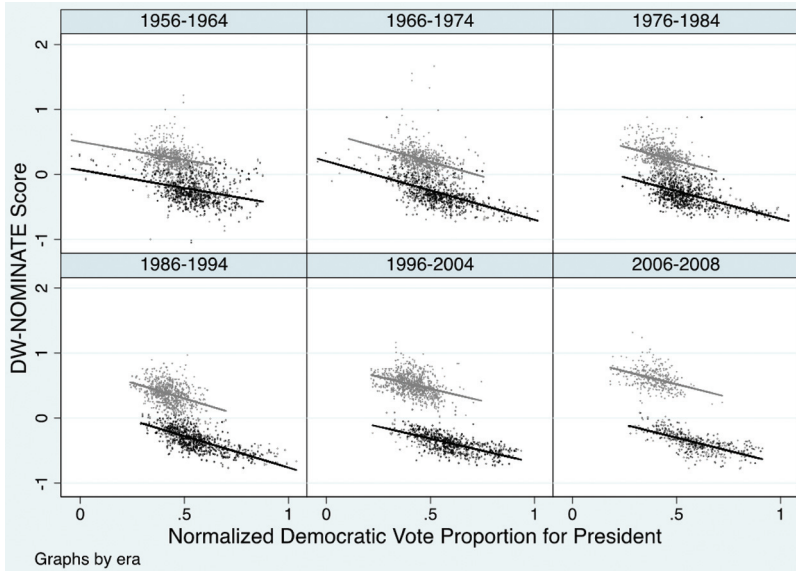


Figure 4. Presidential vote share and ideology for US House members in different time periods with regression lines for Democrats and Republican based on a combined regression with party dummies.

for Democratic winners, and

$$y_R = \alpha_R + \beta x + \varepsilon \tag{8}$$

for Republican winners, where α_D , α_R , and β are coefficients and ε is normally distributed with mean 0. We posit a common slope because the data shown in Figure 3 are nearly consistent with the lines being parallel, i.e. with the gap between candidates of different parties being essentially invariant across districts and thus not depending greatly upon the ideological location of the district’s median voter. Figure 4 shows those parallel lines. For the full period 1956–2008 and for each of its subperiods by decades, we obtain estimates a_D , a_R , and b (presented in Table 2) for the parameters α_D , α_R , and β of the two regression equations (7) and (8). These values will be used in our empirical calculations. To convert from the 2-point interval of DW-NOMINATE scores (which extends from -1 to $+1$) to our 100-point interval, we multiply the estimates by 50.

Thus, $50(a_R - a_D)$ is our estimate of district-specific party differentiation, i.e. the empirical estimate for the parameter k . In particular, this difference in intercepts represents a difference between elected Republicans and Democrats from ideologically similar districts – a difference that is essentially constant as a function of the district median. The value $|b|/2$ represents the rate of change in policy position as district support increases and is thus an estimate of the weighting factor w . (We divide by 2 because the range of DW-NOMINATE scores is 2.)

Table 2. Empirical estimates for model parameters: 1956–2008.

Period	Republican intercept: a_R	Democratic intercept: a_D	Common slope: b	Estimate of w ($ b /2$)
(1)	(2)	(3)	(4)	(5)
1956–2008	0.747	0.192	−0.899	0.450
1956–1964	0.501	−0.069	−0.555	0.278
1966–1974	0.647	0.204	−0.902	0.451
1976–1984	0.639	0.170	−0.853	0.426
1986–1994	0.783	0.204	−0.966	0.483
1996–2004	0.825	0.059	−0.749	0.374
2006–2008	0.925	0.104	−0.811	0.406

Note: The dependent variable is the DW-NOMINATE score. Columns 2–4 report estimates of the regression parameters α_D , α_R , and β for equations (7) and (8), for the full period under study and for each subperiod. To convert from the 2-point interval of DW-NOMINATE scores (which extends from -1 to $+1$) to our 100-point interval, we later multiply the estimates by 50.

Table 3. Empirical estimates for model factors: 1956–2008.

Period	Variance of district medians: σ_M^2	District-specific party differentiation: $50(a_R - a_D)$, i.e. k	Mean partisan bias	Legislative polarization: estimate from Proposition 2	District partisanship: $50b(\bar{x}_R - \bar{x}_D)$	Legislative polarization: estimate from regression
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1956–2008	154	27.8	0.448	30.3	5.7	33.4
1956–1964	135	21.6	0.447	22.9	2.9	24.5
1966–1974	143	22.2	0.316	23.8	3.7	25.9
1976–1984	133	23.5	0.432	25.5	4.7	28.2
1986–1994	146	29.0	0.480	31.7	6.2	35.1
1996–2004	192	38.3	0.633	41.9	6.9	45.2
2006–2008	218	41.1	0.641	45.6	7.8	48.9

Notes: A 100-point scale is used for m ; regression terms have been multiplied by 50 to convert from the DW-NOMINATE scale to the 100-point scale. The legislative polarization estimate from Proposition 2 (column 5) is computed from equation (4): Legislative polarization = $0.08 \times (\text{mean partisan bias}) \times w\sigma_M^2 + k$.

The legislative polarization estimate (column 7) is computed from equation (9):

$\bar{y}_R - \bar{y}_D = (a_R - a_D) + b(\bar{x}_R - \bar{x}_D)$. We note that, generally, the values from the two formulas are similar, although the values estimated from Proposition 2 run lower, in part because the linear form for the partisan asymmetry function likely underestimates its true deviation from 0.5, as we saw above and in Appendix B, and because of possible asymmetry of the district-median distribution.

Table 3 presents our estimates both for σ_M^2 (in column 2) and for k (in column 3), for the full period 1956–2008 and for each of five sub-periods. For the full period, for example, $50(a_R - a_D)$, the estimate for the district-specific party differentiation, i.e. the estimate for k , is $= 50(0.747 - 0.192) = 27.75$. What we see from

the values in column 3 is that the estimate for k increases from 21.6 in 1956–64 to 41.1 in 2006–08, roughly doubling over the period of our study.

Note that the estimates of district-specific party differentiation reported in Table 3 are comparable to our earlier estimates based only on districts in which an MC was replaced by a member of the opposite party. This can be seen by comparing the party differentiation in Table 3 for the periods 1986–1994 (29.0) and 1996–2004 (38.3) with the earlier estimate based on partisan replacement alone for the period 1982–2004 (about 33.5 when the 2-point DW-NOMINATE scale is converted to the 100-point scale). This observation provides confirmation that the estimates obtained from using presidential vote shares as a proxy for district medians are plausible.

3.2.3. Estimation of the mean partisan bias and the weighting factor, w . The third factor to take into account is the likelihood that a constituency with given median voter location would elect a Republican. Empirical analysis (omitted for space reasons)¹⁶ suggests that the Republican and Democratic candidates do not, in fact, on average, equally straddle the district median, but rather typically straddle a position intermediate between the district median and the national median of their party. This implies, *ceteris paribus*, that liberal districts will be much more likely to be won by Democrats and conservative districts much more likely to be won by Republicans than were it the case that both candidates locate at the district median.

Using equation (6) to calculate the value of *mean partisan bias*, we show in Table 3, column 4, the estimates of the mean partisan bias for the elections from 1956–2008.¹⁷ As expected what we find is increasing bias over time, particularly in the most recent years of the study, i.e. it becomes more and more predictable which districts will be won by Democrats and which by Republicans. This reinforces the trend we earlier noted of an increased heterogeneity among the districts, but is a distinct phenomenon since we can, in principle, have a rise in ideological differentiation of the districts without that being reflected in a rise in *constituency specific* partisan bias.

3.3. Overall finding about the relative importance of the three factors in affecting changes in legislative polarization since the 1950s

Proposition 2, according to equation (4), provides a decomposition formula for legislative polarization under the assumption that the partisan asymmetry function is linear:

$$\text{Legislative polarization} = 0.08 \times (\text{mean partisan bias}) \times w \sigma_M^2 + k$$

Using the values of the three factors in columns 2–4 of Table 3, the estimated values of legislative polarization computed from this formula are presented in column 5 of Table 3. (Estimated values for w are given in Table 2.) For the full period 1956–2008, Proposition 2 yields:

$$\text{Legislative polarization} = 0.08 \times 0.448 \times 0.450 \times 154 + 27.8 = 2.5 + 27.8 = 30.3.$$

Not only is district-specific party differentiation now nearly double its value in the first two decades of the study, so also has the other term in this formula (involving district heterogeneity and mean partisan bias) approximately doubled over the period of the study, so that legislative polarization has increased likewise. For example, for the earliest sub-period 1956–64,

$$\text{Legislative polarization} = 0.08 \times 0.447 \times 0.278 \times 135 + 21.6 = 1.3 + 21.6 = 22.9,$$

whereas for the most recent sub-period 2006–08,

$$\text{Legislative polarization} = 0.08 \times 0.641 \times 0.406 \times 218 + 41.1 = 4.5 + 41.1 = 45.6.$$

These calculations suggest that, for the full period, 92% of legislative polarization is due to district-specific differentiation (i.e. $k/|\mu_R - \mu_D| = 27.8/30.3 = 0.92$, or 92%). Similarly, for the subperiods, the percent of legislative polarization due to district-specific differentiation ranges from 90% to 94%. Thus, one of our key findings appears to be that, by far, the largest component of the gap between the partisan delegations is due to the ideological distance between MCs representing districts with similar ideology, i.e. due to party, while the much smaller component is due to differences in district ideology and partisan asymmetry. Furthermore, as we can see by comparing the estimates in Table 3 for 1956–64 and 2006–08, the *growth* between these two periods that is due to district-specific party differentiation (19.5) is 86% of the *growth* between the same two periods in partisan polarization in the House (22.7).

Still, this observation about the proportion of legislative polarization explained by district-specific party differentiation depends on the accuracy of our estimates for the remaining two explanatory factors, namely the variance of district medians and the mean partisan bias. As we have seen, these estimates are compromised by the empirical fact that presidential vote shares are an imperfect proxy for the location of the median voter. Furthermore, any non-linearity of the partisan asymmetry function $P_R(m)$ may alter the effects of the partisan bias on legislative polarization, in part because the linear form for the partisan asymmetry function likely underestimates its true deviation from 0.5.¹⁸ In particular, as we have seen in Section 2, use of formula (4) may underestimate legislative polarization due to district heterogeneity and partisan asymmetry when the district-median distribution is asymmetric. Note, however, that even if this underestimate was as high as 50 percent (higher than in any of our examples in Table 1), the proportion of legislative polarization for 1956–2008 due to district specific differentiation would still be at least 80 percent. As a further robustness check to address these concerns, we turn to an alternative decomposition, which depends entirely on regression of DW-NOMINATE scores but does not separate the effects of district heterogeneity and partisan asymmetry.

3.4. Alternative two-factor decomposition of legislative polarization

We show that legislative polarization, i.e. the mean difference in ideology between the party delegations, can empirically be decomposed into district-specific party

differentiation, i.e. factor 2 in the previous decomposition, and a second factor that, following Hussey and Zaller (2011), we will call *district partisanship*, which reflects both district heterogeneity and partisan asymmetry. We then assess the relative impact of each factor in this alternative, two-factor decomposition. Finally, we will compare the estimates of legislative polarization from the alternative decomposition with that implied by Proposition 2, a decomposition that in part employs different data.

Suppose, as above, that regressions of DW-NOMINATE scores versus presidential vote shares are performed separately for seats won by Democrats and seats won by Republicans and that they yield the same estimated slope, b , so that the estimated regression equations are of the form $\hat{y}_D(x) = a_D + bx$ for the Democratic seats and $\hat{y}_R(x) = a_R + bx$ for the Republican seats. Denote by \bar{y}_D and \bar{y}_R the respective mean locations of the Democratic and Republican delegations and by \bar{x}_D and \bar{x}_R the respective mean ideologies of the set of districts won by Democrats and the set of districts won by Republicans. Because, in general, the intercept a in a simple regression $\hat{y} = a + bx$ is given by $a = \bar{y} - b\bar{x}$, it follows that, using the regression equation for Democratic seats,

$$\hat{y}_D(\bar{x}_D) = a_D + b\bar{x}_D = (\bar{y}_D - b\bar{x}_D) + b\bar{x}_D = \bar{y}_D,$$

and similarly, using the regression equation for Republican seats,

$$\hat{y}_R(\bar{x}_R) = \bar{y}_R.$$

Thus,

$$\bar{y}_R - \bar{y}_D = \hat{y}_R(\bar{x}_R) - \hat{y}_D(\bar{x}_D) = (a_R + b\bar{x}_R) - (a_D + b\bar{x}_D),$$

so that

$$\bar{y}_R - \bar{y}_D = (a_R - a_D) + b(\bar{x}_R - \bar{x}_D). \quad (9)$$

Thus – again converting to our 100-point scale – legislative polarization, i.e. the difference between the mean locations of the Republican and Democratic delegations, is the sum of two quantities: (1) $50(a_R - a_D)$, i.e. our estimate for k , the district-specific party differentiation, and (2) $50b(\bar{x}_R - \bar{x}_D)$, i.e. district partisanship, which represents the combination of district heterogeneity and partisan asymmetry.¹⁹ This decomposition is depicted schematically in Figure 5.

For the period 1956–2008 in the House, regression assuming a common slope yields $\hat{y}_D = 0.192 - 0.899x$ for Democrats and $\hat{y}_R = 0.747 - 0.899x$ for Republicans. For the same period, the mean Democratic presidential support for seats won by Democrats was 0.554 and for seats won by Republicans was 0.428, which reflects district differentiation. Thus, multiplying all values by 50 to convert to the 100-point scale,

$$\begin{aligned} \text{Legislative polarization} &= 50(\bar{y}_R - \bar{y}_D) = 50(a_R - a_D) + 50b(\bar{x}_R - \bar{x}_D) \\ &= 50(0.747 - 0.192) + 50(-0.899)(0.428 - 0.554) = 27.75 + 5.66 = 33.4. \end{aligned} \quad (10)$$

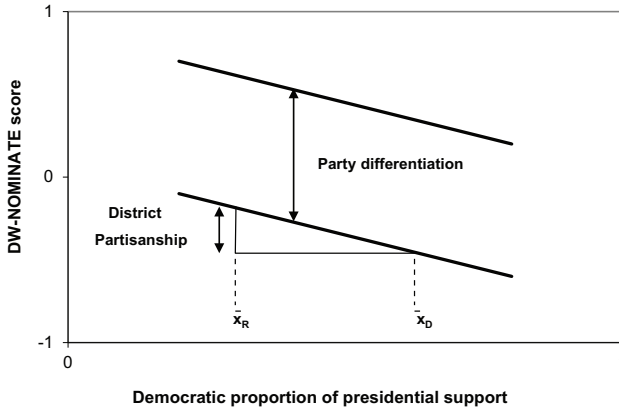


Figure 5. Decomposition of legislative polarization.

As we have seen, Table 3 presents (in column 3) values of district-specific party differentiation, i.e. $50(a_R - a_D)$. In column 6 of that table, we present the second factor in this two-factor decomposition, i.e. $50b(\bar{x}_R - \bar{x}_D)$; and in column 7, their sum: $50(\bar{y}_R - \bar{y}_D) = 50(a_R - a_D) + 50b(\bar{x}_R - \bar{x}_D)$, as specified by equation (10) and which provides our alternative estimate of legislative polarization. These values are given for the full period 1956–2008 and for each subperiod. Note that, as for the original three-factor decomposition, under this alternative approach, both district-specific party differentiation and district partisanship approximately doubled their values over the period of the study, so that legislative polarization increased likewise.

This alternative estimate of the percent of legislative polarization due to party is 83%, similar to but somewhat lower than the estimate from the three-factor decomposition above. But both estimates indicate that the lion’s share of legislative polarization in the legislature can be traced to district-specific party differentiation. We note that both formulas for legislative polarization use the same calculation for district-specific party differentiation and the weighting factor w , but for the remainder of the calculation, the alternative decomposition defined by equation (10) uses DW-NOMINATE scores whereas Proposition 2 defined by equation (4) does not. Because the two-factor, alternative decomposition assesses the proportion of legislative polarization explained by party using only regression from the data and does not depend on estimating district heterogeneity and partisan bias, *per se*, the fact that the two estimates (one from the three-factor model and one from the two-factor model) are roughly similar reinforces confidence in the numerical results.

Likewise, as we can see by comparing the alternative estimates in Table 3 for 1956–64 and 2006–08, the *growth* between these two periods that is due to district-specific party differentiation (19.5) is 80% of the *growth* between the same two periods in legislative polarization in the House (24.4).²⁰

4. Discussion

We have measured changes in each of the three factors that determine the level of legislative polarization over the period 1956–2008 to see how each has contributed to the increased polarization over this period. What we find is that the striking increase in Congressional polarization during the last half century is due not to a single factor but rather to a combination of all three of the factors identified in this study; namely, a growth in the number of districts that are ideologically more homogenous, corresponding to an increase in heterogeneity between districts, an increasing divergence between the positions taken by winning candidates of opposite parties in ideologically comparable districts, and an increase in the likelihood that more conservative or more liberal districts will be safe for one party. However, consistent with the findings of McCarty et al. (2009), far and away the most important of these factors is district-specific party differentiation, i.e. the ideological difference between House members of different parties from the same or similar districts. In our estimates of electoral effects we attribute to this single factor about 80% of the legislative polarization in the US House as well as about 80% of the *change* in polarization over the last 50 or so years.²¹ Rough agreement between the estimates from two methodologies – which in part use different data – to estimate the proportion of legislative polarization explained by party lends further credence to the estimates.

In this paper we have limited ourselves to an analytic understanding of the three factors that together allow us to go from party differentiation at the district level to party polarization in the legislature. We have treated these three factors as independent of one another and we believe that this is a plausible approximation to reality for at least the first of our factors in that the ideological sorting of voters into districts may well occur regardless of the degree of district-specific party differentiation at either the district or the legislative level. However, the other two factors are almost certainly interrelated.²²

The distance between the platform a candidate offers and the location of the median voter in her/his constituency is constrained by national party positions given a lack of credibility with voters for party candidates who claim to locate themselves far from the national party position, but also by the reluctance of party voters and activists to nominate candidates too far from the national position (Merrill et al., 2014; Winer et al., forthcoming), especially insofar as the national parties have already taken polarized positions. We can see direct examples of the difficulty facing candidates who seek to moderate their position away from the national party position to move closer to their own district's median, when we consider Tea Party challenges to Republican incumbents. Even when such challenges are not successful, they may motivate candidates to move closer to the party's ideological line, lest they continue to face such costly challenges in the future. On the other hand when candidate 'wiggle room' at the constituency level to credibly espouse a position offering a reasonable chance to attract the median voter in the district is large, then the party delegations in the legislature will not be far apart. This follows because most constituencies will be competitive for both parties and

thus the set of constituencies won by each party will be representative of a broader range of ideological locations of the districts. We expect that greater (lower) candidate differentiation and greater (lower) legislative polarization are mutually reinforcing.²³ This linking suggests that there may well be ways to endogenize partisan differentiation at the district level, but that task must be left to future research. Another topic to examine in the future is the effect of electoral tides, i.e., change in which party, on balance, gains seats over a given period of time (cf. the literature on realignment and partisan cycling, e.g., Mayhew, 2002; Merrill et al., 2008).

The model we have presented posits one dimensional political competition. A natural next step, beyond the scope of the present essay, would be to consider how the model could be extended to deal with, say, the addition of a cultural as well as an economic dimension of party competition (see, e.g., Krasa and Polborn, 2014). We believe that the basic intuitions of the one-dimensional case, with legislative polarization accounted for by both district level and national level phenomena, would continue to apply.²⁴ But in any case, we believe that evidence for the present high degree of unidimensionality in Congressional voting and the preeminence of the first dimension of DW-NOMINATE scores argues for the contemporary empirical relevance of our unidimensional model.²⁵

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Notes

1. Updated data and analysis from Keith Poole’s website (voteview.com/polarizedamerica.asp) August 2010.
2. However, polarization is always relative to the space of policy positions ‘mainstream’ enough to allow candidates to be elected. Certain kinds of extremism we got when racist views were publically stated are seldom found now. Today we debate how to finance Social Security, not whether to have it; but national health insurance still generates truly polar positions.
3. In our subsequent discussion we consider what happens when, as we find empirically to be the more realistic case, candidates of each party are not located symmetrically around the constituency median.

4. In this paper we distinguish polarization in the legislature (by which we mean distance between the ideological means of the two party delegations) from polarization in the electorate. We also focus on polarization rather than sorting, where the latter refers to the degree of correlation between voter ideology and voter partisanship (see Levendusky, 2009).
5. See also Austen-Smith (1986). For a variety of other reasons why parties might not converge, see review of two-party competition models in Grofman (2004).
6. The weighting factor, w , is motivated by empirical evidence (to be introduced in Section 3) that winning district candidates locate, on average, about equidistant from a *weighted* average of the (common) *district* median and the *national* median – with the Democratic winner to the left and the Republican winner to the right. Estimation of w from data will be specified in Section 3. The weighting factor w may vary over time, depending on factors such as the degree of national party discipline (see Merrill et al., 2014). Note that the two candidate positions will not be equidistant from the district median (one on either side) unless the district median is such that the two national party positions are equidistant from it.
7. As we will see empirically, k is roughly constant as a function of m . Note that, under an assumption that successful district candidates are equidistant from the effective median over districts, this common distance is $k/2$.
8. In effect, the mean partisan bias is the aggregate deviation of the probability of partisan success from what that probability would be if success were unrelated to district ideology. The factor 2 is introduced so that mean partisan bias ranges from 0 to 1.0.
9. Intuitively, legislative polarization increases with the *square* of σ_M because the deviation of (Republican) legislators' locations for a given m from the center of the scale (i.e. from 50) *and* the propensity of a district to elect a Republican (because of the linear form: $P_R(m) = 0.5 + d^*(m - 50)$) each increase in proportion to deviations of the district median from 50.
10. The presidential vote share in each district is normalized by subtracting the national presidential vote share. This allows us to control for electoral tides. Note that proxying district medians by normalized presidential vote share reverses the direction of the scale, because a median voter on the left corresponds to a high Democratic presidential vote share. If the district voter distribution is uniform on an interval of unit length (and hence centered on the district median), assuming no truncation at the ends of the scale, the district median is exactly the Republican proportion of the vote. Insofar as the voter distribution differs from this form, the equivalence between median voter position and presidential proportion is only approximate. Later, using data on legislative replacements, we support the plausibility of the presidential vote proxy.
11. District-by-district DW-NOMINATE scores for Dimension #1 were obtained from Keith Poole's website http://voteview.com/dw-nominate_textfile.htm. House members whose parties were coded from 100 to 199 were classified as Democrats; those coded between 200 and 299, as Republicans.
12. Note that this quantity reflects, among other things, the fact that, in a district in which the presidential proportion of the vote for one party is low, the candidate of the other party is likely to be the closer one to the district median.
13. There are two reasons to expect recent variance changes in this distribution. First, we have the 'big sort' (Bishop, 2008), which shows that, at various levels of geography, there is greater clustering of like-minded individuals. Second, we have intentional gerrymandering to increase district homogeneity in partisan terms (eliminating marginal seats in favor of safe seats for both parties), e.g., by concentrating African-American

and Hispanic voters in majority-minority seats (see, e.g., Brunell and Grofman, 2008a: Table 5). Also, there is clear change in the urban-rural nature of each party's support base. Increasingly the Democrats are an urban party and the Republicans a rural and suburban one (Brunell and Grofman, 2008a: Tables 1–2). Using Koetzle's (1998) measure of partisan homogeneity to compare constituency homogeneity over recent decades, Brunell and Grofman (2008b: Table 5.1) show that House seats are growing more homogeneous in partisan propensities, while there is no real change at the state level.

14. The mean change when Democrats were replaced by Republicans has increased significantly over the period studied (by about 0.030 per Congress, $p = 0.04$); the mean change for Republicans replaced by Democrats has also increased, but statistically, not significantly. Replacement data at the turn of each decade was omitted because of the change in constituencies due to redistricting.
15. It is possible that using presidential vote share (or any other imperfect measure) as a proxy for district ideology may bias the estimate of party differentiation. Specifically, an over-estimate for party differentiation may occur if Democratic candidates are more likely to win in districts where the true ideology is more liberal than the Democratic presidential vote share (and analogously for Republican candidates). This effect would widen the observed gap between the two partisan regression lines that we are using to estimate party differentiation. However, as we will see, the estimates we obtain for this gap via regression analysis on all districts is quite comparable to the estimate provided above based entirely on districts in which an MC was replaced by a member of the opposite party, so we expect that the size of the possible bias described above is quite small.
16. See Appendix C, available online at <http://course.wilkes.edu/Merrill/>.
17. Variation in the number of bins used in the calculation of equation (6) leads to similar patterns of values for mean partisan bias. Using either 10 or 50 bins, mean partisan bias is lowest for the 1966–74 subperiod (0.318, 0.316, and 0.338, for 10, 20, and 50 bins, respectively) and highest for the most recent subperiod 2006–2008 (0.638, 0.641, and 0.648, respectively), just as is the case for the 20 bins used in column 4 of Table 3. The maximum deviation (over subperiods) in the estimates below of legislative polarization based on using other than 20 bins is less than 1 percent of total polarization.
18. If a step function (see Appendix B) is used to model the partisan asymmetry function (in place of a linear function) then the percentage of party polarization explained by district-level party differentiation drops to 87% for the full period of study (and 87–90% for the subperiods).
19. Analytically, $(a_R - a_D)$ is the distance between the regression lines for the two parties, and $b(\bar{x}_R - \bar{x}_D)$ is the rise in the common slope of the DW-NOMINATE score between an MC representing an ideologically average Republican-won district and an MC of the same party representing an ideologically average Democrat-won district. Our approach is similar to that of Hussey and Zaller (2011), who distinguish between 'Party Effect' and 'Effect of District Partisanship'. However, Hussey and Zaller (2011) arbitrarily evaluate a regression line at points on the x-axis that are 0.5 apart and take the difference. Above we justify analytically the evaluation of a regression line at \bar{x}_R and \bar{x}_D and taking the difference.
20. Alternatively, the regression coefficient (over eras) for the district-specific party differentiation component is 81% of the regression coefficient for partisan polarization in the House.

21. As shown in Theriault (2008), it is possible to further decompose changes in party differentiation into replacement effects and conversion effects, but we will not pursue that direction here.
22. There are the further complications raised by the work of Levendusky (2009) in his contribution to the debate over the 'culture wars'. He finds that greater partisan sorting may lead to shifts in attitudes of some voters to more closely match those of the current party base, and there may also be a limited number of cases of partisan conversions. These possibilities mean that district level ideological heterogeneity (as proxied by presidential voting patterns) may be affected by polarization of elites in the legislature, so that the causality goes in both directions.
23. In particular, this partisan differentiation at time t may be a function of party polarization at the national level at time $t - 1$, while party polarization at the national level at time $t + 1$ will itself be a function of partisan differentiation at the district level during that same time period. Similarly, once we allow for change in district-level partisan differentiation, then we may see that partisan asymmetry should also be expected to rise with increasing partisan differentiation, thus increasing legislative polarization.
24. Of course, there are a variety of complications when we shift from the unidimensional context, since the repertoire of strategies open to the parties increases and we may wish to assign different strategies to different parties (see, e.g., the distinction in Laver and Sergenti (2012) among 'sticker', 'aggregator', and 'hunter' parties). Moreover, as noted by one of the reviewers, when there are multiple important dimensions of competition, even if competition in a given district is unidimensional, there is no guarantee that the same dimension is the most salient in all constituencies.
25. We recognize that the substantive content of the first dimension of DW NOMINATE scores has changed over time. One reason that parties can be modeled in unidimensional terms is because of projection of multidimensional issues into a single dimension of conflict defined by the two party locations (see, e.g., Hinich and Munger, 1994; cf. Taagepera and Grofman, 1985). Another is that, for voters, minor dimensions may become more or less 'noise', with only the main dimension emerging as 'signal' (Feld and Grofman, 1988). Nonetheless, a natural next step, beyond the scope of the present essay, would be to consider how the model could be extended to deal with, say, the addition of a cultural as well as an economic dimension of party competition (see, e.g., Krasa and Polborn, 2014).

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