Modeling the Electoral Dynamics of Party Polarization 
in Two-Party Legislatures

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ABSTRACT

While there are many formal models that generate predictions about polarization, only a handful address the question of how, with no change in electoral rules, levels of polarization can dramatically vary over time, as they have in the U.S. House during 150 years of two-party competition. We propose a model that emphasizes national party constraints on district candidates’ ability to locate at positions far from the national party stance. The model predicts a close relation between tight tethers maintained by the national parties and congressional polarization, suggests implications for political competition, and generates the empirically accurate prediction that partisan polarization and within-party differentiation are negatively correlated. When the tethers of the two parties are not equally strong, the model suggests modifications to the conditional party governance approach and helps explain ideological shift/drift affecting both parties, with the party with the tighter tether moving the other party toward its ideological wake.
I. Introduction

Ideological polarization and partisan enmity is arguably the driving force of the past several decades of U.S. electoral history. But, while there are many formal models that generate predictions about polarization, only a handful address the question of how, with only limited change in electoral rules, levels of polarization can dramatically vary over time, as in fact they have in the U.S. House over the course of more than 150 years of two-party competition (McCarty, Poole and Rosenthal, 2006 and see below). Virtually all the work that seeks to provide a dynamic perspective on congressional polarization looks at macro-level factors such as changes in immigration levels or economic inequality.

Our approach is quite different, and is based on the interplay between national party expectations and constituency level electoral dynamics. We seek a model that can relate electoral dynamics to party discipline and district ideology.

We model replacement dynamics in terms of the ideological wiggle room that parties permit their candidates to (credibly) locate at positions close to those of the median voter in the constituency. We explore national party tethers that can constrain the feasible range of party competition about each national party position (which, we specify empirically as the mean ideological position of the party delegation in the current legislature, specifically the average DW-NOMINATE score). Our model generates changing party polarization endogenously and predicts that partisan polarization and within-party differentiation are negatively correlated. Furthermore, the model allows for asymmetry in tether strength. We show that, if one of two national parties exerts a tighter tether than the other, both partisan delegations can shift significantly in the direction of the party exercising the tighter tether. These results have important implications for the structure of political competition at the constituency level, and the
nature of party polarization in the legislature and, thus, for conditions under which conditional party governance will be met (see Rohde, 1991; Aldrich and Rohde, 1998; Aldrich, Rohde and Tofias, 2007). In particular, we show that if one party is more ideologically rigid than the other, its cohesiveness has impact on the distribution of policy positions taken by members of the other party.

1. Literature Review: Explaining Party Positioning at the Constituency Level

There have been numerous models of ideological differentiation in two party contests, beginning with Downs’s seminal (1957) model, which was generally interpreted as predicting tweedledum, tweedledee politics in any constituency. New models challenged the assumption that politicians cared only about reelection and not about policy (Wittman, 1973, 1977, 1983). Winer, Kenny, and Grofman (2009) define models in terms of where they fit on a continuum that has two opposite poles. At the office-seeking extreme, each candidate, regardless of party, will offer a platform that is identical to the preferences of the median voter in the district in which s/he is competing. At the partisan policy-seeking extreme, each party’s candidates will offer a platform that will be invariant with respect to district or, to paraphrase Gertrude Stein, “A Democrat is a Democrat is a Democrat; a Republican is a Republican is a Republican” (Winer et al., 2009).

The empirical reality is apt to be in-between. National parties are typically motivated by both office-seeking and policy-seeking objectives (Wittman, 1973; Adams, Merrill, and Grofman, 2005), and hence seek optimal ideological or issue positions that are separated from one another. Typically a national party is motivated to advance a legislative agenda and to establish and protect its political brand. A national party may be motivated to withhold support from wayward candidates, in the words of Winer, Kenny, and Grofman (2009), “to keep the
party true to its ideals, to help the party put forward a more cohesive message, or to make the party’s caucus in Congress more effective by limiting disagreement.”

In effect, party leaders may trade off the ability to be competitive in many districts for greater ideological purity that may allocate more weight to the median views inside the party, since it is easier to enforce within-party unity when the party’s congressional members are ideologically homogeneous. While party leadership may prefer to have several votes over a majority to serve as a buffer, it is also the case that the larger the majority party delegation, the more likely it is to have less ideological homogeneity. Optimally, for the U.S. House, one might prefer to have 218 members of the majority party, all of whom are tightly clustered around some ideal point. Within-party ideological variance is a key element of the theory of conditional party governance (Rohde, 1991; Aldrich and Rohde, 1998; Aldrich, Rohde and Tofias, 2007) that seeks to understand the conditions under which Congress enacts policies that are closer to the median legislator in the majority party than to the median legislator in the legislature as a whole.

Although candidates of the respective parties may conform to positions proposed by party leaders in the legislature because these positions are in line with their own policy preferences, they may also need to do so to get campaign funding and campaign support from the national (or state) party organizations. Another potential incentive for legislators to take positions consistent with those of the national party is that candidates who do not reflect the party’s brand may anticipate lack of acceptance into the governing structure should they reach Congress.

The policies espoused by state party leaders may also matter, if their party controls the state, since incumbent candidates may wish to avoid party retaliation in the form of being redistricted out of their seats. However, neither national party leaders nor state party leaders are the only relevant actors. Increasingly, party activists from both within and without the district exert a combination of carrot and stick influences (Sorauf, 1992; Marshall, 1998). On the one
hand, activists may offer substantial financial support to candidates who express strong support for policies espoused by activists. On the other hand, funding from national sources may not be forthcoming to candidates who stray too far from positions that groups associated with the party regard as acceptable (see, for example, Jacobson 2006 and Masket 2009; and for data concerning out-of-state financing from 2000–2010, see www.opensecrets.org). And there is a potential big stick facing incumbent legislators, namely, being confronted with a primary challenger financed by party activists. Constraints on candidate positioning may be particularly pressing if the district is competitive, because in this case support from outside the district may be more crucial to reelection. But the conflict between national party positions and activists may be minimal if the activists exert a major role in shaping the party’s candidate pool and if they are powerful enough to potentially mount a credible challenge even to party leaders seen as deviating too far from ideological purism – as in the threat that has been made by Tea Party activists to mount a primary challenge to Speaker of the House John Boehner (Boatright 2013).

Voter perceptions, too, must be taken into account. Yet another reason that candidates may avoid straying too far from their party’s national ideology is that such positions may not be credible to district voters, who suspect that if elected, the candidate will be pressured by the national party leadership to adhere to the national party line rather than to conform more closely to the views of the district electorate that voted for them. There are numerous recent examples of this phenomenon, including the 2013 Markey-Gomez contest for U.S. Senator in Massachusetts to fill the unexpired term of John Kerry. According to the New York Times article on this election (June 26, 2013; p. A13), the Republican Mr. Gomez, the loser, “could not convince enough Massachusetts voters that he would vote independently of the national Republican party.”
The range of districts in which candidates of each party can mount a credible challenge determines (probabilistically) the likelihood that each party will control the district and thus the feasibility of genuine political competition in the district (Grofman, 1987). In relatively liberal districts “moderately liberal” candidates of the more conservative party may be defeated, since they will be unable to present themselves credibly as liberals. Similarly, in relatively conservative districts “moderately conservative” candidates of the more liberal party are disadvantaged, since their conservative credentials will be questioned (cf. Grofman, Koetzle, McDonald, and Brunell, 2000). Only when there is strong regional differentiation of the parties, such as those in the U.S. attributable to the lingering effects of the Civil War, can candidates out of tune with the national party position present fully credible claims to track the median voter in their district. Absent such special conditions, the more strongly are the parties differentiated at the national level, the harder it will be for a candidate of a party whose national position is located far from the district median to win. Exactly what ideological range of districts will be competitive varies over time (Winer, Kenny, Grofman, 2009).¹

¹ Exactly how tether length will affect levels of political competition is not a straightforward question, since effects will vary with not just the mean tether length but also with the difference in tether lengths between the two parties, and the relative ideological dispersion of the two parties at the district level. A discussion of the theoretical and empirical links between tether length and political competition is beyond the scope of the present work. Some related issues are dealt with in Merrill et al. (1999).
2. Literature Review: Party Polarization in the Legislature

A number of authors (e.g., McCarty et al., 2006; Theriault, 2008; Butler, 2009) have looked at changing patterns of polarization. Ansolabehere, Snyder, and Stewart (2001) find empirical evidence that historically national ideology has been much more important than district ideology in determining candidate stance. Analyzing House candidates from 1874 to 1996, Ansolabehere et al. (2001: 136) conclude that congressional candidates

“… primarily espoused the ideology associated with the national party, moderating very little to accommodate local ideological conditions. 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.”

Thus, responsiveness to district ideology was observed to be higher toward the middle of the 20th century, during the era in which partisan polarization in Congress was at or near its lowest ebb. On the other hand, when district candidates follow the national party lines, generally Republicans will be elected in Republican districts and Democrats in Democratic districts, so that the two party cohorts will form polarized groups.

Using the same presidential voting data to measure district-level ideology as did Ansolabehere et al. (2001), Hussey and Zaller (2011) analyzed the relation of NOMINATE

2 In particular, Ansolabehere et al. (2001) find that Republicans became district-responsive in the 1930s and the Democrats in the 1960s, with both parties peaking in district-responsiveness in the early 1970s. Both of these partisan peaks in district-responsiveness occurred primarily before the recent dramatic upswing in party polarization.
scores to district ideology and to party. Hussey and Zaller (2001: 336) find that “Between 1876 and 1940, MCs were almost exclusively responsive to the agendas of their parties, regardless of the partisanship of the districts that elected them. Since the 1940s, MCs may have become more responsive to the partisanship of their voters, but still appear to give more allegiance to party agendas then voter preferences.” In particular, as indicated in Hussey and Zaller (2001: Fig. 11.5), the effect of the MC’s party was found to be highest -- i.e., in our terms, the partisan tether was tightest -- about 1900 and again about 2000 and least -- i.e., the partisan tether was most lax -- during the middle decades of the 20th century.

What is absolutely clear from the historical record is that, in the U.S. House, the degree of overall polarization has ebbed and flowed over the past century and a half of the modern two party era, with low intraparty variance often associated with high interparty divergence (see Figure 1). 3

3 Some models for Congress emphasize party control (e.g., Cox and McCubbins, 2005, 2007); others emphasize informational aspects of policy making (Krehbiel, 1992), while others models focus on the incentives of individual legislators to retain office and to structure legislative institutions to help achieve that aim (Mayhew, 2004), while other models of legislative behavior encompass the veto game between Congress and the president (Krehbiel, 2010). Cox and McCubbins (2005, 2007) argue that parties act as cartels and that the majority party seizes the power, ostensibly residing in the chamber as a whole, to make rules governing the structure and process of legislative decision-making. The conditional party governance literature (e.g., Aldrich, Rohde, and Tofias, 2007) argues, instead, that majority party control is contingent on maintaining unity within that party, and identifies conditions under which that unity is more likely to be achieved, such as between-party differentiation and within party homogeneity. McCarty, Poole, and Rosenthal (2001) and Snyder and Groseclose (2001), among many others,
We see in Figure 1A that means (for DW-NOMINATE scores) of the party delegations in the U.S. House were at their most disparate about 1900 and after 2000, whereas these means were least separated about 1860 and about 1950. Figure 1B shows that furthermore, for both parties, intraparty variation was relatively low at approximately the times that partisan separation was greatest (during the late 19th century and at least for the Democratic Party at the end of the 20th century), while intraparty variance was greatest when partisan separation was least (around 1860 and again from about 1950 to 1970).

have investigated possible effects of party discipline on members of Congress. The bulk of this research, however, assesses the possible effects of party discipline on roll call voting on specific bills in Congress (which Snyder and Groseclose find to be significant but which McCarty et al. find to be marginal) rather than effects of party discipline on the creation of party ideological images that may impact on the range of “credible” positions taken by Congressional candidates standing for election.

4 The data for Figure 1 are computed from the district-by-district DW-NOMINATE scores for Dimension #1 available in Keith Poole’s website Hhttp://voteview.com/dwnominate.aspH. House members whose parties were coded from 100 to 199 were classified as Democrats; those coded between 200 and 299, as Republicans. Figures 1A and 1B are similar to Figures 1.3 and 2.5, respectively, in McCarty, Poole, and Rosenthal (2006). The first dimension of the DW-NOMINATE scores reflects primarily economic issues.
The correlation between the absolute value of the Democratic mean scores with the within-party standard deviations for Democrats is –0.60; the corresponding correlation for the Republican Party is –0.53. Both correlations are significantly negative at the 0.0001 level. When data is limited to the non-South, the negative correlation disappears for the Democrats but remains for the Republicans (-0.56; significant at the .0001 level). Correlations relating the separation between the party means and either intraparty standard deviation are both significantly negative at the .01 level or better, even for the non-South. Thus, despite the noise in the data, high separation between narrow distributions of partisans is characteristic of strong polarization; reduced separation and broad (overlapping) distributions are characteristic of low polarization. Hence, in our view, any theoretical model of polarization should predict (negatively) correlated polarization and intraparty variance over the long term.

There are various explanations for the increasing polarization for the past fifty years (following a decline in polarization in the previous half century). Taking a structural tack, McCarty, Poole, and Rosenthal (2006: 6) argue that recent growing polarization of the electorate has resulted from two major factors: increased income inequality and immigration. They note that income inequality has increased (the Gini index of family income has increased from about 0.36 in the 1950s and 1960s to about 0.43 by 2000), and argue that the voting population has become increasingly polarized around income (with higher income voters more Republican; lower income voters more Democratic). Abramowitz (2010), however, finds factors other than income such as race, gender, marital status, and religious commitment much more predictive of partisan voting. For example, in recent House and presidential elections, a large majority of lower income whites who regularly attend religious services voted Republican; whereas, a majority of upper income whites who rarely or never attend religious services voted Democratic. Thus, although there is a strong longitudinal correlation between income inequality and partisan
polarization, it appears problematic to argue that polarization is a consequence of income inequality.

McCarty et al. (2006: 9) also offer a different, though partly related explanation of polarization changes over time. They note that during the past century the foreign born proportion in the U.S. increased from about 5 percent to about 12 percent, with the Democrats seen as the party more sympathetic to immigrants, and that growth in size of the immigrant population has followed a pattern that resembles the change in degree of polarization in Congress.

A quite different explanation for increasing polarization is offered by Fiorina (2005). During the last half of the twentieth century, party control was influenced by the replacement of many office-oriented professional political leaders by amateur activists with a deep commitment to policy change and often relatively extreme views. As Fiorina (2005: 5) argues, even if voters have not become more polarized, “partisans have become better sorted into the parties.” Such sorting has occurred in part because of activists’ and other politically engaged citizens’ insistence on issue or ideological purism so that catch-all parties are no longer viable (see Abramowitz, 2010). Fiorina and Abrams (2009: 110) identify a number of other key demographic and cultural changes that they see as linked to post-WWII increased polarization, including migration of African-Americans from the South to the North, the rise of the sunbelt,

\[\text{\textsuperscript{5}}\text{Relatedly, Theriault (2008) argues that polarization is in part due to geographical sorting, but also to institutional and procedural changes in Congress related to a culture of rewards and punishments (such as through campaign contributions and committee assignments).}\]
the revolution in the role of women, the politicization of evangelism, and the resumption of immigration.⁶

Here we will focus not on macro-social explanations, but rather on the specific electoral mechanisms that can affect polarization by affecting the winnability of districts whose median voters have a particular ideological location.

II. Modeling Changes in Polarization

1. The basic model for party polarization

We seek to model party polarization in a two-party legislature, allowing for both constituency-specific and national effects. For convenience, we will refer to the two parties as the Democratic and Republican parties. Our model has four elements of which the fourth is key to our study:

(i) constituencies that differ in the location of their median voter,

(ii) partisan candidates in each district that typically have distinct platforms,

(iii) national party differences tied to the ideological preferences of the set of representatives elected from each party,

(iv) constraints on the degree of deviation from national policy positions allowed to candidates (we will refer to such a party constraint as a national party tether, or simply tether for short) that affect how easy it is for candidates of each party to be competitive in any given district and that may prevent full convergence to the district median.

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⁶ There are also numerous other research articles discussing factors that may affect polarization (see e.g., Butler, 2009).
In particular, to develop a tractable but yet realistic model, we posit

(1) The district median voter ideal points follow a specified distribution on a $[0,100]$ left-right continuum (with higher numbers indicating more conservative positions), i.e., similar to a scale such as ADA or ACU scores, or the first dimension of DW-NOMINATE scores.

(2) We assume that the platform positions of Democratic and Republican candidates are located on the $[0,100]$ continuum and that these positions do not change after the election. In any district, the platform of the Republican candidate is to the right of the position of the Democratic candidate.

(3) We let $D$ and $R$ denote the positions of the national parties, assumed initially to be equidistant from the midpoint of the scale. After any election, we define the national positions of the Democratic and Republican parties, $D$ and $R$, as the mean positions of that party’s set of representatives in the legislature.

As indicated above, any national political party has competing motivations that may affect incentives that it offers or restraints that it may impose on candidates of that party at the district level. If primarily motivated to gain and preserve control over the legislative agenda, a rightist party may disfavor candidates taking moderate or leftist positions because such candidates if elected may not support – in fact may oppose – the party agenda. Extreme rightist candidates, on the other hand, may be tolerated because they are likely to be loyal supporters under a two-party system. Such motivations may be modeled by assuming that the party exercises a \textit{one-sided} tether, reigning in candidates or opposing the nomination of candidates who drift too far in the \textit{moderate} direction.

Alternatively, a party that is most sensitive to maintaining the credibility of its brand may expect candidates to be nominated that do not deviate too far in \textit{either} direction from the ideal position that reflects its brand. These alternative motivations suggest a \textit{two-sided} tether, under
which a center-right party, for example, is resistant to candidates either too moderate or too conservative. Mirror image motivations apply to a center-left party.

Accordingly, we introduce parameters $W_D$ and $W_R$ (using the scale of the $[0, 100]$ continuum) to define the *tethers* constraining Democratic and Republican candidates, respectively, from their national party positions, as defined in item (3) above. In other words, in our model, we specify either:

(4A) *One-sided tethers*: The most liberal position that can be taken by any Republican candidate is $R - W_R$, and the most conservative position that can be taken by any Democratic candidate is $D + W_D$, i.e., the Republican and Democratic candidates are restricted to $[R - W_R, 100]$ and $[0, D + W_D]$, respectively,

or

(4B) *Two-sided tethers*: Republican and Democratic candidates are restricted to policy positions in the line segments $[R - W_R, R + W_R]$ and $[D - W_D, D + W_D]$, respectively.

In either case, we replace the lower bound with 0 and the upper bound with 100, if needed. Finally, in each district, the candidate closer to the district median voter wins.

To make the modeling more tractable we initially make several further simplifying assumptions (that will be relaxed later):

(1’) Median voters follow a continuous, *uniform distribution* on $[0, 100]$.

(2’) $R$ and $D$ are initially exogenously given, and symmetrically located around 50.

(3’) $W_D = W_R = W$, and the value of this parameter is exogenously given.

These assumptions allow us to focus on the long run effects of $W$ on legislative polarization by holding fixed other factors that would affect polarization.
III. Consequences of Party Constraints for a One-sided Tether

1. Candidate strategies by district location for a one-sided tether

In this section we focus on a one-sided tether (initially assumed equal for both parties according to 3’ above), associated with a desire for each party to maintain and preserve control of the legislative agenda. In section IV, we consider the effects of unequal tethers on polarization, majority control, and party strategy. In section V, we investigate the consequences of a two-sided tether, associated with primacy of maintaining a partisan brand.

Figure 2 plots bounds for a one-sided tether, $W$, against the district median, $m$, assuming, in this example, that the Democratic and Republican congressional means fall at 40 and 60, respectively, on the [0, 100] scale. The blue and red lines in the figure represent the tether bounds for the Democratic and Republican parties, respectively, so that a horizontal line at level $W$ typically cuts through three intervals that specify the possible categories of options for district candidates when the tether equals $W$. For example, if $W = 20$, these three intervals, as labeled in Figure 2, are interval (1) where only the Democrat can locate at the median voter and can be expected to win; interval (2) where both parties can locate at the median voter and where we expect half the seats to be won by each party; and interval (3) where only the Republican can locate at the median voter and can be expected to win. For convenience, in the following examples, we will assume 100 seats.

Example 1. Under these simplifying assumptions, first suppose that $R = 60$, $D = 40$ and assume a loose tether $W = 40$. In districts whose median voter $m$ lies in the range $(80, 100]$, the
Democratic candidate is constrained by the tether from entering this interval so that the Republican can locate at \( m \) but the Democrat cannot. Hence the Republican wins, taking a position at \( m \). Similarly, in the interval \([0, 20)\), the Democrat wins with a position at \( m \). Within the central interval \([20, 80)\), both candidates can locate at \( m \), each winning with probability 0.5.

Thus, Republicans expect to win 20 seats with a mean location of 90, and have a fifty-fifty chance of winning an additional 60 with a mean location of 50, so that their expected mean (and our estimate of the national Republican position for the next election) is now \((20 \times 90 + (1/2) \times 60 \times 50)/50 = 66.0\). By symmetry, the expected mean for Democrats is 34.0, so the partisan gap between the mean legislative delegations is 32.0. Thus, in this example, under our simplifying assumptions, the electoral competition model we have posited moves the parties further apart than their previous positions at \( R = 60 \) and \( D = 40 \).

Example 2. Again we have \( R = 60 \), and \( D = 40 \), but now suppose a tight tether, setting \( W = 5 \). In districts in the range \([55, 100)\) the Republican can locate at the position of the median voter, but the Democrat cannot, so the Republican wins at location \( m \). In the interval \((50, 55]\), the Republican wins while constrained to locate at 55. Similarly, Democrats win at location 45 for district medians in the interval \([45, 50)\). Overall, the Republican mean is \((45 \times 77.5 + 5 \times 55)/50 = 75.25\) (and similarly, the Democratic mean is 24.75), yielding a partisan gap of 50.5.

To unify the results suggested by the two examples above, let \( G \) be the pre-election gap between the Democratic and Republican means, i.e., \( G = R - D \). When \( W \leq G/2 \) (i.e., \( W \leq 10 \) for this setting), the Republican candidate wins at location \( 60 - W \) if \( 50 \leq m \leq 60 - W \) and s/he wins at \( m \) if \( 60 - W \leq m \leq 100 \). These conditions and those for \( W \geq G/2 \) are summarized in
Table 1. Similar conditions for Democratic candidates are mirror images of these because of the symmetry.

2. Comparative statics of overall polarization as a function of a one-sided tether

For convenience in calculating mean partisan positions, we replace the continuum [0, 100] of our illustrative examples by a continuum of length one centered about zero, i.e., the interval [-0.5, 0.5]. Thus, for \( D \) and \( R \) symmetrical about 0, if \( W \geq G / 2 \), the mean Republican position is given by

\[
\frac{1}{0.5} \left[ \frac{1}{2} \int_{G / 2 - W}^{G / 2 + W} m \, dm + \int_{-G / 2 + W}^{0.5} m \, dm \right] = 1/4 - (W - G/2)^2
\]  \hspace{1cm} (1)

and, similarly, if \( W \leq G / 2 \), the mean Republican position is given by

\[
\frac{1}{0.5} \left[ \int_{0}^{G / 2 - W} (G / 2 - W) \, dm + \int_{G / 2 - W}^{0.5} m \, dm \right] = 1/4 + (W - G/2)^2 .
\]  \hspace{1cm} (2)

Note that, after the election, the difference between the Republican position and the Democratic position is by our assumption the post-election gap between the congressional party means, which, by symmetry, is twice the value of the expression in equation 1 (for \( W \geq G / 2 \)) and twice the value of the expression in equation 2 (for \( W \leq G / 2 \)). Thus, converting back to the [0, 100] scale, the post-election gap, which is our measure of Congressional polarization, is given by:

\[
Post-election \ gap = f(G;W) = \begin{cases} 
50 - 0.02(W - G/2)^2, & G \leq 2W \\
50 + 0.02(W - G/2)^2, & G \geq 2W 
\end{cases}
\]  \hspace{1cm} (3)
where $G$ is the pre-election gap.

Figure 3 plots this post-election gap as a function of the tether, $W$, for several successive elections.\(^7\) For values of $W$ above 25, Republican candidates continue to be competitive in some liberal districts, balancing and hence moderating their overall delegation (and similarly, the Democrats moderate their delegation); hence for high values of $W$, the post-election gaps are relatively small. Conversely, for values of $W$ below 25, post-election gaps are relatively high, i.e., polarization is high. Graphically, the curves for successive elections appear to converge to a limiting curve; in fact, this limit (equilibrium gap) is approached rather rapidly, except for quite small or very large values of the tether $W$.\(^8\) Thus, it appears that for each value of $W$, there is a specific partisan gap that becomes stable after several elections. In the next section, we confirm this expectation.

\[\text{<<< Figure 3 about here >>>}\]

3. Polarization at equilibrium for a one-sided tether

At each stage, the new values of $R$ and $D$ determine which constituencies each party can compete in and what the winner’s ideology will look like. For a fixed value of the tether $W$, we

\(^7\) Here we set initial values for the means of the Democratic and Republican delegations at 40 and 60, respectively. Note that each post-election gap becomes the pre-election gap for the next election.

\(^8\) For $W$ between 5 and 45, the post-election gap approaches within 5 units of its limit in two elections or less.
are interested in the behavior – over a series of elections – of the post-election gap. We show that the post-election gap converges to a limit, and we determine that limit.

Recall that each post-election gap becomes the pre-election gap for the next election. The sequence over elections of partisan gaps defined by repeated application of the function \( f(G;W) \) defined by equation 3 (for fixed \( W \)), can be shown to converge when the gaps lie in an interval slightly smaller than the interval from 0 to 100, i.e., as long as the distance between the parties is neither zero nor the full length of the scale, and when \( W \) lies in an interval slightly smaller than from zero to 50. Thus, to determine the limit of the iterated sequence of post-election gaps, it suffices to solve the equation \( G = f(G;W) \).

Denoting the solution of this equation by \( \bar{G} \), we have:

\[
\bar{G} = \begin{cases} 
2W - 1 + \sqrt{2 - 4W}, & G \leq 2W \\
2W + 1 - 2\sqrt{W}, & G \geq 2W 
\end{cases}.
\]

Thus, equation 4 defines the post-election limit of the partisan gap at equilibrium, for any given value of \( W \), i.e., the gap to which the system will settle down after a sequence of elections. This

\[9\text{ The sequence } \{G_n\} \text{ where } G_{n+1} = f(G_n;W) \text{ and } G_0 \text{ is an appropriate starting value will converge if } \left| \frac{\partial}{\partial G} f(G;W) \right| \leq K < 1 \text{ for some } K \text{ (Henrici } 1964: \text{Ch. 4). Calculation of the derivative shows that this is true as long as } G_n \text{ remains bounded away from 0 and from 100 and } W \text{ remains bounded away from 0 and 50, i.e., for any intervals of the form } \varepsilon \leq G_n \leq 100 - \varepsilon \text{ and } \varepsilon \leq W \leq 50 - \varepsilon \text{, for some positive } \varepsilon .\]
limiting post-election gap is plotted in Figure 3 against the tether $W$. Note that the equilibrium gap decreases as $W$ increases from 0 to 50, i.e., polarization is greatest for tight party tethers.

### 4. Extension to other distributions of district medians for a one-sided tether

So far we have considered only a uniform distribution for the district medians. If instead the district medians are normally distributed, numerical calculation shows that after successive elections, the post-election gap quickly approaches a limit whose plot against the tether is similar in shape to that for the uniform distribution (as in Figure 3). However, the size of the gap varies in proportion to the standard deviation of the normal distribution. The plots of gap versus tether for the uniform and normal distributions of district medians are almost identical if the normal distribution parameters are chosen so that the standard deviations of the two distributions are the same.\(^\text{10}\) We conjecture that, for symmetric distributions of district medians, the shapes of the gap-versus-tether plots are similar but the amplitudes of the partisan gaps are roughly proportional to the standard deviation of the distribution.

### 5. Intraparty variance at equilibrium for a one-sided tether

Not only do the mean positions of the respective parties (and hence the gap between them) depend on the value of the tether $W$, but the variance of the distribution of each party delegation also depends on the tether. Returning to the uniform district median distribution, equal tethers for

\[^{10}\text{For the uniform distribution, } W = G/2 \text{ when } W \approx 0.25, \text{ i.e., when } G = 0.5. \text{ For a normal distribution with the same variance, } W = G/2 \text{ when } W \approx 0.23, \text{ i.e., when } G \approx 0.46; \text{ for a normal with half that standard deviation, } W = G/2 \text{ when } W \approx 0.115, \text{ i.e., when } G \approx 0.23.\]
both parties, and letting $X$ denote a random Republican member of the House, we can show that, at equilibrium\(^{11}\)

\[
\text{Var}(X) = 10^4 \left\{ \left( \frac{1}{48} + \frac{1}{8} \right) \left( 1 - 0.1 \sqrt{200 - 4W} \right)^2 - \left( \frac{1}{16} \right) \left( 1 - \sqrt{200 - 4W} \right)^4 , \quad \bar{G} \leq 2W \right\} \quad \frac{\bar{G}}{2} > 2W .
\]

(5)

By symmetry, the same formula holds for the Democrats. The standard deviation of the distribution of each party delegation, given by the square root of the variance, is plotted in Figure 4A.

Note that this measure of heterogeneity of each party’s delegation increases with the value of the tether. Thus, as the tether increases, not only do the party means approach each other, the distribution of each party delegation becomes more spread out. This pattern is depicted in Figure 4B, which plots both the model-projected Democratic and Republican means and bounds for these means one standard deviation above and below the respective partisan means.

This pattern can be compared with the historical record shown in Figure 1B, in which – just as in the model projections – as the partisan means diverge, generally each party delegation become more concentrated, accentuating the effects of polarization. Figure 1B shows that intraparty variation was at its lowest at approximately the times that partisan separation was greatest (at each turn of a century), while intraparty variance was greatest when partisan separation

\(^{11}\) We first compute $E(X^2)$ using formulas analogous to those of equations 1 and 2, then employ the formula $\text{Var}(X) = E(X^2) - E(X)^2$ and evaluate when the system is at equilibrium.
was least (approximately mid-century or shortly thereafter).\textsuperscript{12} Thus, strong polarization reflects high separation between narrow distributions of partisans; low polarization represents reduced separation and broad (overlapping) distributions.

**IV. Effects of Asymmetry in the Strengths of the National Party Tethers**

To this point we have assumed that the partisan tethers of the two parties were equally strong. We now relax that simplifying assumption in order to investigate the consequences in the asymmetrical case in which one party’s tether may be stronger than that of the other party. A number of recent authors have provided evidence that the Republican party, which has historically been the less catch-all of the two parties, today exerts far greater pressure for ideological conformity than does the Democratic party (see, e.g., Hacker and Pierson, 2006; Seo and Theriault, 2012). Mann and Ornstein (2012), in particular, see the present problems of congressional gridlock as being far more due to Republican ideologically grounded intransigence than to similar hardened attitudes on the left.\textsuperscript{13} Indeed, Tea Party activists threaten to campaign against incumbents who fail to show sufficient ideological purity, and this threat extends even to party leaders (Boatright 2013). Here we consider the relation between unequal tethers on the one hand and polarization, the positioning of the two parties, and the strategic use of tethers on the other.

\textsuperscript{12} Both the breadth of the distributions and their separation are depicted in Figure 1C, in which – for each partisan mean – bounding curves one standard deviation above and one standard deviation below the mean are portrayed.

\textsuperscript{13} See also Theriault and Rohde (2011).
Let us suppose that the Republican Party has a tighter tether, and in particular that
\[ W_R = q W_D, \] where \( 0 < q < 1 \). Figure 5A depicts the post-election partisan gap as a function of
the Democrat Party’s tether \( W_D \) for several successive elections, with \( q \) set equal to 0.5 (plots
for other values of \( q \) show similar patterns).\(^{14}\) The pattern of the plots are similar to those for
equal tethers, except that – when tethers are unequal -- the gap remains substantial for larger
values of \( W_D \) because the other party still has a relatively tight tether, \( W_R \).

\[^{14}\]Because of the analytical complexity, we rely here on numerical calculations.

But perhaps more notable is that – although the partisan gaps are not greatly different
from the equal-tether scenario – the partisan means are decidedly asymmetrical when tethers are
unequal, as we see in Figure 5B. Replacing equal with unequal tethers transfers marginal races
from the party with the tighter tether (in this example, the Republicans) to the party with the
looser tether (the Democrats). This effect shifts the distributions of both partisan delegations in
the direction of the party with the tighter tether. For example, in Figure 5B, when the
Democratic tether is of size 30 (on our 100-point scale) and the Republican tether is 15, the
Democratic mean is about 18 points from the center of the scale whereas the Republican mean is
about 33 points – i.e., nearly twice as far -- from that center. According to the model, in this
example, the Democratic delegation attains 60 percent of the seats by the second election.
To investigate the strategic use of tether strength, let us suppose that initially both partisan tethers are strong, but equal.\footnote{We thank an anonymous referee for raising questions addressed in this section.} If exogenous conditions are such that one party, say the Republicans, wins a legislative majority, the opposition (Democratic Party) has an incentive to relax its tether in order to help win marginal seats and improve its chances of becoming the majority. As we have seen from Figure 5A, this is not likely to have a large effect on the polarization gap, but the evidence from Figure 5B suggests that the Democratic delegation will moderate whereas the Republican delegation may become more extreme, i.e., both parties will shift to the right.

Carrying this scenario forward, other things being equal, if the Democrats by relaxing their tether regain a majority, the Republican Party should have an incentive to loosen its tether as well, leading to looser tethers for both parties and eventually less polarization. In contradiction, however, to this succession of depolarizing moves, the theory of conditional party government (Rohde, 1991; Aldrich and Rohde, 1998; Aldrich, Rohde and Tofias, 2007) would maintain that a homogeneous, polarized party provides the conditions for the delegation of procedural tools to the party leadership leading to legislative efficiency and even more party discipline. The tension between these two forces – on the one hand, the successive loosening of tethers by minority parties in their scrambles to regain power, and, on the other hand, the strengthening of tethers to establish efficient rule by the majority party – renders the course of inter-party polarization and intra-party homogeneity difficult to predict. In particular, if the parties are asymmetric in the relative weight they place on winning and policy goals then we can have party governance coming from the more cohesive party.

\section*{V. Consequences of Party Constraints for a Two-sided Tether}
1. Party delegation means under a two-sided tether

In this section, we look at the consequences of a two-sided tether $W$ under which Democratic and Republican candidates are restricted by their parties to locate within the intervals $[D - W, D + W]$ and $[R - W, R + W]$, respectively. Figure 6 plots bounds for a two-sided tether, $W$, against the district median, $m$, assuming as with a one-sided tether that initially the Democratic and Republican congressional means fall at 40 and 60, respectively, on the [0, 100] scale. The blue and red lines in the figure represent the tether bounds for the parties, respectively, but in the two-sided tether case a horizontal line at level $W$ typically cuts through five intervals. Outcomes for each interval are given in Table A.1 in the Appendix; the Appendix also describes calculations for a two-sided tether, analogous to those for a one-sided tether, for post-election gaps and convergence to equilibria.

From Figure A.1 in the Appendix, we see that, unlike for a one-sided tether, the equilibrium gap is constant and high for values of $W$ between 0 and 25; then drops off, slowly at first, as $W$ moves form 25 to 50. Accordingly, we conclude that after equilibrium is reached, polarization occurs for either low or moderate levels of the tether; only for very generous levels of the tether (i.e., low party discipline) does polarization disappear. This follows because, when $W$ is high, each party wins a number of districts in the other’s “territory” and so the post-election gap $G$ is small. For a uniform distribution of district medians, for any values of $W$ up to and somewhat beyond 25, there is an equilibrium with the Democratic mean in the legislature at about 25 and the Republican mean at about 75. Given a two-sided tether, the constraints on the extreme sides
prevent the party delegations from migrating even further apart. But, of course, this symmetry in equilibrium posits symmetry in the relative importance each party gives to winning as opposed to policy goals (see earlier discussion of the asymmetric case).

As is the case for one-sided tethers, the two-sided patterns of equilibria for various, symmetric district-median distributions are similar to one another. The gap between the partisan delegations, however, will vary with the degree of central concentration of the district median distribution.

VI. Discussion

This paper represents an initial effort to investigate, under simplifying assumptions, the relationships between national party constraints on district candidates and polarization in the resultant legislature. And we have shown how relaxing one of those initial assumptions, symmetry in the tether length of the two parties, can lead to a different expectation of the nature of party competition, namely a shift of the legislative debate in the direction of the more cohesive (more restrictive) party. Understanding how and why congressional polarization levels might change for reasons having to do with the nature of constituency level competition, especially in terms of which types of constituencies (in terms of the location of their median voter) are likely to be won by candidates of each party, is important for a number of reasons. Party divergence affects the capacity of a legislature to find common ground and the motivation of the dominant party to seek the common interest, as made evident, for example, in the U.S. House in the summer of 2011 as the government struggled to raise the debt ceiling. The effects of party divergence are exacerbated if either or both party delegations are ideologically concentrated. When this is the case, as is true as of this writing, albeit with Republicans more
cohesive than Democrats, polarization degrades representation for moderate voters by tending to make every choice into a choice between polar opposites.

Insofar as legislation reflects the ideology of the median legislator, when we have extreme polarization, even relatively small shifts over elections in the location of the median voter can lead to wide swings in the legislative output when the partisan majority shifts (Grofman et al., 2001; Bafumi and Herron, 2010). Insofar as legislation reflects the majority party’s median legislator – as the conditional party government model suggests will happen under polarized conditions -- the nature of legislation can tend to alternate even more wildly between two extremes. But, even if the strict conditions for the conditional party government model are not met, if there is asymmetry in party ideological cohesion, with one party more of a catch-all party, we can still have dramatic changes arising from changes in party control as long as one party is ideologically cohesive – although the changes will not be as great as when both parties are ideologically cohesive. This is what we saw in 1994 (Grofman et al., 2001).

When the tethers in both parties are tight, the gap between party delegation means at equilibrium is large and both party delegation distributions are narrow as well as separated from one another, i.e., party differentiation and party cohesiveness go together. As noted earlier, this theoretical prediction of our model is fully born out by the empirical evidence. Toward the end of the twentieth century and the beginning of the twenty-first, increasing ideological party branding, partisan sorting of the electorate, and the role of party activists substantially tightened the district tether from national policy positions, widening the partisan gap at equilibrium and maintaining high partisan polarization in Congress, but with somewhat greater impact on Republicans.

Whatever may have been the initial impetus for the tightening of such constraints, e.g., changes in the ability of Republicans to be competitive in the South after the Democrats under
Lyndon Johnson enacted major civil rights and voting rights policies, our model demonstrates that constraints on candidate positioning tied to national party positions can operate in a dynamic and self-reinforcing fashion. In particular, partisan differentiation can lead to pressures for additional polarization as the zone in which a given party can be competitive shrinks.\textsuperscript{16} This effect is especially strong when parties exercise tight constraints on candidates that limit changes only in the direction of moderation. On the other hand, while asymmetry in the strength of the tethers of the two national parties can have relatively little direct effect on the degree of polarization, it can shift both partisan delegations decidedly in the direction of the party exercising the tighter tether. This will be reflected in the kinds of bills and amendments that come up for a vote. We need to distinguish polarization between parties from a shift in the ideological interval over which legislative competition is waged.

While our model is perhaps most useful in explaining how party polarization might be expected to increase over time, it also helps us understand conditions of party overlap. If the tether by which national parties constrain the positioning of district candidates -- whether one-sided or two-sided -- is sufficiently loose so that district candidates can deviate greatly from national policy norms, then -- as we have seen -- party delegation distributions are broad and

\textsuperscript{16} While stringent party discipline within a legislature can, in principle, lead to even greater polarization than the process we have described, we would argue that in the single seat plurality elections in the U.S., unlike European parliamentary systems where list PR methods give parties much greater control over their representatives, it is the forces that operate at the constituency level to determine the ideological variation within and between parties that are most determinative of the degree to which party discipline can be enforced (cf. the conditional party governance model in Aldrich, Rohde, and Tofias, 2007).
close to each other, i.e., there is extensive overlap of party policy distributions and party means may not be too far apart. In that case the gap at equilibrium is low and parties are much less polarized. Historically in the U.S. Congress, extensive wiggle room was the norm during the mid twentieth century, when conservative Southern Democrats and liberal Northern Republicans – both of whom deviated greatly from national party means – were electable. Consequently, during this period congressional partisan delegations were relatively unpolarized. Here, regional variation linked to a Civil War legacy allowed for a four party situation: Northern Democrats, Southern Democrats, Northern Republicans and Southern Republicans.

To make further progress we believe that there are two things needed, one empirical and one theoretical. On the empirical side, most needed, in our view, is a direct empirical measure of the degree of national party constraint on district candidates. Such a measure could be used to evaluate the verisimilitude of the models presented here. On the theoretical side, what is most needed is a theory of optimization that would allow us to specify how parties make choices to trade off the potential for competing in many districts against maintaining ideological purity. Such purity reduces overall competitiveness but increases the likelihood that the party will be able to act as a legislative bloc and thus impose its preferred policies. We conjecture that the tension between these two imperatives may, in the long run, lead to a pattern of cyclic alternation between periods of loose and periods of tight tethers, but that this potential alternation is further complicated by tethers that differ by party.
Appendix: Determination of an Equilibrium for a Two-sided Tether

1. The gap at equilibrium for a two-sided tether

For a two-sided tether, if \( W \geq G/2 \), the mean Republican position is given by

\[
\frac{1}{0.5} \left[ \frac{1}{2} \int_{G/2-W}^{G/2+W} m \, dm + \int_{G/2+W}^{G/2+W} m \, dm + \int_{G/2}^{0.5} (G/2 + W) \, dm \right] = G(1-G)/2 + W(1-2W)
\]

and, similarly, if \( W \leq G/2 \), the mean Republican position is given by

\[
\frac{1}{0.5} \left[ \int_{0}^{G/2-W} (G/2 - W) \, dm + \int_{G/2}^{G/2+W} m \, dm + \int_{G/2}^{0.5} (G/2 + W) \, dm \right] = G/2 + W(1-2G),
\]

so that, converting as before to the 0 to 100 scale, we have

\[
\text{Post-election gap} = f(G;W) = 10^{-2} \begin{cases} G(100-G) + 2W(100-2W), & G \leq W \\ G + 2(100-2G)W, & G \geq 2W \end{cases}
\]

where \( G \) is the pre-election gap.

Figure A.1 plots this post-election gap as a function of the tether, \( W \), for several successive elections (with initial values for the means of the Democratic and Republican delegations set at 40 and 60, respectively). In contrast to the effects of a one-sided tether, for a two-sided tether, the initial effects of changes in \( W \) need not be monotonic. Starting with relatively close party means (at 40 and 60 in our example), the post-election gap is small for small values of \( W \), but as we increase \( W \), the post-election gap does not increase monotonically, but rather peaks when \( W = 25 \). If instead, we start with the party means wide apart, the post-election gap is large for small values of \( W \) and drops monotonically as \( W \) increases.
In any event, as for a one-sided tether, the curves for successive elections with a two-sided tether appear to converge to a limiting curve; in fact, this limit (equilibrium gap) is approached rather rapidly, except for quite small or very large values of the tether $W$.\textsuperscript{17} For a two-sided tether we obtain a limit for the iterated sequence of post-election gaps, which in this case is given by:

\[
\hat{G} = \begin{cases} 
\sqrt{2W(100-2W)}, & G \leq 2W \\
50, & G \geq 2W
\end{cases},
\]

(7)

where $\hat{G}$ denotes the limiting gap, i.e., the gap at equilibrium.\textsuperscript{18}

2. \textit{Intraparty variance at equilibrium for a two-sided tether}

The variance of the distribution of each party delegation, for the uniform district median distribution, is given at equilibrium by

\[
\text{Var}(X) = \begin{cases} 
-(4/300)(\hat{G}/2+W)^3 + (\hat{G}/2+W)^2 - (\hat{G}/2)^2, & \hat{G} \leq 2W \\
-(8/300)\hat{G}^3 + \hat{G}^2 & \hat{G} \geq 2W
\end{cases},
\]

(8)

where $X$ denotes a random Republican member of the House; by symmetry, the same formula hold for the Democrats. The standard deviation of the distribution of each party delegation is

\textsuperscript{17} For $W$ between 10 and 45, the post-election gap approaches within 5 units of its limit in four elections or less.

\textsuperscript{18} The existence of this limit is verified by the method described in footnote 9.
plotted in Figure A.2A; the Democratic and Republican delegation means and error bounds are depicted in Figure A.2B.
References


Table 1. District outcomes for a *one-sided* tether by location of district median

A. \( W \leq G / 2 \)

<table>
<thead>
<tr>
<th>Interval</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>( m \leq 40 + W )</td>
<td>Democrat wins at ( m )</td>
</tr>
<tr>
<td>( 40 + W \leq m \leq 50 )</td>
<td>D wins at ( 40 + W )</td>
</tr>
<tr>
<td>( 50 \leq m \leq 60 - W )</td>
<td>R wins at ( 60 - W )</td>
</tr>
<tr>
<td>( 60 - W \leq m )</td>
<td>Republican wins at ( m )</td>
</tr>
</tbody>
</table>

B. \( W \geq G / 2 \)

<table>
<thead>
<tr>
<th>Interval</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>( m \leq 60 - W )</td>
<td>Democrat wins at ( m )</td>
</tr>
<tr>
<td>( 60 - W \leq m \leq 40 + W )</td>
<td>R/D each win at ( m ) with probability 0.5</td>
</tr>
<tr>
<td>( 40 + W \leq m )</td>
<td>Republican wins at ( m )</td>
</tr>
</tbody>
</table>

Mean Democratic and Republican party delegations set at 40 and 60, respectively.
Table A.1. District outcomes for a *two-sided* tether by location of district median

### A. $W \leq G/2$

<table>
<thead>
<tr>
<th>Interval</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>$m \leq 40-W$</td>
<td>Democrat wins at $40-W$</td>
</tr>
<tr>
<td>$40-W \leq m \leq 40+W$</td>
<td>Democrat wins at $m$</td>
</tr>
<tr>
<td>$40+W \leq m \leq 50$</td>
<td>D wins at $40+W$</td>
</tr>
<tr>
<td>$50 \leq m \leq 60-W$</td>
<td>R wins at $60-W$</td>
</tr>
<tr>
<td>$60-W \leq m \leq 60+W$</td>
<td>Republican wins at $m$</td>
</tr>
<tr>
<td>$60+W \leq m$</td>
<td>Republican wins at $60+W$</td>
</tr>
</tbody>
</table>

### B. $W \geq G/2$

<table>
<thead>
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<th>Interval</th>
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<tbody>
<tr>
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<td>Democrat wins at $40-W$</td>
</tr>
<tr>
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<td>Democrat wins at $m$</td>
</tr>
<tr>
<td>$60-W \leq m \leq 40+W$</td>
<td>R/D each win at $m$ with probability 0.5</td>
</tr>
<tr>
<td>$40+W \leq m \leq 60+W$</td>
<td>Republican wins at $m$</td>
</tr>
<tr>
<td>$60+W \leq m$</td>
<td>Republican wins at $60+W$</td>
</tr>
</tbody>
</table>

Mean Democratic and Republican party delegations set at 40 and 60, respectively.
Figure 1. Partisan means and standard deviations in the U.S. House


B. Intraparty Variation in Partisan Scores in the House: 1856-2006
Figure 1 (continued)

C. Partisan Bounds in the House: 1856-2006

Note: For each partisan mean, the curves on either side are one standard deviation above and below the mean.
Figure 2. Bounds on partisan position as a function of a one-sided party tether

 Bounds on Candidate Position as a Function of a One-sided Party Tether $W$, when Gap $G = 20$

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- **Democratic bounds**
- **Republican bounds**
- **Example with $W < G/2$**
- **Example with $W > G/2$**

40
Figure 3. Post-election gap for a one-sided tether

Note: Before the first election, the means of the Democratic and Republican delegations are set at 40 and 60, respectively.
Figure 4. Standard deviation and bounds at equilibrium for a one-sided tether

A. Standard Deviation of a Party Delegation at Equilibrium versus Equal, One-sided Tethers

B. Partisan Bounds at Equilibrium versus Equal, One-sided Tethers

Note: For each partisan mean, the curves on either side are one standard deviation above and below the mean.
Figure 5. Partisan gap and partisan means for unequal, one-sided tethers

Note: Before the first election, the means of the Democratic and Republican delegations are set at 40 and 60, respectively.
Figure 5 (continued)

B. Partisan Means at Equilibrium
Unequal, One-sided Tethers ($W_r=0.5W_D$)

Note: Before the first election, the means of the Democratic and Republican delegations are set at 40 and 60, respectively.
Figure 6. Bounds on partisan position as a function of a two-sided party tether
Figure A.1. Post-election gap for a two-sided tether
Figure A.2. Standard deviation and bounds at equilibrium for a two-sided tether

**A. Standard Deviation of a Party Delegation at Equilibrium versus Equal, Two-sided Tethers**

**B. Partisan Bounds at Equilibrium versus Equal, Two-sided Tethers**

Note: For each partisan mean, the curves on either side are one standard deviation above and below the mean.