The Dimensionality of Cosponsorship Behavior in the House of Representatives

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Abstract

Explanations for legislative stability in the House of Representatives include: 1) Preference Induced Equilibriums (PIEs), which predict that if preferences are unidimensional an equilibrium can be found at the position of the median legislator, and 2) Structure Induced Equilibriums (SIE), which predict that multidimensional legislative preferences must be constrained by institutions to produce stable outcomes. Both explanations expect unidimensional roll-call behavior, but the former expects unidimensional cosponsorship while the latter expects multidimensional cosponsorship behavior. This article explores whether it is both accurate and useful to treat legislative preferences as multidimensional. I find that the inclusion of a second dimension explains an additional 4-14% cosponsorship items, meaning that the assumption of multidimensionality can be supported. In terms of usefulness, I consider how unidimensional and multidimensional models explain agenda-setting dynamics. Although both models are similar, the multidimensional model provides information about stability of outcomes in addition to partisanship of outcomes.

1 Introduction

Despite Arrow's (1951) prediction of cycling majorities and unstable outcomes under conditions of majority rule, legislative behavior in the U.S. House of Representatives has mostly produced stable policy outputs (Tullock and Brennan, 1981). In attempting to account for why so much stability exists, two broad families of explanations have been proposed. The first, called Preference Induced Equilibrium (PIE) argues that if legislative preferences are unidimensional, then legislative stability is easily explained as the equilibrium outcome of the chamber would be found at the preferences of the median legislator (Black, 1948; Krehbiel, 1998). The second, called Structure Induced Equilibriums (SIE) argues that if legislators have multidimensional preferences legislative stability is only possible through institutions that create stable policy outputs (Shepsle and Weingast, 1981; Aldrich, 1989). A critical limitation to discerning whether a PIE or a SIE takes place in the House is that, although widely used, roll-call data is not ideal for differentiating between these two causal mechanisms for stability. This is because both PIEs and SIEs predict that roll-call data will be unidimensional, making it difficult to distinguish between these mechanisms (Dougherty, Lynch and Madonna, 2014).

In this paper I propose attempting to distinguish between a PIE and an SIE by using cosponsorship data because PIEs and SIEs *do* have very different expectations for the structure of cosponsorship data. Given that PIEs assume that legislator preferences are ideological and unidimensional, then cosponsorship behavior should be unidimensional as well, since just like roll-call data they should be a reflection of underlying ideological, unidimensional preferences Black (1948). In contrast, a SIE would assume that underlying preferences were distributive and multidimensional, and therefore legislative stability would only be able to be produced if institutions constrained roll-call behavior into unidimensionality, but behavior that is unconstrained by institutions—like cosponsorship behavior—should therefore be multidimensional (Shepsle and Weingast, 1981).

In analyzing the dimensionality of cosponsorship behavior, this paper seeks to answer two questions. The first question is whether the assumption of unidimensionality of cosponsorship behavior is *accurate*. Previous researchers have attempted to explore this in the past (Talbert and Potoski, 2002; Jones, Talbert and Potoski, 2003; Alemán et al., 2009; Desposato, Kearney and Crisp, 2011), but their findings were not in agreement. Talbert and Potoski (2002) and Jones, Talbert and Potoski (2003) found that cosponsorship behavior was four-dimensional, Alemán et al. (2009) found that cosponsorship behavior was only two-dimensional, and Desposato, Kearney and Crisp (2011) found that Alemán et al.'s (2009) findings may be upwardly biased. In contrast to these previous works, I analyze the dimensionality of cosponsorship behavior using a Bayesian item-response theory framework, which, as we will see, allows for the comparison between the dimensionality of cosponsorship and roll-call behavior in a more direct way.

The second question this paper seeks to answer is whether the the assumption of unidimensionality of cosponsorship behavior *useful* for understanding legislative behavior. This latter question is important because even if unidimensional preferences are not completely "true" the assumption of unidimensionality may still be useful for understanding legislative preferences if legislators behave "as if" their preferences were unidimensional. To explore this latter question, I analyze agenda setting—or which bills are selected to receive a roll-call vote—to see whether multidimensional models of legislative preferences improve upon unidimensional predictions. However, even unidimensional models have provided contrasting predictions for which bills should be selected for roll-call votes, with some models expecting partisan outcomes and others expecting non-partisan outcomes (Kessler and Krehbiel, 1996; Cox and McCubbins, 2005). Following the methods provided by Bianco and Sened (2005), and the conception of parties developed by Aldrich (2011), I create multidimensional partisan and non-partisan expectations for agenda-setting outcomes. I create multidimensional non-partisan expectations by using the uncovered set of the floor as a whole. For partisan outcomes, I assume that parties have supermajoritarian internal institutions, and I therefore predict that a 2/3 majority uncovered set of the majority party would explain partisan outcomes (Aldrich, 2011).

I conclude by arguing that the assumption of unidimensional cosponsorship behavior is not completely accurate, and I argue that predictions developed on multidimensional expectations are more useful than predictions developed by unidimensional expectations. In terms of accuracy, while unidimensional roll-call models explain almost all roll-call behavior, a unidimensional cosponsorship model only explains around 75% of non-lopsided cosponsorship behavior, and a two-dimensional model accounts for 4-14% more cosponsorship items than the unidimensional model does.

In terms of usefulness, both unidimensional and multidimensional models of agenda setting provide evidence partisan models are better than non-partisan models at explaining which bills get selected for roll-call votes. However, multidimensional models allow us to see something that is not visible in unidimensional models: the sizes of partisan and non-partisan uncovered sets. I find that more distance from the uncovered set of the floor *increases* the probability that one's bill will be chosen for a roll-call vote, and I find that this effect is even stronger when the size of the uncovered set of the floor is large. In contrast, I find that more distance from the supermajoritarian uncovered set of the majority party *reduces* the probability that a bill will be selected for a roll-call vote, and this effect gets larger when the uncovered set of the majority party is small. These findings provide strong support for partisan theories of agenda-setting in the House of Representatives, but they add the finding that the strength of partisan and non-partisan outcomes may be dependent on the size of the uncovered set of the floor and the size of the supermajoritarian uncovered set of the majority party.

2 Theoretical Background

Large parts of the literature of legislative behavior have been driven by two research questions. Tullock and Brennan (1981), in their paper titled "Why so much stability?" wondered, given that formal theories seem to expect legislative instability (Arrow, 1951), why is this instability so rarely observed in real life? In another vein, Krehbiel (1993), in his article titled "Where's the party?", asked whether our intuitions about the effects that political parties have on legislative outcomes are correct, or whether parties are in fact secondary to the preferences of individual legislators.

As mentioned in the introduction, to address the issue of stability, two broad families of solutions have been proposed. Preference Induced Equilibriums (PIEs), by assuming that legislators have single-peaked unidimensional preferences, explain stability by saying that under these conditions an equilibrium can be found at the preferences of the median legislator (Black, 1948). Structure Induced Equilibriums assume multidimensional preferences, and they argue that under these conditions stability can only be created through the use of institutions (Shepsle and Weingast, 1981). These competing explanations focus mainly on the dimensionality of preferences, and they seek to explore *how* legislative stability is created.

To address the question of partisan outcomes, most researchers have to an extent taken legislative stability for granted, and they have focused on finding out whether legislative outcomes are partisan or non-partisan. However, in proposing their explanations for partisan or non-partisan outcomes, they have relied on very different assumptions. For example, Shepsle and Weingast's (1981) "Distributive Model" argues that outcomes will be largely non-partisan, but this expectation is created through the assumption of multidimensional preferences and a strong reliance on institutions. In contrast, Krehbiel's (1998) "Pivotal Model" has agreed that legislative outcomes would be largely non-partisan, but he constructed this argument on the assumption of unidimensional preferences. In the partisan camp, Cox and McCubbins (2005) have constructed "Cartel Theory" as a partisan model of legislative outcomes, which relies largely on a unidimensional modeling of legislative preferences, but which also relies heavily on the negative agenda-setting powers of party leaders. Finally, Aldrich, Berger and Rohde (2002) and Aldrich, Rohde and Tofias (2007) created "Conditional Party Government" (CPG), which argues that when legislative preferences meet the conditions of homogeneity within parties and polarization among parties, then there will be partisan legislative outcomes, but when these conditions are not met, then there will be non-partisan legislative outcomes. CPG has evolved to be applicable in multidimensional settings as well (Aldrich, Rohde and Tofias, 2007), and in fact the model is so flexible that it might be considered a generalization of all the other models that simply collapses on them in the extent to which "the conditions" are met. These latter partisan explanations focus less on the question of *how* legislative stability is created, and they zoom into *where* legislative stability is created—whether outcomes are partisan or centrist. Table 1 shows a summary of all these theories presented and their dimensionality assumptions.

Table 1: Theories and Dimensional Assumptions

	Partisan	**Non-Partisan**
Unidimensional	Cartel or CPG (meeting cond.)	Pivotal or CPG (failing cond.)
Multidimensional	None	Distributive, Chaos or CPG (failing cond.)

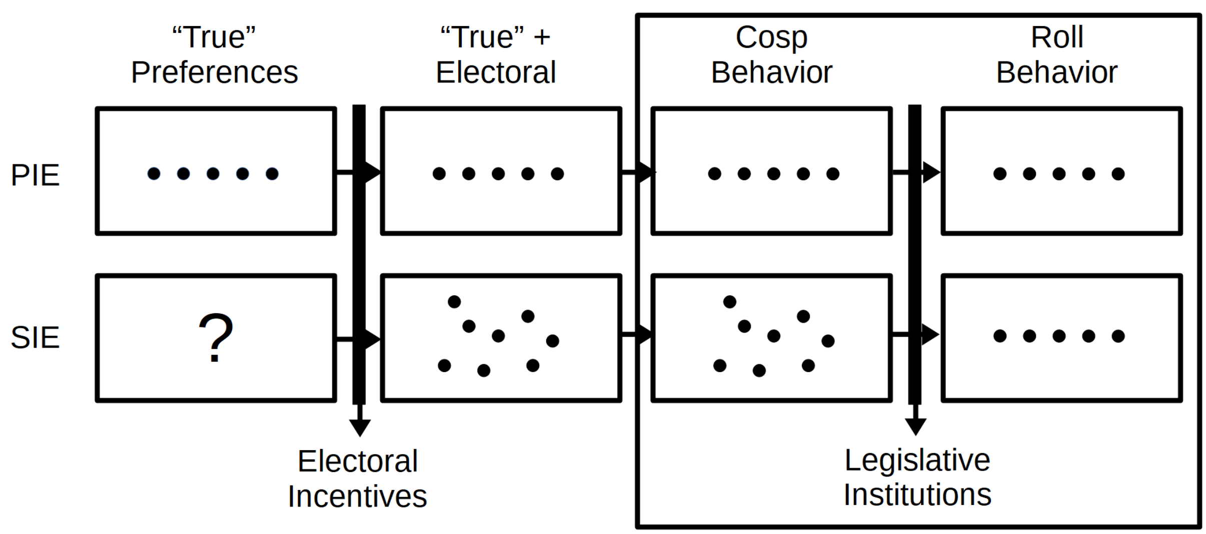
The least analyzed of these quadrants has been the analysis of parties in a multidimensional fashion. I argue that this analysis of multidimensional parties has been difficult for two reasons. First, it has been difficult to *perceive* multidimensional legislative preferences (Poole and Rosenthal, 1997). To an extent this has been caused by the fact that people who are highly involved in politics are likely to have lower-dimensional preferences than average (Converse, 1964), but it may also be due to the fact that roll-call data, which is often used to understand legislative preferences, may be subject to selection problems (Hug, 2010), and these selection problems, in turn, may artificially lead to low-dimensionality estimates of roll-call behavior (Cox and McCubbins, 1993, 2005; Wright and Schaffner, 2002; Dougherty, Lynch and Madonna, 2014). If theories of legislative outcomes, both partisan and non-partisan, were mostly developed on roll-call data, it may be no wonder that most researchers have been mostly comfortable with assuming that legislators have unidimensional preferences.

Second, even if multidimensional legislative preferences can be perceived, it is difficult to create expectations of legislative outcomes in multidimensional settings. Whereas in unidimensional settings researchers can focus on *where* legislative stability is created, in multidimensional settings researchers have to explain both *where* stability is created and *how* stability is created at the same time. Therefore, partisan outcomes, which implicitly assume stability, must find a way to explain both stability and partisan stability at the same time if multidimensional settings are assumed.

3 How is Legislative Stability Created?

In following the structure created by the previous section, my first task will be to understand *how* legislative stability is created. As mentioned in the introduction, cosponsorship data is useful for distinguishing between an SIE and a PIE because although both PIEs and SIEs assume that roll-call data will be unidimensional, they make competing assumptions for cosponsorship data. The reason why these comping predictions exist for cosponsorship data and not roll-call data can be seen in Figure 1.

Figure 1: **Theories of Legislative Stability**



Because PIEs only create legislative stability through the preferences of legislators, it is essential that those preferences be unidimensional throughout the entire legislative process. Therefore, as shown in Figure 1, a PIE would expect legislator's true preferences to be unidimensional, and they would expect these preferences to be mostly unchanged—at least in terms of their dimensionality—after electoral incentives and legislative institutions intervene.

In contrast, SIEs tend to be less concerned with the "true" preferences of legislators, and they are more concerned in what incentives electoral institutions create for legislators to pursue (Mayhew, 1974). These "electoral" preferences are usually assumed to be distributive and multidimensional (Shepsle and Weingast, 1981; Cox and McCubbins, 2005). Because multidimensional settings are expected to create legislative instability (Arrow, 1951; Riker, 1988), the only way through which legislative stability is assumed to be produced is through the use of legislative institutions (Shepsle and Weingast, 1981; Aldrich, 1989). The expression of preferences in SIEs is likely to vary widely then, in expressions of preferences that take place before legislative institutions have a chance to function (cosponsorship behavior), and in expressions of preferences that take place under the influence of legislative institutions (roll-call behavior).

In short, by observing the dimensionality of cosponsorship behavior in comparison to roll-call behavior we will be able to observe whether a PIE or a SIE receives stronger support. If cosponsorship behavior is as unidimensional as roll-call behavior, then a PIE will be supported. If cosponsorship has higher dimensionality than roll-call behavior then we would expect an SIE. Finally, discerning betweeen a PIE and an SIE would contribute to our understanding of how, but not where, legislative stability is created. However, answering this first question is necessary in order to be able to address the second question.

3.1 Data

In order to analyze the dimensionality of cosponsorship behavior, and compare this to the dimensionality of roll-call data, I have relied on two well-known sources of data. Roll-call data was retrieved from Voteview, which assembled legislative roll-call behavior from the first Congress to the 115th (Lewis et al., 2020). Although cosponsorship data was already collected by Fowler (2006), I opted to re-scrape cosponsorship data from congress.gov because I was interested in assessing the dimensionality of *original* cosponsorship behavior against the dimensionality of *final* cosponsorship behavior.

I chose to analyze both original and final cosponsorship data because Kessler and Krehbiel (1996) argued that cosponsorship behavior should be seen as a *process* rather than as a final product, where legislators see their available options, gain information about projects, promote their own projects, and anticipate the success or failure of a bill on the floor before deciding whether to sign onto a bill. Furthermore, as hypothesized by Talbert and Potoski (2002), this information-gathering and floor-success anticipation may lead to a reduction in the dimensionality of cosponsorship behavior as time goes by. However, whether this dimensional reduction actually takes place is an empirical question, so throughout this paper I will be analyzing not only the dimensionality of final cosponsorship behavior, but also the dimensionality of original cosponsors of a bill. That being said, I although I re-assembled Fowler's (2006) database to explore information about original cosponsors, in most respects our data are the same.

Cosponsorship data exists for a shorter period of time than roll-call data does. Prior to the 96th Congress there was a 25 cosponsor limit per bill in the House. Furthermore, the 97th Congress was the first one where complete data for amendments were available. Despite the fact that amendments almost never cosponsored, all my analysis will begin in the 97th Congress because from this point on all the data is complete, and cosponsorship behavior is less restricted (Fowler, 2006). Section 1 of the Appendix provides a summary of all the data I based my analysis on.

3.2 Previous Analysis of the Dimensionality of Cosponsorship Behavior, and Unresolved Issues

The dimensionality of cosponsorship behavior in the U.S. House of Representatives has been analyzed before. Talbert and Potoski (2002) and Jones, Talbert and Potoski (2003) ran W-NOMINATE on cosponsorship data, and by analyzing the APRE[1] statistic, they showed the mismatch between multidimensional preferences before legislative institutions affect behavior (cosponsorship data) and unidimensional preferences after legislative institutions affect behavior (roll-call data), and through this mismatch they argued that a SIE must be creating stability. They concluded by showing that cosponsorship behavior did have higher dimensionality than roll-call behavior, and they described the content of the four most relevant dimensions of cosponsorship behavior: 1) the party and ideology dimension, 2) the law and order/foreign affairs and civil rights dimension, 3) the agricultural/environmental dimension, and the 4) fiscal affairs dimension.

However, Alemán et al. (2009) argued that applying W-NOMINATE to cosponsorship data is not methodologically sound. Alemán et al. proposed using social-network analysis to estimate ideal points using cosponsorship behavior instead. With their novel method the authors found that "two dimensions explain the vast majority of the variance in the United States cosponsorship data," and that their discrepancy with Talbert and Potoski (2002) was because "[T]he NOMINATE algorithm... treats the decision not to cosponsor a bill as akin to a vote against a bill on the floor. Since the vast majority of bills have relatively few cosponsors, applying this algorithm to the two-mode cosponsorship matrix results in most cutpoints being set at spatial extremes." They argued that because of these extreme cutpoints, and because NOMINATE drops lopsided votes leading to a drop of most cosponsorship bills that tend to have few signatures, then using NOMINATE on cosponsor-

[1]APRE stands for Aggregate Proportional Reduction of Error, and it is a common measure used to gauge the dimensionality of W-NOMINATE estimates. Intuitively, APRE takes the minority vote as an error baseline, and then it estimates the extent to which a given W-NOMINATE model can improve on this baseline of errors. The full model for the APRE statistic can be found in the Appendix.

ship behavior artificially inflates estimates of dimensionality. By analyzing the eigenvalues of their PCA-based method, in comparison to the eigenvalues produced by W-NOMINATE, they showed that their procedure only showed two relevant dimensions for cosponsorship behavior, while W-NOMINATE eigenvalues were higher for the same data.

Finally, in response to Alemán et al. (2009), Desposato, Kearney and Crisp (2011) used simulated data to explore how varying data generating processes (DGP) affected how closely W-NOMINATE and PCA retrieved the true ideal points. The different DGP they considered were 1) the Sincere Model, 2) the Random Model, 3) the Neighbor Model, and the 4) Network Model. Of all these DGPs, only the Sincere Model assumes that failure to sponsor a bill entails true opposition to the bill, and therefore only this model matches the assumptions under which NOMINATE models were constructed. One of the main findings of Desposato, Kearney and Crisp's (2011) work is that both PCA and W-NOMINATE estimates of dimensionality of preferences (eigenvalues) are always biased upwards when the DGP is not the Sincere Model—regardless of which estimation procedure is used.

In summary, we still do not have a definitive understanding about whether cosponsorship behavior is mostly unidimensional or multidimensional. Talbert and Potoski (2002) found that preferences were four-dimensional, Alemán et al. (2009) found that preferences were two-dimensional, but Desposato, Kearney and Crisp (2011) called into question both these findings by suggesting that due to the fact that the DGP of cosponsorship behavior is different than the DGP of roll-call data, then both of these dimensionality findings may be biased upwards. In other words, we still do not have conclusive evidence to show whether cosponsorship behavior is in fact high-dimensional—suggesting a SIE given unidimensional roll-call behavior—or whether cosponsorship behavior is unidimensional—suggesting a PIE given unidimensional roll-call behavior.

3.3 A Bayesian Alternative

In order to explore the dimensionality of cosponsorship data more directly, I have opted to move away from the frequentist frameworks of PCA and W-NOMINATE, and towards a Bayesian implementation of item-response theory (IRT) that can be used to estimate legislator ideal points (Jackman, 2001). Bayesian IRT was originally intended to create latent measures for student intelligence or "capacity" in test-taking (Poole, 2005). Through MCMC sampling, this method simultaneously uncovers parameters for capacity of the student, the difficulty of the question, and the discrimination of the question—how well a question divided smart from not-so-smart students. In the context of politics, capacity is interpreted as ideology, difficulty is conceptually similar—more difficult bills are less likely to gain support—, and discrimination is also conceptually similar—higher discrimination parameters indicate bills that more strongly divide legislators on each ideological dimension. These three parameters are retrieved through this formula in a unidimensional model:

$$Pr(Cosp_{ij} = 1) \sim Bernoulli(\theta)$$

$$\theta = \Phi(\alpha_j - \beta_j x_i)$$

Where Φ is the standard normal distribution (a probit-link function), α_j are the difficulty parameters, x_i are the estimates for the ideology of legislators, and β_j are the discrimination parameters. The discrimination parameter provides the slope for a probit line for each bill, and the difficulty parameter provides the intercept for each bill. Finally, these parameters, although estimated jointly, are indexed differently as the x parameter is indexed by legislator (i), whereas both α and β parameters are indexed by roll-call (j).

The way Bayesian IRT estimates the dimensionality of the policy space is also different from W-NOMINATE and PCA. Instead of using APRE[2] or eigenvalues, Bayesian IRT simply

[2] Strictly, APRE can also be estimated for IRT, but it may not be ideal because APRE takes the minority vote as a baseline of errors, and then analyzes the extent to which this baseline of errors can be improved upon by the ideal point estimation model. However, cosponsorship behavior is *not* voting, and therefore a

observes the proportion of bills where β is significantly different from zero. The higher the proportion of explained bills by a single dimension, the lower the dimensionality of behavior.

The IRT framework is convenient because Desposato, Kearney and Crisp (2011) found, through simulations, that with a large n the estimation of first-dimensional ideal points under different DGP are mostly unbiased. This finding is useful for my purposes because, if the first-dimensional ideal points are the same for cosponsorship data and roll-call data, then independently estimated ideal points should be highly correlated and mostly interchangeable. Once these unbiased ideal points are estimated, the issue of dimensionality can be addressed by exploring how much cosponsorship behavior can be accounted for by unidimensional ideal points. Following the logic of the Bayesian dimensionality assessments is therefore quite straightforward for both roll-call and cosponsorship data.

Furthermore, if the same—or very similar—first-dimensional ideal points can be estimated from cosponsorship behavior and roll-call data, then it is even possible to estimate the extent to which roll-call ideal points explain cosponsorship behavior. This can simply be done by using roll-call ideal points as independent variables in a series of probit regression models that predict each cosponsorship decision as a dependent variable. Then, just like with the Bayesian IRT beta coefficients, we could simply take the proportion of slope coefficients of these probit regression models that are significant to understand the extent to which this first dimension explains cosponsorship behavior. The main advantage of doing this would be that by explaining cosponsorship behavior from independently estimated roll-call behavior we can have more confidence about the findings, because our understanding of the data generation process of roll-call data is more straightforward—or as Desposato, Kearney and Crisp (2011) would say, we can have more confidence that roll-call data was created under the Sincere Model.

Of course to do these assessments, we need to show that 1) first dimensional ideal

minority vote does not exist. Virtually no bills are cosponsored by a majority of legislators, so the "yeas" effectively always become the minority vote in cosponsorship data. In other words, because a minority of legislators always cosponsors bills, APRE does not have the same intuitive sense it has when carried out on roll-call data.

points estimated from roll-call and cosponsorship data are highly correlated, and 2) Bayesian IRT and probit regression coefficients estimated from independently estimated roll-call ideal points show similar assessments of dimensionality of roll call data. To save space, the verifications of the plausability of these assumptions are contained in Sections 3, 4, and 5 of the Appendix. The analyses presented in these three sections show that, in fact, the first dimension of roll-call and copsonsorship data is highly correlated, regardless of which estimation procedure is used. Because of these unbiased ideal points, Bayesian IRT parameters and independently estimated probit regression coefficients provide widely similar assessments of dimensionality of cosponsorship behavior.

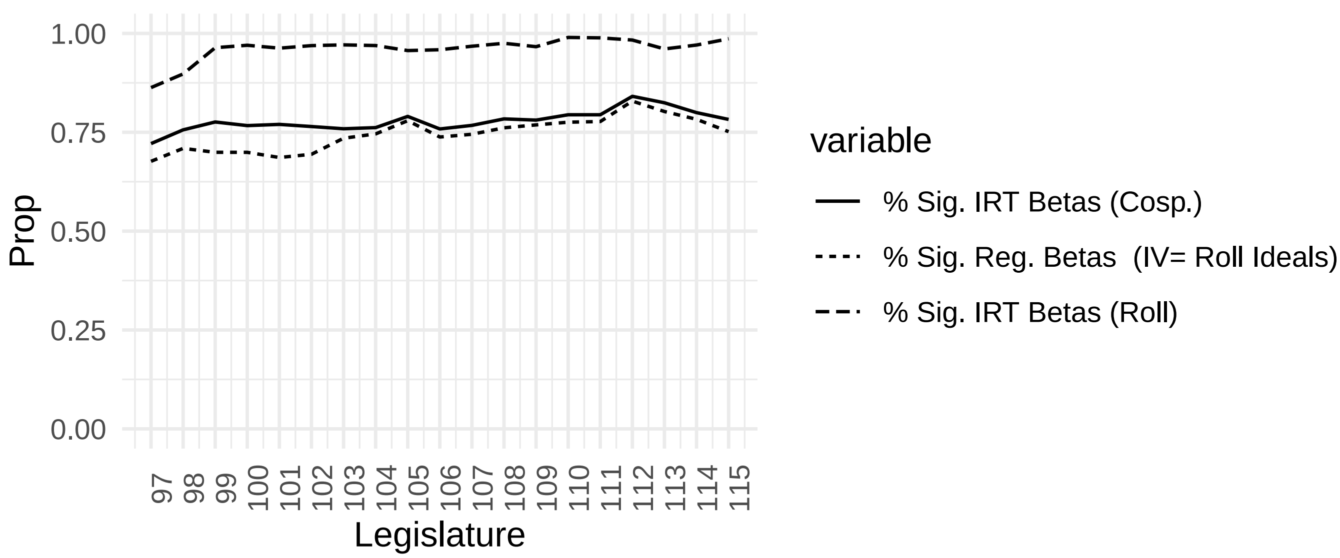
3.4 Assessment of Dimensionality

Figure 2 shows the first assessment of dimensionality. This figure shows three lines. The dashed line (% Sig. IRT Betas Roll) shows the proportion of Bayesian IRT betas that were significant in predicting roll-call behavior. I have simply included this measure of roll-call dimensionality as a comparison baseline on which to compare the dimensionality measures of cosponsorship behavior. As expected, the data is almost completely explained by the first dimension as Bayesian IRT betas are overwhelmingly significant in explaining roll-call behavior (Poole and Rosenthal, 1997).

Moving on to cosponsorship data, the solid line (% Sig. IRT Betas Cosp.) shows the extent to which Bayesian IRT betas are significant in explaining cosponsorship data. According to these IRT beta parameters, around 75% of cosponsorship behavior is explained by the first dimension. This indicates that cosponsorship behavior does seem to be of higher dimensionality than roll-call behavior because less cosponsorship behavior can be explained by the first dimension. However, up to this point the difference between these two data sources does not seem to be very dramatic.

Finally, the dotted line (% Sig. Reg. Betas IV=Roll Ideals) shows the extent to which first-dimensional roll-call ideal points predict cosponsorship behavior. This line shows the

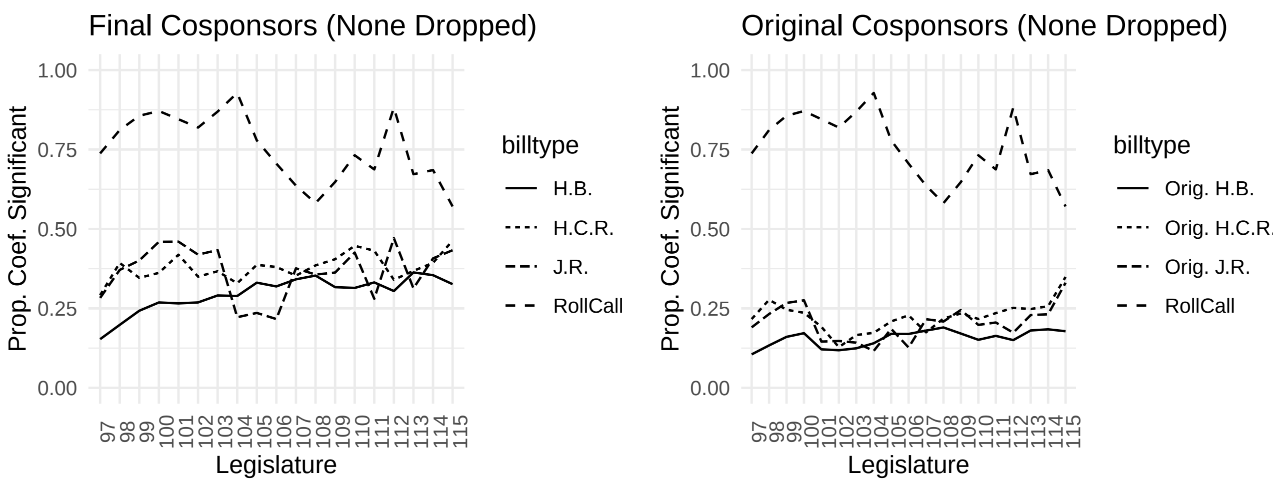
Figure 2: **Assessment of Dimensionality (Non-Lopsided)**



proportion of exogenously-created probit regression coefficients that significantly predict cosponsorship behavior. The proportion of significance of these estimates are consistently lower than simultaneously estimated Bayesian IRT betas, but not by much. Therefore, even when roll-call ideal points are used to estimate cosponsorship behavior, the assessment of dimensionality provided by these ideal points is very similar to the assessment provided by Bayesian IRT betas that are simultaneously estimated to cosponsorship ideal points. All in all, these two indicators of dimensionality may be taken to suggest that cosponsorship behavior is higher dimensional than roll-call behavior—because less cosponsorship behavior is accounted for by the first dimension—but the first dimension does seem to explain more behavior than we may have expected.

However, the findings presented in Figure 2 are a bit misleading because most ideal point estimation procedures automatically drop lopsided data. If, of all those that are present in a roll-call voting situation, the proportion of yeas or nays of a given roll-call are smaller than 2.5% of those present, then that vote is not used for the estimation of ideal points (Jackman, 2001). This problem of lopsided data is even a bit more pronounced for cosponsorship data because there are no "absences." Therefore, the the 2.5% yea and nay threshold always applies over all legislators, while it only applies to present legislators in roll-call data. That is, if there are 435 legislators, then cosponsorship decisions have to have at least 11 yeas and nays in order to not be dropped. Section 1 in the Appendix, which summarizes the data used for this study, shows that only 15-30% of cosponsorship items and only 10-18% of original cosponosorship items clear this restriction. Therefore, the estimates of dimensionality presented in Figure 2 only shows the extent to which the first dimension explains a severely subsetted portion of cosponsorship behavior.

Figure 3: **Assessment of Dimensionality With Lopsided**



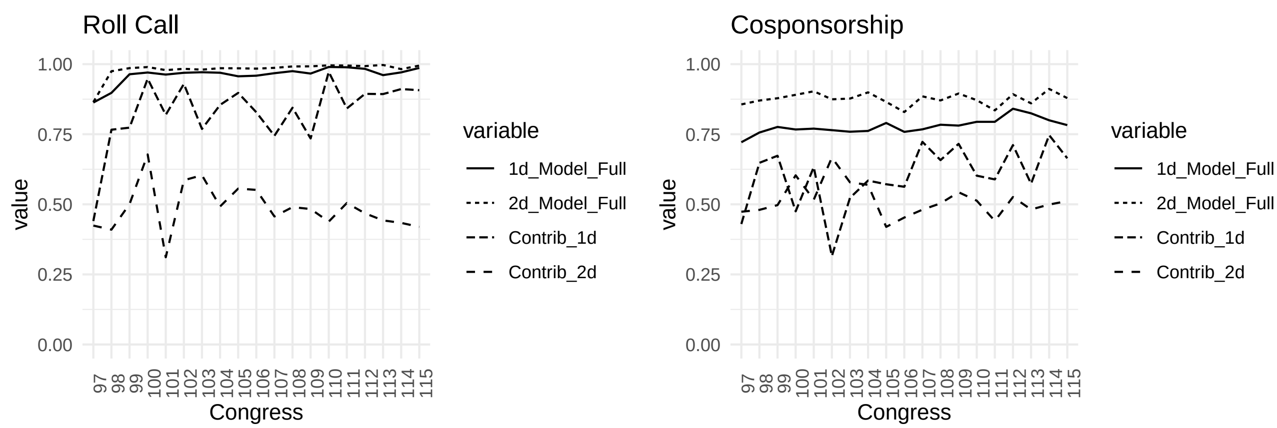
To visualize the extent to which this is a problem for understanding the true dimensionality of cosponsorship behavior, I estimated the dimensionality on all roll-call votes and on all cosponsorship items, whether or not they reached the lopsided threshold. Again, this can be done by using unbiased ideal points—in this case I am using roll-call ideal points—and running one regression probit model per each item of behavior with ideal points as independent variables and each item of behavior as the dependent variable—either roll-call or cosponsorship behavior. Then, we look at the proportion of times those regression models have significant coefficients, and that tells us the extent to which the first dimension explains cosponsorship or roll-call behavior. These estimates can be found in Figure 3, and they show that only around 25-40% of cosponsorship behavior can be explained by the first dimensions—and final cosponsorship data has lower dimensionality than original cosponsorship data. All in all, including lopsided data seems to give us an indication that cosponsorship may be a lot more multidimensional than we may have originally expected.

However, some models of cosponsorship behavior may argue that the fact that unidimensional ideal points do not account for a large portion of cosponsorship behavior, does not immediately imply that legislator preferences are not unidimensional. Desposato, Kearney and Crisp (2011), in creating their Random Model, Network Model and Neighbor Model argue that the decision to cosponsor or not cosponsor a bill is nested within the decision to *consider* a bill—because the choice to consider a bill may be costly. Each of these models make different assumptions of how legislators choose to consider bills, but using proportion of bills explained may become problematic if the choice to consider to sponsor bills is high. That is, the fact that many bills are unexplained by the first dimension may simply be the result of a high cost to consider bills, leading to high levels of lopsided bills—and lopsided data will have a hard time having significant betas.

Another final way to analyze the dimensionality of cosponsorship behavior is therefore to calculate a two-dimensional model of legislator ideal points using Bayesian IRT, and exploring the extent to which this two dimensional model improves in explaining cosponsorship behavior relative to the one-dimensional model. This analysis is carried out for both cosponsorship data and roll-call data in Figure 4.

The solid lines in Figure 4 show the proportion of bills that are explained by a one-dimensional model, essentially replicating what we have seen in Figure 2. The dotted lines show the proportion of bills that are explained by a full two-dimensional model. As we can see, for roll-call data the contributions of a two-dimensional model relative to a one-dimensional model are not very large—a marginal contribution of 1-3%. In contrast, the dotted line in the cosponsorship panel is consistently higher than the solid line, indicating that a two-dimensional model provides a significant contribution—a marginal contribution

Figure 4: **Two-Dimensional Model: Explanatory Capacity**



of 4-14% per session. Furthermore, two-dimensional models can be further decomposed to analyze the independent contribution of each dimension to the variance explained of the model as a whole. The two dashed lines indicate the independent contribution of each dimension in two-dimensional models. What seems clear is that in the roll-call model the first dimension always contributes more to the overall explanation of variance in two dimensional models, but for cosponsorship data there are some periods where the second dimension actually contributes more to the overall two-dimensional model than the first dimension of the model.

3.5 Stability is Created by a SIE

In sum, the assessments of dimensionality I have provided seem to show that cosponsorship behavior is not unidimensional. The first dimension of preferences explains a smaller percent of non-lopsided cosponsorship data than it does non-lopsided roll-call data. The amount of lopsided data in cosponsorship behavior is really quite high, which might indicate higher dimensionality of preferences as well. However, even if this high level of lopsided data does not indicate higher dimensionality, among non-lopsided data cosponsorship behavior seems to show a significant second dimension. The two-dimensional model accounts for a marginal

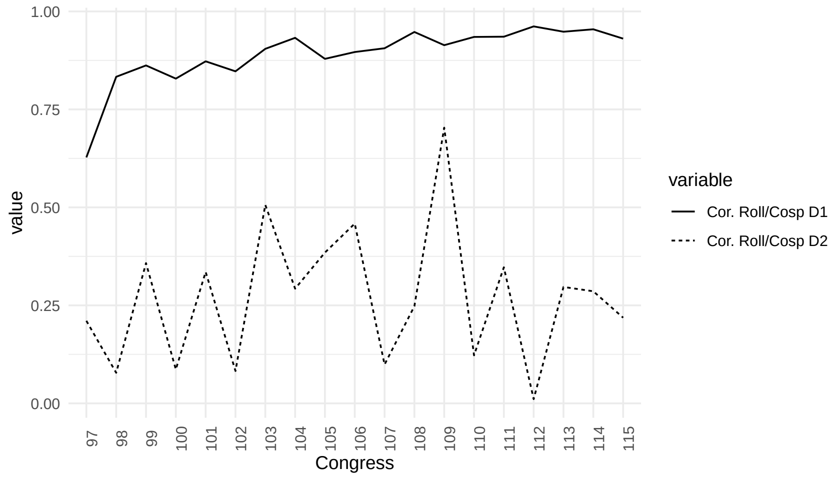
4-14% of cosponsorship behavior in relation to the one-dimensional model, and analyzing the individual contributions of each dimension within the two-dimensional model shows that the second dimension is on par with the first dimension in its contributions to the overall model.

4 Where is Legislative Stability Created?

As mentioned in the introduction, this article is focused on answering two questions. In the previous section we tested the *accuracy* of a unidimensional model of cosponsorship behavior, and we found that cosponsorship behavior does not seem to be strictly unidimensional as roll-call data, but we also found that one-dimensional models did not perform terribly. Furthermore, although roll-call and cosponsorship first-dimensions are almost identical, an issue with the second dimension of cosponsorship behavior is that, as can be seen in Figure 5, this second dimension is *not* highly correlated to the second dimension of roll-call data. Given that our understanding of the data generation process of cosponsorship behavior is less clear it therefore becomes necessary to explore whether this second dimension of cosponsorship behavior is substantively useful, or whether this large, second dimension only captures residual noise. The purpose of this section is therefore to explore whether it is *useful* to treat cosponsorship preferences as multidimensional. That is, is there any additional feature of legislative competition that we can capture through a multidimensional model of legislative preferences, which is unobservable with a unidimensional model?

To analyze the usefulness of a two-dimensional model, I will be using cosponsorship and roll-call data to explain a substantively interesting dependent variable in the literature on legislative behavior: agenda-setting. A key argument of Cartel Theory is that legislators are allowed to vote as they wish after a bill reaches the floor, but that party leaders use negative agenda-setting powers to prevent bills that might roll the majority from reaching the floor in the first place (Cox and McCubbins, 1993, 2005). However, non-partisan alternatives to Cartel Theory would predict that if agenda setting exists, it might only exist in anticipation

Figure 5: **Correlation Between Roll Call and Cosponsorship Dimensions**



of the preferences of the median legislator of the floor, which is the equilibrium in unidimensional spaces. In this section, then, I will use cosponsorship and roll-call data to attempt to explore *where* legislative stability takes place—that is, is stability partisan or not?

4.1 Data and Dependent Variable

The data I have is the same roll-call data derived from Voteview, and the same cosponsorship data scraped from congress.gov, which I described in Section 3.1 and in Section 1 of the Appendix. However, bill names for both cosponsorship data and roll-call data were only available from the 102th Congress to the 115th Congress. Because I seek to link these two data sources to create a dependent variable that observes agenda setting, only this time period will be used for the data analysis that follows.

In this section I wish to analyze all Congresses jointly, so I therefore calculated DW-NOMINATE ideal point estimates on two dimensions for all cosponsorship data using a squared-term time trend. This allows us to have one ideal point per legislator per Congress, placed on a common space, which in turn allows us to compare preferences from one period to another. As we will see, this will be useful as I will create independent variables that vary by both Congress and by individual legislator.

The dependent variable of interest is agenda setting. Specifically, I wish to analyze which legislators are more effective at getting their bills on the floor for a roll-call vote. To create this variable I take cosponsorship data as a universe of all proposed bills, and then I see which of these bills receive a roll-call vote. Then, I simply counted the number of original cosponsors that proposed bills that reached the floor for a roll-call vote. This count variable captures the "success" legislators have in getting the bills they cosponsor to reach the floor. I am using the count of successful *original* cosponsors in reaching the floor rather than *final* cosponsors because I wished to avoid capturing legislators that may simply tag onto popular policy. Original cosponsors are more likely to support a bill since its inception, understand it fully, and they are more likely to work to actually get their bill on the floor. Therefore, focusing on the success of legislators in getting their originally cosponsored bills on the floor for a roll-call vote will allow us to observe agenda setting in action. More influential legislators are likely to be successful more often than less influential legislators, and therefore they should have higher counts of bills receiving roll-call votes.

4.2 Expectations and Hypotheses From Unidimensional Models

Unidimensional models of legislative behavior have two main hypotheses for agenda setting. The first assumption may simply be that agenda setting only takes place in so far as it anticipates the non-partisan equilibrium of the floor. This hypothesis would simply argue that bills that are supported by the median legislator are more likely to reach the floor for a vote. The further away from the median legislator, the less likely your bill is to reach the floor (Kessler and Krehbiel, 1996).

> **Median Distance Hypothesis:** As the distance from the median member of the floor rises, the probability that one's bills will reach the floor decreases.

The independent variable used to test this hypothesis is called "Median Distance." This independent variable simply takes the distance of each legislator *on the first dimension* to the distance of the median legislator of the floor on the first dimension. Because this hypothesis is unidimensional, all data on the second dimension is simply discarded.

The second hypothesis would be supported by cartel theory. This hypothesis would state that party leaders use their powers to influence negative agenda setting in the benefit of the party as a whole. Therefore, bills supported by the median member of the majority, and not bills supported by the median member of the floor, will be the most likely bills to reach the floor.

> **Median Majority Distance Hypothesis:** As the distance from the median member of the majority party rises, the probability that one's bills will reach the floor decreases.

Similar to above the independent variable of interest to test this hypothesis is called "Maj. Median Distance," and it simply takes the distance of each legislator from the median member of the majority party *on the first dimension*.

5 Expectations and Hypotheses from Multidimensional Models

The main difference with multidimensional models of legislative behavior is that they do not provide equilibrium expectations. However, there still is the possibility of creating some expectations of where policies will commonly result by using concepts such as the "uncovered set." Point x is said to be "covered" by y when all alternatives z that beat y also beat x. The "uncovered set" is therefore the set of points that cannot be covered by any alternative (Bianco, Jelizakov and Sened, 2004; Bianco and Sened, 2005; Bianco et al., 2006, 2008; Tsebelis, 2002). This uncovered set of points provides a reasonable expectation for where legislators would seek to propose policy in multidimensional settings. However, strictly speaking predictions of the uncovered set of the floor are a non-partisan prediction. That is, the uncovered set would be predicted as the outcomes even if parties did not exist. Therefore, our first, non-partisan, prediction in multidimensional settings would be:

Distance U-Set Hypothesis: As the distance from the uncovered set of the floor as a whole rises, the probability that one's bills will reach the floor decreases.

To create an independent variable that captures this hypothesis, I took the distance of each legislators' ideal point to *all* points in the uncovered set of the floor as a whole, and then I kept the *minimal* distance of each legislator to the uncovered set. This essentially captures how close each legislator is to the closest edge of the uncovered set of the floor as a whole.

In order to create a partisan expectation in multidimensional settings, I take the intuitive argument presented by Aldrich (2011) about the meaning of parties. Aldrich defines parties as "long-term legislative coalitions." However, parties, just like legislatures as a whole, are subject to instabilities when simple majority rule is used. As a threshold rises from simple majority to supermajority, however, then instability is less likely as the "core" of policies that cannot be defeated by any alternative exists in more dimensions as the voting threshold rises. Therefore, a conception of parties in multidimensional settings may be operationalized as: a group of legislators who agree to respect an internal supermajoritarian threshold before voting on something on the floor. This concept can be predicted by creating a 2/3-threshold uncovered set for the majority party. Therefore, our partisan prediction would be:

Distance Maj. U-Set Hypothesis: As the distance from the supermajoritarian uncovered set of the majority party rises, the probability that one's bills will reach the floor decreases.

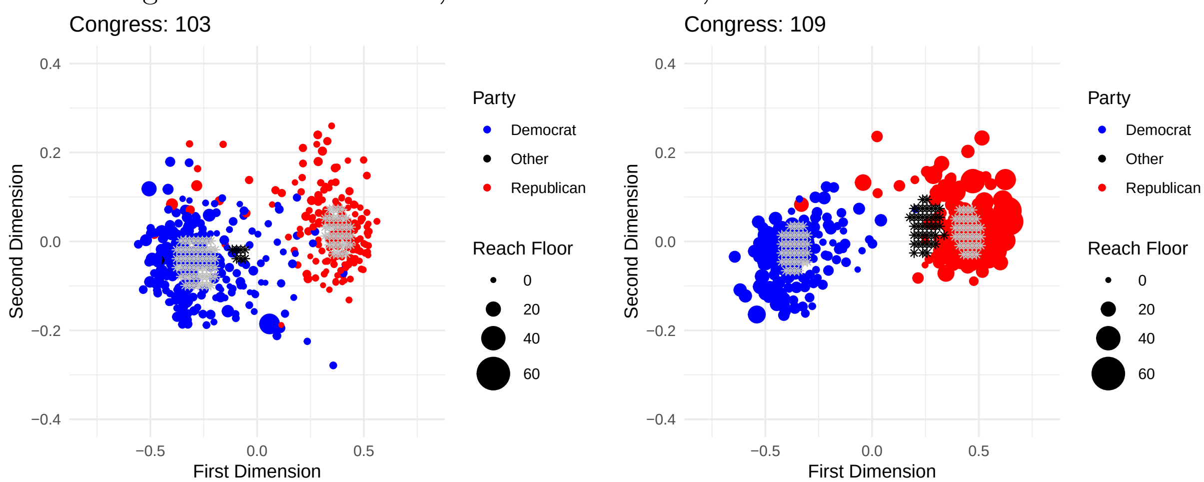
Similar to the previous hypothesis, this variable was created by taking the distance of each legislator to the closest edge of the supermajoritarian uncovered set of the majority party.

Figure 6 show two examples of the uncovered sets of the floor as a whole and supermajoritarian uncovered sets for each party.[3] Blue points are Democratic legislator ideal points,

[3]All uncovered sets carried out with the R package I developed based on methods detailed by Bianco, Jelizakov and Sened (2004). Package can be found here: https://github.com/acarrizosa/uset.

red points are Republican legislator ideal points, black stars show the uncovered set of the floor as a whole, gray stars show the supermajoritarian uncovered set of each party, and the size of legislator ideal points show the count of successes that each original cosponsor had in getting a roll-call vote for their proposed bill. Something that becomes clear through this exercise is that in multidimensional spaces, the size, in addition to the location, of the uncovered set may be substantively interesting. Larger uncovered sets create expectations for higher levels of instability, while the opposite is true of smaller uncovered sets.

Figure 6: **Ideal Points, Uncovered Sets, and Reach Floor Counts**



Furthermore, there is another possibility for partisan outcomes in multidimensional settings that depends on the relative sizes of each uncovered set. Bianco and Sened (2005), for example, argued that one way the majority party may exert influence *within the uncovered set of the floor* is through agenda setting. That is, if the uncovered set of the floor is large and the majority party controls agenda setting, then the majority party may be able to dominate outcomes simply by proposing policies that fall within the uncovered set of the floor as a whole, but that are as close to the majority party as possible.

We can therefore create two interactive predictions that take into account the sizes of the uncovered set of the floor and the supermajority uncovered set of the majority party into account as well.

Size U-Set Hypothesis: The effect between the distance of the uncovered set and success in reaching the floor will be stronger as the size of the uncovered set gets smaller.

Size Maj. U-Set Hypothesis: The effect between the distance of the super-majoritarian uncovered set of the majority party and success in reaching the floor will be stronger as the size of the uncovered set gets smaller.

5.1 Unidimensional Results

As mentioned, the dependent variable is a count variable that counts how many times each legislator was able to reach the floor for a roll-call vote with their bills. The higher the count variables, the more successful the legislators were at having their bills reach the floor for a roll-call vote. Because of the count nature of this variable, all models shown are negative-binomial regressions. Table 2 shows the results of the unidimensional models.

Model 1 of Table 2 shows the predictions of the non-partisan, unidimensional hypothesis. As expected by this hypothesis, the larger the distance between legislators and the median of the floor, the less likely these legislator's probability of proposing legislation that reaches the floor for a roll-call vote. However, Model 2 shows the pure, party expectations. As expected by this model, the larger the distance between the median of the majority party and a given legislator, the less likely this given legislator is to successfully reach the floor with his bills as well.

However, when we include *both* partisan and non-partisan expectations simultaneously it seems like the party expectation receives stronger support. While the negative sign for this coefficient is maintained in Model 3, the coefficient for Median Dist. flips and becomes positive. This model, then, implies that moving away from the median of the floor and towards the median of the majority party makes it more likely that a legislator's bill will reach the floor for a roll-call vote. These findings are very much in line with the expectations of Cartel Theory (Cox and McCubbins, 1993, 2005).

Table 2: Unidimensional Models

	Model 1	Model 2	Model 3
Intercept	2.94^{***}	2.86^{***}	2.73^{***}
	(0.02)	(0.02)	(0.02)
Median Dist.	-1.18^{***}		0.97^{***}
	(0.04)		(0.10)
Maj. Median Dist.		-0.95^{***}	-1.53^{***}
		(0.03)	(0.07)
Num. obs.	4815	4815	4815

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

5.2 Multidimensional Results

Models 1, 2 and 3 of Table 3 simply replicate what we had seen in Table 2, but using the multidimensional concepts of distance from uncovered set of floor and distance from supermajority uncovered set of majority party rather than floor medians and majority party medians, respectively. As we can see, the findings of these three multidimensional model are very much in line with the unidimensional models we had seen in Table 2. Distance from the floor uncovered set is negatively related to success on reaching the floor in Model 1, distance from the supermajorityarian uncovered set of the majority party is negatively related to success in Model 2, and when both these concepts are included simultaneously, the sign of the coefficient for the distance from the uncovered set of the floor becomes positive and while the coefficient for distance from the supermajoritarian uncovered set of the majority party maintains its negative sign. This, again, indicates that moving away from the floor uncovered set and towards the uncovered set of the majority party may be beneficial for legislators trying to get their bills voted on in the floor. So far, then, the multidimensional models seem to be performing at least as well as unidimensional models.

The advantage of multidimensional models is that they can look at both the location and the stability of legislative outcomes simultaneously. Unidimensional models narrow expectations to two single points—the median of the majority and the median of the floor—, but multidimensional models allow us to create expectations for how strong or weak the

Table 3: Multidimensional Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	2.92***	2.83***	2.72***	2.98***	3.51***
	(0.02)	(0.01)	(0.02)	(0.08)	(0.11)
Uset Dist.	−1.26***		0.90***	1.01***	0.32*
	(0.04)		(0.11)	(0.11)	(0.15)
Maj. Uset Dist.		−0.99***	−1.51***	−1.59***	−2.52***
		(0.03)	(0.08)	(0.08)	(0.19)
Uset Size				0.00	−0.01***
				(0.00)	(0.00)
Maj. Uset Size				−0.01***	−0.02***
				(0.00)	(0.00)
Uset Dist * Size					0.03***
					(0.00)
Maj. Uset Dist. * Size					0.03***
					(0.01)
Num. obs.	4815	4815	4815	4815	4815

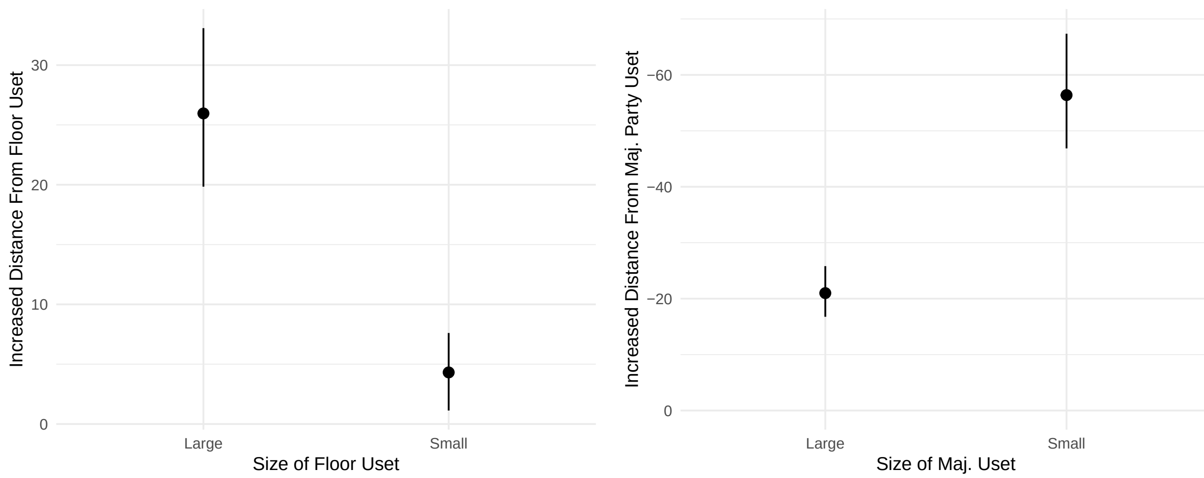
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

pulls of partisan and non-partisan expectations should be. This can be done by observing the size of each uncovered set. Smaller uncovered sets would indicate stronger pulls from each uncovered set, and larger uncovered sets would indicate weaker pulls from each uncovered set.

Model 4 includes the size of the uncovered set of the floor as a whole, and the size of the uncovered set of the majority party as independent variables. This model shows that as the size of the uncovered set of the floor gets larger, the more likely everyone in the chamber is to be able to reach the floor. This may be due largely to the opposition being able to access some agenda setting powers when the floor uncovered set is large. Interestingly, when the size of the majority party uncovered set gets larger, the ability of all legislators to reach the floor goes down. This may mean that when the party uncovered set is large, it is easier for the majority party to reach consensus, and therefore it is less likely that anyone outside of the majority party will be able to get a vote on their bills.

We have clearer predictions for the interactive model shown in Model 5. This model shows that the interaction between distance to the uncovered set and the size of the uncovered set is significant, and it shows that the interaction between distance to the majority party uncovered set and the size of this uncovered set is significant. In the table, though, it is difficult to interpret what this means substantively. I therefore calculated substantive effects for each of these interacted effects, and they are presented in Figure 7.

Figure 7: **Interactive Effects: Uncovered Set Sizes**



To create this figure I held everything constant in Model 6 of Table 3, and I set the size of the uncovered set to small (2 standard deviations below average), and with this small setting I moved the distance from the floor from small to large (2 standard deviations below the mean of distance to floor to 2 standard deviations above). I then repeated this by holding the size of the floor uncovered set to large. Then repeated this same process with the distance to the uncovered set of the majority party. What this figure shows is that as the size of the uncovered set of the floor gets larger, it becomes more difficult to propose centrist bills (it is more probable that non-centrist legislators will reach the floor with their bills). In contrast, when the size of the uncovered set is small, non-centrist legislators still have an advantage (as distance from uncovered set still makes it more likely bills will reach floor), but that advantage is much smaller than under conditions of large floor uncovered sets.

In contrast, distance from the uncovered set of the majority party is always negative, but the size of that effect gets stronger when the size of the majority party uncovered set gets smaller. When the majority party uncovered set is large, legislators do get penalized for being centrists, but that negative effect is even larger when the uncovered set of the party is small. That is, when parties have a small region of consensus, they are more likely to prevent anything that falls far away from that region of consensus from reaching the floor. When their region of consensus is larger, they may be willing to—or may be more likely to be coerced into—accepting that more centrist policies may reach the floor.

6 Conclusions

This article started out by asking two questions: 1) is it *accurate* to depict legislative preferences as being unidimensional, and 2) is it *useful* to depict legislative preferences as being unidimensional? The answer to both of these questions is: to an extent. Unidimensional models did explain a substantive amount of cosponsorship behavior—around 75%. Furthermore, unidimensional models were able to capture agenda setting dynamics as expected by cartel theory. My unidimensional models of success reaching the floor did show that the majority party median was good at explaining which legislators were more likely to reach the floor with their bills, and I was able to provide support against non-partisan, centrist models of agenda setting.

However, more details can be captured and understood by considering multidimensional models of legislative preferences. While unidimensional models focus on exploring *where* policy outcomes are likely to result, multidimensional models can provide information about where outcomes are likely to result *and how stable these outcomes are likely to be* given legislative preferences. I was able to show that this was the case by showing that not only the location of the uncovered set of the floor and the majority parties mattered for understanding legislator success in reaching the floor, but also the relative sizes of each of these uncovered sets also affected the strength of these relationships.

This article also addressed two main questions that have been foundational to the study of legislative behavior. Where Tullock and Brennan (1981) asked "Why so much stability?", Krehbiel (1993) asked "Where's the party?" By showing that the dimensionality of cosponsorship behavior is higher than the dimensionality of roll-call behavior, I was able to provide support for the argument that Structure Induced Equilibriums are likely to be the main cause of legislative stability on the floor. In terms of the second question, I was able to provide evidence for the idea that negative-agenda setting is more likely to prevent centrist partisans than non-centrist partisans from reaching the floor. Furthermore, these partisan results are likely to be strengthened when preferences induce a large uncovered set for the floor as a whole, and a small uncovered set for the majority party.

In sum, it seems to be both more accurate and more useful to consider multidimensional preferences of legislative behavior. In terms of accuracy, two-dimensional models perform better than one dimensional models in accounting for cosponsorship beavior. In terms of usefulness, multidimensional models of preferences allow us to understand the stability of legislative outcomes and the partisanship of legislative outcomes at the same time. This is not possible in unidimensional models because, by assuming equilibriums, the issue of stability is effectively assumed away. In contrast, multidimensional models need to deal with instability at the outset. Therefore more effort should be put into refining multidimensional theories of parties if we wish to finally respond both questions about legislative instability and partisan outcomes simultaneously.

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