District Complexity as an Advantage in Congressional Elections

Michael J. Ensley Kent State University
Michael W. Tofias University of Wisconsin–Milwaukee
Scott de Marchi Duke University

Scholars of congressional elections have argued that an increase in constituent diversity increases the level of electoral competition. Following models of boundedly rational candidates, we argue that there is strong reason to believe that the opposite is true. As the complexity of the electoral landscape increases, challengers will have a more difficult time locating an optimal platform when facing an experienced incumbent. Using data from the 2000 National Annenberg Election Study, we construct a novel measure of district complexity for U.S. House districts and test whether the entry of quality challengers and the incumbent's share of the two-party vote are affected by the complexity of the electoral landscape. We find strong support for the hypothesis that complexity benefits incumbents for both indicators of electoral competition, which stands in contrast to most of the existing literature on diversity and incumbent performance.

In Federalist 10, Madison famously worried about the threat posed by factions. As remedy, he believed the young republic could avoid tyranny by creating a large and diverse republic. The citizenry would provide a robust defense through a pluralistic mechanism. In Madison's idealized state, individual factions would be less likely to trample the rights of minorities, as a more diverse citizenry could prevent a single faction from being able to cobble together a majority and enforce its will. Winning coalitions would have to be built on compromise between multiple factions.

Perhaps because of the spirit of persuasion in which the *Federalist Papers* were written, Madison neglected to mention that coalitions are hard to piece together. Formation is beset by well-known collective action problems (Laver and Shepsle 1996; Olson 1965). In electoral settings, challengers face coalition formation with a kind of identification problem: they must actually discover a platform that will resonate with constituents and deliver victory. We show that electorates presenting greater complexity to challengers do in fact buffer incumbents, and we add this uninvestigated difficulty to the well-known list of problems faced by office seekers.[1]

Many models of congressional elections preclude this identification problem by assumption. Employing a simple Downsian model, scholars often characterize district preferences along a *single* partisan or ideological dimension. One implication of rational choices plus unidimensionality is that competition between candidates is reduced to a simple problem: locate the platform at the position of the median voter. While a single dimension may adequately define the space of elite partisan conflict in Congress (Poole and Rosenthal 1997, but also see Cho and Fowler 2007 and Laver and Fowler 2008), public opinion across major policy issues cannot be reduced to a single dimension of conflict (Layman and Carsey 2002). By assuming away the problems introduced by multidimensionality, our understanding of electoral competition will at best be incomplete (Kim, Lodge, and Taber 2004). Specifically, the complexity of the electoral landscape may

Michael J. Ensley is Assistant Professor of Political Science, 302 Bowman Hall, P.O. Box 5190, Kent State University, Kent, OH 44242 (mensley@kent.edu). Michael W. Tofias is Assistant Professor of Political Science, 3210 North Maryland Avenue, University of Wisconsin–Milwaukee, Milwaukee, WI 53211 (tofias@uwm.edu). Scott de Marchi is Associate Professor of Political Science and Social Science Research Institute, 326 Perkins Library, Box 90204, Duke University, Durham, NC 27708 (demarchi@duke.edu).

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[1]By "complexity," we do not mean simple variance in voter preferences. Complexity can come from many sources, including greater than one dimension, nonseparable preferences (e.g., voters with budget constraints), nonshared dimensions, etc.

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affect the character and degree of competition, such as the vote shares garnered by incumbents or the emergence of quality challengers.

Concepts of complexity have entered into the elections literature from different traditions, but each approach has been an attempt to understand what happens when the political opinions of an electorate become less alike. Empirical investigations into the impact of diverse or heterogeneous constituencies were first introduced to political science by Sullivan (1973), who found diversity increased party competition. Following in the Madisonian tradition, Sullivan assumed that "[t]he higher the degree of shared [demographic] characteristics, the higher the degree of shared values, and the more likely that these shared values will result in a permanent majority" (1973, 75).

Supported by the research of Fenno (1978), this strand of the literature suggests that as district complexity increases, incumbents become more vulnerable because there are simply more groups in the electorate which create a potentially large number of platforms that will defeat even a well-positioned, but relatively fixed incumbent. Of course, this abstraction depends on the assumptions that incumbent movement is restricted, challengers can freely locate, and information about the electorate is complete. The formal literature rarely speaks to issues of diversity and instead focuses on extensions to the spatial model, like probabilistic voting or models of ideology, which in many formulations tend to reduce the uncertainty present in elections rather than increasing it (see Gill and Gainous 2002 and Hinich and Munger 1994 for overviews).

In contrast, the still nascent tradition of computational political economy provides a perhaps more direct approach to considering complexity and its distinct empirical predictions. Specifically, the adaptive parties model (Kollman, Miller, and Page 1992) investigates complexity through the lens of optimization theory and assumes agents (both candidates and voters) are boundedly rational. The adaptive parties model suggests that increasing district complexity would actually benefit incumbents because it becomes more difficult for a challenger to locate a winning platform given the superior experience and resources of the incumbent (de Marchi 1999; Kollman, Miller, and Page 1992, 1998; Laver 2005).

Models of bounded rationality typically model information as being costly to attain. The adaptive parties model assumes that information about the electorate such as the location of a platform that would defeat an incumbent is not known, but can potentially be discovered. In this model, candidates arrive at platforms by searching a policy space for platforms instead of perfectly devising a best response function. Electorates can be composed of voters with preferences that make it easier or harder for a candidate to find a winning platform. Compared to most formal models, the shape of the electorate itself becomes an important comparative static and elections are seen as selection mechanisms. The electoral selection implied by the adaptive parties model offers a distinct explanation for political behaviors such as polling, focus groups, and highly paid political consultants.[2]

Economists have long understood how selective pressures produce behavior that mirrors rational action. Alchian (1950) explains how observed outcomes (in markets) might be produced as the result of rational agents (neoclassical firms) or more simply from selective pressures inherent in a social system (in an economy, the requirement for positive profits). Even if firms are not individually rational, bankruptcy acts like a fitness function (i.e., selection mechanism) that distinguishes success from failure by filtering out the firms that are unable to produce positive profits. In the long run, the market as a whole becomes populated by firms with positive profits greater than or equal to zero, which is identical to the prediction of competition between rational firms. Similarly, elections act as a selection mechanism where the less successful candidates never win elections, creating a population of incumbents who might appear to be rational actors. Candidates who convince a simple majority of their constituents to vote for them hold elected office; weaker candidates unable to find a coalition become losers. The winners in this framework could have either divined or stumbled upon a useful platform. Bounded rationality models of politics suggest that over time, elections produce an evolutionary pattern where incumbents are more effective candidates than the typical challenger (see Zaller 1998 for a clear exposition of this point).[3]

While some previous empirical studies have focused on the related notions of diversity and heterogeneity, very few scholars have examined how the complexity of the electorate affects a candidate's ability to choose an optimal policy location. In fact, we are aware of no previous research that has attempted to directly test the complexity claim of the adaptive parties model with observational data. Complexity presents us with a theoretically grounded concept, a feature that most diversity studies

[2]The Hillary Clinton campaign, for example, still owes Mark Penn over two million dollars and was reported to have paid him over seven million dollars during her primary campaign for polling alone (see "Should Clinton's Campaign Pay Mark Penn?" at http://www.time.com/time/politics/article/0,8599,1891723,00.html).

[3]We are assuming that one of the main selective pressures on candidates is the fitness of their platform choice. There are certainly other choices and features of candidates that may influence their success: valence issues, fundraising, charisma, etc.

are lacking. In the present context, complexity can be refined to mean the varying level of difficulty that a challenger would encounter in trying to solve the problem of selecting a policy platform (and by Fenno's lights, a home style) with which to unseat a rival incumbent (see Page 2008 on measures of difficulty). Further, articles that have examined the relationship between diversity and electoral competition have relied on proxy measures of public opinion (e.g., demographics, partisanship, population size), which are not always well motivated and do not accurately capture the actual political space that candidates and parties compete in. Since most models of electoral competition assume that the main focus of candidate choice is a set of platforms in a policy space, the best approach to measuring complexity is to use the electorate's policy preferences directly, rather than by the proxy of demographics.

Using data from the 2000 National Annenberg Election Study, a district-level measure of political complexity is constructed based on public opinion across two major issue dimensions. This measure is used to test whether district complexity increases or decreases electoral competition. Specifically, regression analysis is used to estimate the effect of complexity on the likelihood of a quality challenger entering a race against an incumbent and on the incumbent's share of the two-party vote. The results indicate that district complexity benefits incumbents, which stands in stark contrast to most of the existing literature.

The article proceeds as follows. First is a review of the existing perspectives on the relationship between electoral landscapes and electoral competition. Then there is a discussion of the complexity measure constructed using data from the 2000 National Annenberg Election Study. This is followed by a presentation of the data and the regression models of challenger quality and incumbent vote share. Finally, the article concludes with some thoughts and directions for future research.

Electoral Landscapes and Electoral Competition

The formal theory of electoral spatial competition has a lengthy and illustrious history but not one devoid of controversy (see de Marchi 2005; Fiorina 1999; Grofman 2004). Since Downs (1957) established the spatial model as a groundbreaking approach to studying elections, scholars have been busy specifying how various electoral rules and institutions, as well as behavioral assumptions about candidates, voters, and interest groups, affect the positions candidates adopt (see Grofman 2004 and Osborne 1995 for review). In particular, the focus has been on whether candidates diverge or converge in the policy space.

There are certainly limits to applying the spatial modeling literature toward real-world elections. Grofman notes that there are many examples where the median voter theorem (and thus convergence) does not hold: "when a given constituency elects members of opposite parties (e.g., when a congressional seat changes hands to a member of the opposite party, or in states that are simultaneously represented by senators of opposite parties), the difference in voting records (as judged, for example, by ADA scores) between the office-holders of different parties can be huge" (2004, 25). Fiorina concurs, noting that both journalists and professional political advisors no longer pay much attention to the median voter: "Whatever happened to the median voter? Rather than attempt to move her 'off the fence' or 'swing' her from one party to another, today's campaigners seem to be ignoring her" (1999, 3).

In part, the failure to locate at central positions may be the result of a failure of candidates to discover feasible platforms in the middle of the political space.[4] It is well known that in deterministic models when there are multiple policy dimensions a single optimal platform does not generally exist (McKelvey 1976; Plott 1967). The implication of analytic models of multidimensional electoral competition is that a challenger should always be able to locate a superior position against a fixed incumbent. However, this result is of limited use in a multidimensional policy space since the implication of chaos theorems has to be juxtaposed with an empirical reality where incumbents rarely lose and candidates diverge. The result is that we need an alternative theoretical approach to elections. In this article, evidence is presented that suggests that instead of engaging in purely strategic action, candidates are also facing an optimization problem stemming from a lack of information about how to win their elections. In short, the proposition is tested that candidates lack the ability to solve the platform selection problem and instead search for policy platforms.[5]

[4] While some analytical research has considered the effect of random uncertainty and concluded the core spatial model's implications remain largely unchanged (Calvert 1985; Glazer, Grofman, and Owen 1989), this does not address the problems listed above. Rather, it deepens the mystery of why candidates diverge and incumbents lose.

[5] Multiple dimensions are our focus here, but there are other constraints which make platform selection a complicated process for candidates. For example, Ansolabehere, Snyder, and Stewart (2001) illustrate how national parties may constrain candidates; Goff and Grier (1993) point out that there may exist multiple constituencies within a district that do not share the same issue space.

The theoretical framework for this approach was introduced by Kollman, Miller, and Page (1992) with the adaptive parties model. In their model, information is costly, the policy space is multidimensional, and candidates do not have the ability to analytically solve for an optimal platform (if one exists); rather, candidates search electoral landscapes with limited resources. Kollman, Miller, and Page (1992) illustrated the effects of different assumptions about boundedly rational parties and showed that it may be difficult for a challenger to beat a well-positioned incumbent *even if* a winning platform exists.

The key results of the adaptive parties model have been confirmed in a laboratory setting where human subjects have great difficulty locating an optimal platform even when it exists (Ensley, de Marchi, and Munger 2007). Ensley, de Marchi, and Munger compared subject performance on two electoral landscapes, a more complex landscape with voters drawn from a uniform distribution and a less complex landscape with voters drawn from a skewed bivariate normal distribution. The probability of the subjects winning against a beatable but well-positioned incumbent was significantly higher in the less complex landscape.

The research on electoral complexity is particularly important because it stands in stark contrast to the existing empirical literature on the related concept of heterogeneity. Notably, Fenno (1978) argued that district heterogeneity was positively related to electoral vulnerability. In his investigation of congressional members' home style, he paid special attention to how the incumbents viewed and characterized their districts. Fenno (1978) argued that the more heterogeneity there is in the opinions of constituents, the more difficult it is for a member to understand the district. Statistical evaluations of this hypothesis about constituency diversity have been met with mixed results (Bond 1983; Fiorina 1974; Koetzle 1998; Krasno 1994; Lee and Oppenheimer 1999; Patterson and Caldeira 1984; Sullivan 1973). Further, the diversity or heterogeneity of opinions may only be imperfectly related to the level of cognitive difficulty that a candidate faces. Neither heterogeneous demographics nor variance of preferences in a single dimension (as in Gerber and Lewis 2004) necessarily imply the sort of diverse opinions in the electorate that foster complexity.

In one sense, Fenno's heterogeneity thesis may be exactly right; heterogeneous districts may be more difficult to classify and understand. But an electorate that is difficult to please in office is likely also one that is difficult to appeal to at the ballot box. Fenno might have misplaced who bears the burden of complex districts the hardest. The difficultly of platform selection applies to challengers as well as incumbents; incumbents, however, are in possession of a winning platform since by definition they have survived the selective pressures of the electorate at least once. Combining Fenno's observation about heterogeneity with Alchian's insight about survival under uncertainty encourages the use of a theoretical framework based around these assumptions. These assumptions about candidate cognitive limitations are captured in the adaptive parties model and lead to the hypothesis that an increase in district complexity should decrease electoral competition. This article offers an empirical test of the adaptive parties model and shows that electoral competition does indeed decrease with increasing complexity in the electorate.

Measuring District Complexity

The adaptive parties model of Kollman, Miller, and Page (1992) is based on a fitness landscape, which represents aggregated voter preferences over the platforms of two candidates. In this model, candidates pick a platform in the political landscape but do not have complete information about it—their experience, polling, and focus groups allow them limited information about the landscape. Specifically,

- the issue space forms an *adaptive landscape*, of dimensionality $N + 1$ (where the first N dimensions record all possible platforms which span all N issues and the $N + 1$th dimension is a measure of the election outcome while positioned at that unique platform). Landscapes are much like geographical landscapes, where regions of greater height represent policy platforms that will likely be more successful than lower regions.
- the complexity of a given landscape is characterized by measures of dimensionality and ruggedness (see especially Kollman, Miller, and Page 1998). Higher dimensional policy spaces are more difficult to search than lower dimensional spaces, and rugged landscapes have many local optima. Alternatively, simple landscapes are one-dimensional and may have a single peak or an optimal platform location for a challenger.

To test the adaptive parties hypothesis we need a district-level measure of complexity based on the policy preferences of the electorate. Prior work in population genetics and optimization theory, in particular the work on N-K landscapes of Kauffman (1993), Kauffman and Levin (1987), and Kauffman and Weinberger (1989),

provide analytic frameworks that are enormously useful in approaching the problem of arriving at appropriate measures for electoral complexity. We are, however, limited by the available data and must settle on a measure of complexity that is easily generated using available survey data. The 2000 National Annenberg Election Study (NAES) is an appropriate data source, in large part due to its sample size, which allows us to investigate elections at the level of House districts. In essence the NAES is used to measure preferences at the microlevel and then aggregated up to the district level for the measure of complexity.

As with other sources of data on voter preferences, in the NAES data there are two main dimensions recovered using a principal components factor analysis (see, for instance, Hinich and Munger 1994). The measure of district complexity is based on the correlation between the social-welfare and cultural dimensions, which captures the intuition that the more similar these dimensions are, the simpler the electoral landscape is. There is abundant evidence that at least two dimensions are needed to describe the preferences of voters, and this implies that no median in all directions exists. Absent the possibility of choosing the median, there is no way that an incumbent can secure victory by choosing a single "best" platform. What does matter, however, is the relative quality of the incumbent's choice, which depends on the complexity of the problem faced by the candidates. This correlation measure, though by no means perfect, is justified by the theoretical literature on optimization. Kollman, Miller, and Page (1998), for example, find that "consistency of preferences appears to reduce ruggedness [complexity] across all landscape types" (152; see also de Marchi 2005). Simply put, there is no single measure of complexity, nor is there a general measure suitable for all types of data. The measure settled on is nearly ideal, given the limitations of the NAES data.[6]

Although there may be more than two dimensions underlying the structure of public opinion in America, there is strong evidence that two dimensions capture a large amount of the variation in public opinion (Layman and Carsey 2002; Miller and Schofield 2003; Shafer 2003; Shafer and Claggett 1995), particularly in the year 2000 where the issues related to race have been absorbed into the social-welfare dimension (Kellstedt 2003). Analytically, two dimensions are qualitatively different (in terms of the complexity of choosing a platform for a candidate) than one, and our measure captures this fact. In a formal sense, the *first* additional dimension is all that is needed to arrive at the chaos results that motivate the optimization approach of Kollman, Miller, and Page (1992).

As noted above, each respondent's preference along these two dimensions is measured, and then aggregated to compute the score for each House district. The social-welfare dimension captures issues concerning the distribution of wealth and economic benefits, such as social security, unemployment, tax policy, and the government's role in the provision of health care. The cultural dimension concerns values and issues that define the appropriate mode of conduct and behavior in American society. Further, this dimension captures an underlying desire to protect, maintain, and spread American ideas and culture. Issues such as gay rights, abortion, and prayer in schools define current debates over what is considered to be appropriate social behavior (see Shafer and Claggett 1995 for more about these two dimensions of public opinion). Appendix A includes the specific questions we used for each dimension.

To create the scores, we created a scale where all of the questions were coded such that more conservative responses were on the higher end of the scale. Each question was standardized to have the same weight on the scale. Appendix A provides the details of the two summated rating scales.[7] The NAES survey did not ask every issue question in every wave, and therefore, we imputed the missing responses (the amount of missing data for each question is reported in Appendix A).[8] The district correlations are calculated based on the imputed responses for each dimension for each individual. In the sample of districts we analyze below, the mean correlation between the two dimensions is 0.3 and the standard deviation is 0.1.

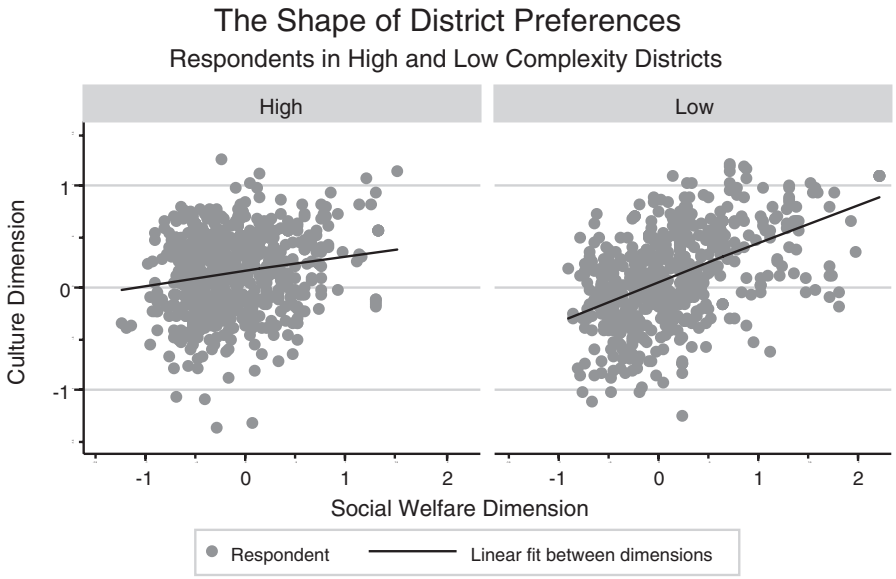
Given that the complexity measure is constructed from public opinion data, and thus subject to sampling error, we ensured that these indicators are reliable

[6] Another source of complexity would be nonseparable preferences. Unfortunately, any measure that aims to uncover this sort of complexity would be impossible given the format of the NAES.

[7] We also performed principal components factors analysis using the issue questions. The first two factors uncovered are closely related to the dimensions we defined. The first factor was correlated with our social-welfare dimension at 0.95, and the second dimension was correlated with our cultural dimension at 0.85. Thus this supports our assumption that the social-welfare and cultural dimensions are the two main sources of conflict in current American politics.

[8] We used PROC Mi procedure in SAS Version 9.1 to generate five data sets. A respondent's score on each dimension is the average from the five data sets. The MCMC algorithm with an uninformative Jeffery's prior was used. Further, we used the default 200 burn-in iterations and the starting values were created using the Expected Maximization (EM) algorithm. This approach is based on the multivariate normality assumption, which King et al. (2001) suggest using, but it employs a different estimation technique than they use.

FIGURE 1 An Illustration of the Complexity Measure



The high complexity example district is PA-7 and the low complexity example is MI-11. *Data Source*: 2000 National Annenberg Election Study.

measures. First, the social-welfare and cultural measures when considered separately have high individual-level reliability (social welfare is 0.81, cultural is 0.68). Second, the measures have high aggregate reliability. Following the procedure advocated by Jones and Norrander (1996), we calculated the aggregate reliability of the social-welfare dimension (0.78) and the cultural dimension (0.91).[9] Finally, to control for the heteroskedasticity introduced by the unequal sample sizes across districts, the standard errors in the regression models are adjusted by using NAES respondents per district as weights (see Greene 2003, 236; Kennedy 2003, 145).

The correlation of respondents' positions on the two dimensions is a good measure of complexity in this context and represents one manner in which Kollman, Miller, and Page (1998) generated complexity in their electoral simulations. If the two dimensions are perfectly correlated, then knowing a voter's position on one dimension is equivalent to knowing his or her position on the other dimension.[10] In this situation, and assuming that the incumbent is to some degree fixed, the challenger faces a relatively easy task of finding a superior platform. Conversely, if the dimensions are uncorrelated, then knowledge of a voter's position on one dimension provides no information about a voter's attitudes on the other dimension.[11] The lower the correlation between the two dimensions, the more difficult it is for a challenger to locate a platform that beats an incumbent. Kollman, Miller, and Page (1998) illustrate how complexity is distinct from centrism, a fact that is quite evident in the data.

In Figure 1, we compare Pennsylvania's 7th district with Michigan's 11th district. Both are suburban (Philadelphia and Detroit, respectively) districts represented by Republican incumbents preceding the 2000

[9]For comparison purposes consider that the aggregate reliability of partisan identification is 0.82 and the aggregate reliability of ideology is 0.76 when calculated for House districts based on NAES respondents.

[10]In actual districts, none have dimensions that are perfectly correlated/unidimensional, which means it is unlikely that there is ever a median-in-all-directions. One way to visualize our complexity measure is to imagine a Cartesian plane where each dimension is scaled such that positive numbers represent conservative responses and negative represent liberal responses. If the data largely fall in the first and third quadrants, one has a simpler district; many respondents have positions that tend to be in the same direction on both dimensions of choice. If the data tend to fall evenly across the four quadrants (i.e., like a cloud), then one has a more complex district. Respondents in this case are sometimes conservative on one dimension and liberal on the other (or vice versa). Again, this measure captures only one (albeit essential) feature of complexity, but it does accommodate the limitations of the NAES.

[11]Also, the correlation between the two dimensions captures the notion of complexity used in Ensley, de Marchi, and Munger (2007). In the complex distribution in their experiments, voters were distributed uniformly over the two dimensions (i.e., the dimensions were uncorrelated). In the less complex distribution, voters were drawn from a skewed (i.e., a nonzero correlation) bivariate normal distribution.

election. George Bush received 48.5% of the two-party vote in PA-7 and 50% in MI-11. The districts are 93% white and are similar based on other demographic characteristics (Barone and Ujifusa 1999). Despite these similarities the districts have very different scores on the complexity measure. The correlation between the two dimensions in PA-7 is 0.04, which is near the bottom of the scale. The correlation in MI-11 is 0.49, which is near the top of the observed scale. In line with our hypothesis, the incumbent in PA-7 received 64% of the vote and the incumbent in MI-11 received only 55% in the 2000 election.

As Figure 1 illustrates, PA-7 voters are located in a rough circular pattern; there is very little correlation between the issue factors and one would need both of them to reconstruct the policy space. Put another way, if a candidate positioned on only one dimension in PA-7, he or she would perform very poorly and information about a given voter's position on one dimension is not helpful in guessing his or her position on the other dimension. For a candidate, it would be twice as costly to discover issue positions of the electorate in this space since the dimensions are uncorrelated. In MI-11, on the other hand, a single dimension does a much better job at capturing the policy space, and thus the platform location problem is not as complex. Given the outcome in the presidential race, this example is consistent with our argument that the more complex the district, the better the incumbent will do and encourages the investigation to see whether this relationship holds more generally.

Data and Regression Analyses

The NAES is a six-wave national, rolling cross-section of the American voting population. The first five waves of the study produced over 50,000 respondents.[12] We use all of the respondents in the survey regardless of vote intention.[13] The large sample is critical because it provides enough respondents per House district to create reliable, aggregate measures of public opinion, which are discussed below.

[12]We exclude the sixth, postelection wave because it did not include the issue-preference questions.

[13]One could make an argument that the sample should be limited to respondents who intend to vote. This entails an endogeneity problem—candidate positioning may be a crucial factor in motivating voters (or those who abstain). Regardless, the results reported here are qualitatively identical if the sample is limited.

Dependent Variables

To test whether district complexity has an effect on electoral competition, two different factors of competition are analyzed. First, we examine whether district complexity affects the probability that a quality challenger emerged. Quality challengers (operationalized as candidates with previous office-holding experience) typically enter when conditions are favorable for defeating an incumbent (Bianco 1984; Bond, Covington, and Fleisher 1985; Jacobson 1989; Kernell and Jacobson 1983; Maisel and Stone 1997; Stone and Maisel 2003). Additionally, we include a small extension to the strategic politician thesis (Kernell and Jacobson 1983). A (boundedly rational) politician will be less likely to enter a race as a challenger if he or she cannot ascertain a policy platform that might be able to defeat an incumbent. Thus, if district complexity affects an incumbent's electoral prospects, we would expect that quality challengers would be less likely to emerge as district complexity increases.

Second, we analyze incumbents' electoral performance to see if their vote shares are affected by district complexity. The operationalization of the dependent variable in the second analysis is the incumbent's share of the two-party vote.

Independent Variables

We use the inverse of the absolute correlation between the social-welfare and cultural issue dimensions as our measure of district *Complexity* $(1 - r)$. By using the absolute value, we account for districts that might exhibit unidimensional politics, but with a pattern of conflict that is orthogonal to mainstream political conflict (i.e., constituents that were all either libertarians or statists).[14] Stewart (2001) describes unidimensional politics as an "equilibrium of tastes" (2001, 24). Agreement on the basic structure of political conflict within an electorate should explicitly be a precursor to the shared values that Sullivan and Madison demand. Therefore, this measure of complexity distinguishes between the key difference in the competing theoretical accounts as the adaptive parties model predicts complexity should benefit incumbents and the demographic heterogeneity accounts would clearly anticipate that increases in our measure of complexity would be detrimental to incumbents.

In order to obtain valid estimates of the relationship between complexity and electoral competition, we control for other important determinants of electoral

[14]In the sample of districts analyzed, only nine districts had a correlation less than zero. Of these nine districts, only two had a correlation less than −0.05.

competition. We include a dummy variable for *Republican Incumbent* (1 = Republican Incumbent, 0 = Democratic Incumbent) to capture national partisan swings in favor of one party or the other. We also include a dummy variable that indicates whether the incumbent is a *Freshman* (1 = Freshman, 0 = otherwise). All else equal, incumbents are more likely to face a stiff electoral challenge after their first term in office as they have not had as much opportunity or ability to accrue the amount of political capital that their older counterparts possess (Jacobson 2004).

The most important and consistent predictor of congressional vote choice is an individual's partisan identification (Bartels 2000; Jacobson 2004). Therefore, we include a measure of district *Partisanship*, which is a district average of the partisan identification measure in the NAES. The survey had the traditional seven-point branching scale, where strong Democrats are scored as a 1 and strong Republicans are scored as a 7.[15] We expect that Republican incumbents would do better the more Republican the district is, and Democratic incumbents would do worse the more Republican the district is. Therefore, we interacted the Republican incumbent dummy variable with the partisanship measure. Partisanship controls for districts that might be too extreme for challengers of the out-party to compete in.

We also control for the policy preferences of the district. Typically, district policy preferences are measured along a single ideological, liberal-conservative dimension. We have, however, identified two policy dimensions as being particularly important in constructing our measure of district complexity. We include the mean of respondents' positions in the district for the *Social Welfare* and *Cultural* dimensions as explanatory variables. Our expectation is that influence of district preferences will vary depending on whether the incumbent is from the Democratic Party or Republican Party. Again, we interact the Republican incumbent dummy variable with both measures of district policy preferences. Further, given that the complexity measure is constructed from the social welfare and cultural measures, it is necessary to control for the independent effects of these two variables (Brambor, Clark, and Golder 2006).

We attempt to control for the espoused positions of the incumbents, most notably through the incumbent's roll-call record. Canes-Wrone, Brady, and Cogan (2002) showed that after controlling for the district's partisan and ideological predispositions, the more extreme an incumbent's roll-call record (i.e., the more liberal a Democrat's record or the more conservative a Republican's record), the worse the incumbent did in the following election (see also Erikson and Wright 2001). We use Poole and Rosenthal's DW-NOMINATE Scores to measure the extremity of an incumbent's roll-call record. Since we have indentified two relevant policy dimensions, we include both the first- and second-dimension scores from the NOMINATE procedure.[16] Poole and Rosenthal (1997) argue that the first dimension is the main left-right, liberal-conservative economic dimension, which we have labeled the social-welfare dimension. The second dimension in recent years has captured cultural issues along the lines we have identified. *Social Welfare Roll Call* is the first-dimension score for the incumbent and the second-dimension score is the measure of the *Cultural Roll Call* for the incumbent. The scores are scaled between −1 and 1, and since higher numbers indicate a more conservative roll-call record, we interacted each score with the Republican incumbent dummy variable because we expect that Republican incumbents will do worse the more conservative they are and Democratic incumbents will do worse the more liberal they are (Canes-Wrone, Brady, and Cogan 2002).

To control for effects suggested by the diversity literature, we include a variant of the *Sullivan Index*.[17] Sullivan (1973) introduces a measure from the sociology literature to show that political competition increases in population diversity. Similarly, Fiorina (1974) finds further support that diversity increases electoral competition. Bond (1983) finds no relationship between constituency diversity and electoral competition. Koetzle (1998) criticizes the apolitical nature of the Sullivan Index and develops his own measure of political diversity, finding that

[15]Respondents were asked if they identified with the Republican Party, Democratic Party, or neither. Partisan identifiers were asked if they identified strongly or not strongly with their identified party. Nonidentifiers were asked if they leaned toward either party. The answers to these questions are combined to create a seven-point scale (1 = Strong Democrat, 2 = Weak Democrat, 3 = Leaning Democrat, 4 = Independent, 5 = Leaning Republican, 6 = Weak Republican, 7 = Strong Republican).

[16]The data were obtained from Keith Poole's website (http://www.voteview.org).

[17]The three measures of diversity commonly used in the literature are the Sullivan Index (1973), the Koetzle Index (1998), and the standard deviation of ideology (cf. Gronke 2000). These diversity measures are essentially unrelated to the measure complexity we develop here. For the districts used here, the correlation of complexity with the Sullivan Index is 0.03, the correlation with the Koetzle Index is −0.18, and standard deviation of ideology is −0.06. Further, we should note that the regression results reported here are unaffected if the Sullivan Index is excluded from the model, which bolsters our argument that heterogeneity (particularly demographic or socioeconomic) is not the same thing as complexity in preferences.

TABLE 1 Descriptive Statistics

Variable	Mean	Std. Deviation	Min.	Max
Incumbent Two-Party Vote Share	67.13	9.31	45.39	94.66
Challenger Quality	0.22	0.42	0	1
Complexity	0.73	0.09	0.52	1.00
Incumbent Spending (natural log)	13.49	0.64	11.93	15.75
Challenger Spending (natural log)	10.98	1.97	8.52	15.29
Republican Incumbent	0.50	0.50	0	1
Social Welfare	−0.01	0.10	−0.34	0.22
Cultural	−0.02	0.14	−0.52	0.25
Partisanship	3.82	0.48	2.31	4.84
Sullivan Index	0.28	0.01	0.25	0.32
Social Welfare Roll Call	0.02	0.44	−0.77	1.14
Cultural Roll Call	−0.06	0.43	−1.05	1.19
Freshman	0.09	0.28	0	1

N = 327.

political diversity does increase electoral competition.[18] More recent work has found that social and political diversity indices produce similar findings. Aistrup (2004) finds that partisan competition at the state and county level increases as social and demographic diversity increases (with the exception of racial diversity). We implement a fairly standard Sullivan Index with the exception of omitting the occupation category, as the 2000 Census job classifications scheme is quite haphazard.

Summary statistics of the variables used in both analyses are presented in Table 1.

Challenger Quality Results

The dependent variable is a dichotomous variable that indicates whether a challenger has held an elected position; thus we use a probit model and the results are reported in Table 2. If district complexity is an important component of electoral competition as we claim, then we should find that quality challengers are more likely to enter the race when the conditions are favorable. More explicitly, we should find that as the electoral landscape becomes less complex, quality challengers will be more likely to enter. The coefficient on complexity is negative and statistically significant, which indicates that as district complexity decreases a quality challenger is more likely to enter the race; thus we find strong support for the first hypothesis about district complexity and electoral competition.

[18]The Koetzle Index, however, assigns demographic subgroups to parties; it measures diversity in the sense of minority politics, a concept quite separate from the complexity we have under exploration here.

The effect of complexity on the likelihood of a quality challenger entering is substantial. While holding the other variables at their mean values, the predicted probability of a quality challenger entering the race is 10% in a district with a complexity score two standard deviations below the mean. The probability of a quality challenger entering increases to 30% in a district with a complexity score two standard deviations above the mean.

Incumbent Vote Results

We analyze incumbent electoral performance with the incumbent's percentage of the two-party vote as the dependent variable, using ordinary least squares (OLS). The vote share model utilizes the same independent variables as we used for the challenger quality regression model, but we add three variables. First, we use *Challenger Quality* as an independent variable because challengers may possess personal attributes, fundraising skills, and experience that improve their performance relative to political novices. Second, we include *Challenger Spending* and *Incumbent Spending* on their campaigns. The analysis of campaign spending and vote shares is a well-traversed yet controversial area of research given the endogeneity of campaign fundraising; challengers raise money only when they have a reasonable probability of winning and incumbents tend to raise money when they are electorally vulnerable (Erikson and Palfrey 1998; Gerber 1998; Green and Krasno 1988, 1990; Jacobson 1978, 1980, 1990).

Given the difficulties in constructing valid instrumental variables either because of weak instruments (Bound, Jaeger, and Baker 1995) or endogenous instruments (Bartels 1991), our approach to handling the

TABLE 2 Probit Regression of Challenger Quality Emergence

Independent Variable	Coefficient	Standard Error
Complexity	−2.07**	0.99
Republican Incumbent	11.04**	3.08
Social Welfare	−0.77	2.16
Republican Incumbent × Social Welfare	−0.23	2.73
Cultural	−1.93	1.25
Republican Incumbent × Cultural	4.65**	1.88
Partisanship	1.39**	0.63
Republican Incumbent × Partisanship	−2.84**	0.79
Sullivan Index	−11.72	9.57
Social Welfare Roll Call	0.18	1.07
Republican Incumbent × S.W. Roll Call	−0.27	1.52
Cultural Roll Call	0.41	0.40
Republican Incumbent × Cult. Roll Call	−0.61	0.60
Freshman	0.05	0.31
Constant	−1.22	4.06
N	327	
Pseudo R^2	0.10	
Wald $\chi^2_{(12)}$	36.9**	
Percent Correctly Predicted	75	

The emergence of a quality challenger is coded as 1 for the dependent variable. Data weighted by the number of respondents per House district. Entries are coefficients estimates with heteroskedasticity-robust standard errors. ** $p < 0.05$; * $p < 0.10$.

endogeneity of the campaign spending variables is to present a naïve OLS model alongside a two-stage least squares (2SLS) analysis that attempts to control for the endogeneity. Since our goal is to test whether district complexity affects incumbent performance, we hope to show that the effect of district complexity holds regardless of whether we control for the endogeneity of campaign spending or not.

In the first column of results in Table 3, we present the coefficient estimates for the OLS regression of the incumbent's two-party vote share. Again our focus is on the effect of district complexity on vote share. The coefficient is positive and statistically significant, which indicates as the district becomes more complex the incumbent's vote share goes up. As we expect, incumbents benefit from district complexity. In substantive terms, the effect of district complexity is notable. If we compare a district with a complexity score two standard deviations below the mean to a district with a score two standard deviations above the mean, there is a 2.5% difference in the incumbent's expected share of the vote.

It is also worth noting that the issue dimensions are significant for explaining incumbent performance. For Democratic incumbents, the more conservative the district is on social welfare and cultural issues the smaller the share of vote the incumbent receives. For Republican incumbents the effect of social welfare is not statistically significant (the main coefficient plus the interaction term is zero). The effect of the cultural dimension, though, is statistically significant for Republican incumbents; the more conservative the district is on the cultural dimension, the better the Republican incumbents do. We also controlled for the partisanship of the district. Not surprisingly, the more Republican the district, the worse Democratic incumbents fare.

Further, there is evidence that the ideological positions of the incumbents are significant factors in explaining the outcomes. The coefficient on the cultural roll-call score is positive and statistically significant. This indicates that for Democratic incumbents, the more liberal they are on the cultural dimension, the lower their vote share. Also consider that the coefficient on social-welfare roll call is negative, as well as the coefficient on the interaction term between the Republican incumbent and social-welfare roll-call variables. The joint effect of these two variables indicates that Republican incumbents receive a lower share of the two-party vote as they become more conservative on the social-welfare dimension. These results are consistent with the findings of Canes-Wrone, Brady, and Cogan (2002).

As expected, challenger spending has a negative and significant effect on the incumbent's vote share. Incumbent spending, however, has a negative yet statistically insignificant effect on incumbent vote share. Given the well-known issues surrounding the endogeneity of campaign fundraising by incumbents and challengers, we also estimated a 2SLS model, and these regression coefficients are presented as the second set of results in Table 3. Our goal is to verify that the results for district complexity are robust. We used lagged values of challenger party spending and incumbent spending as the instrument for challenger and incumbent spending. The first-stage regression coefficients are discussed and presented in Appendix B. In performing the 2SLS analysis, we lose cases because some incumbents did not face a challenger in the previous election; thus there is missing data for the lagged spending measures.

The 2SLS results are consistent with our hypothesis about district complexity. First, the coefficient on

TABLE 3 Regression Models of Incumbent Share of Two-Party Vote

	OLS		2SLS†	
Independent Variable	**Coef.**	**SE**	**Coef.**	**SE**
Complexity	6.18**	2.84	6.94*	4.17
Incumbent Spending	−0.46	0.50	1.39	1.46
Challenger Spending	−2.59**	0.15	−4.97**	0.81
Republican Incumbent	−38.47**	7.99	−17.74	14.06
Social Welfare	−13.49**	6.54	−8.80	7.95
Republican Incumbent × Social Welfare	15.59*	8.05	7.51	11.71
Cultural	−7.56*	4.00	−4.81	4.14
Republican Incumbent × Cultural	16.04**	5.34	13.51*	7.54
Partisanship	−7.03**	1.76	−4.05	2.56
Republican Incumbent × Partisanship	10.61**	2.10	4.34	3.78
Sullivan Index	22.88	23.08	41.78	39.07
Social Welfare Roll Call	−2.72	2.54	1.68	3.60
Republican Incumbent × S.W. Roll Call	−2.49	3.45	−3.70	5.40
Cultural Roll Call	2.33**	1.11	0.10	1.74
Republican Incumbent × Cult. Roll Call	−2.55	1.60	−0.54	2.76
Challenger Quality	−0.39	0.61	1.84*	1.14
Freshman	−0.97	0.90	0.27	1.14
Constant	115.08**	11.25	101.41**	23.01
N	327		272	
R^2	0.79		0.63	
Anderson Exogeneity Test	–		27.5**	

Data weighted by the number of respondents per House district.
Entries are coefficient estimates and heteroskedasticity-robust standard errors.
** $p < 0.05$; * $p < 0.10$.
† Instrumented: Incumbent Spending, Lagged Challenger Spending.
Excluded instruments: Lagged Incumbent Spending, Lagged Challenger Party Spending (see Appendix B for first-stage regressions).

challenger spending is larger in the 2SLS analysis and the coefficient on incumbent spending is positive but it is not statistically significant. These results are consistent with previous analyses of campaign spending and incumbent vote shares; thus we have confidence that the 2SLS results are reliable. Second, the coefficient on complexity in the 2SLS analysis is statistically significant ($p = 0.09$, two-tail test). More importantly, the size of the coefficient is slightly larger in the 2SLS analysis. Thus, controlling for the endogeneity of campaign spending does not have an effect on our conclusions about effect of complexity on incumbent performance. As a district becomes more complex we find that the incumbent's share of the vote is increasing.

Conclusion

The results presented in this article provide strong support for the hypothesis that district complexity benefits incumbents. Specifically, an increase in district complexity deters quality challengers from entering a race and is also associated with an increase in an incumbent's share of the vote. Fenno (1978) recognized that diversity, or "kaleidoscope variety" to use his term, made it difficult for incumbents to represent their constituents. While we certainly agree with this assessment, many scholars have failed to consider that this difficulty also applies to potential challengers. If we recognize that the complexity of the electoral landscape affects both incumbents and challengers and incumbents have already survived a previous round of electoral competition, we can appreciate how district complexity benefits incumbents. By definition, an incumbent has done a good job of finding a successful platform at least once and the ability of a challenger to unseat a well-positioned opponent becomes more difficult as the complexity of the landscape increases.

In addition to extending these findings to other years and other legislative races, future research could proceed in several directions. First, we should consider

alternative ways of measuring district complexity. There are no uniquely "good" measures of complexity, and any empirical measure depends on the type and quality of data available for a given problem. We have tested a particular measure (and several others, not reported here) and think our measure captures the complexity of the issue space quite well given the NAES data. However, like all scientific endeavors, further support (or criticism) of our results depends on applying our measure or replacement measures to new data. In a related vein, measures that capture the degree to which incumbents are located at relatively good platforms would be extraordinarily helpful in establishing priors for challenger entrance and performance.

Second, despite the relative lack of importance of the more traditional measures of diversity or heterogeneity in the results presented here, there may be benefits to reconciling the theories of diversity with the formal work on complexity. Clearly, there are limitations to doing cross-sectional models when the relationship between demographic or socioeconomic diversity and complexity may be dynamic.

Appendix A

NAES Survey Questions

TABLE A1 NAES Survey Questions

Survey Questions						
			Correlation			
Social Welfare	**Annenberg Code**	**Percentage Missing**	**item-test**	**item-rest**	**inter-item**	**alpha**
Cut taxes or strengthen Social Security	cbb05	22%	0.47	0.36	0.24	0.81
Should cut top tax bracket	cbb10	57%	0.34	0.21	0.25	0.82
Should spend on Social Security	cbc01	3%	0.60	0.50	0.23	0.79
Should spend on Medicare	cbe04	56%	0.63	0.54	0.23	0.79
Should spend on Medicaid	cbe21	56%	0.64	0.55	0.23	0.79
Expand efforts to protect patients' rights	cbe15	57%	0.58	0.48	0.23	0.80
Americans without health insurance a problem	cbe01	56%	0.59	0.49	0.23	0.80
Should spend on health care for uninsured	cbe02	3%	0.66	0.58	0.22	0.79
Expand efforts to prevent job discrimination against blacks	cbm01	3%	0.52	0.41	0.24	0.80
Poverty a problem	cbp01	2%	0.54	0.44	0.23	0.80
Should reduce income differences	cbp02	57%	0.49	0.37	0.24	0.80
Spend on aid to mothers with young children	cbp03	57%	0.57	0.47	0.23	0.80
Expand effort to protect environment	cbs01	56%	0.55	0.45	0.23	0.80
Job loss to foreign competition a problem	cbt02	56%	0.36	0.23	0.25	0.81
Test Scale					0.24	0.81
Cultural						
Should restrict abortion	cbf02	6%	0.50	0.36	0.13	0.65
Should ban abortion	cbf03	57%	0.47	0.32	0.14	0.66
Should restrict gun purchases	cbg06	2%	0.40	0.24	0.14	0.67
Underpunished criminals a problem	cbg12	3%	0.46	0.31	0.14	0.66
Drug use a problem	cbg13	56%	0.38	0.22	0.15	0.67
Should spend on missile defense	cbj03	57%	0.49	0.35	0.13	0.65
Should spend on military	cbj07	2%	0.52	0.37	0.13	0.65
Favor death penalty	cbg01	39%	0.38	0.22	0.14	0.67
Immigration a problem	cbk01	56%	0.42	0.27	0.14	0.66
Favor gays in military	cbl01	42%	0.52	0.38	0.13	0.65

continued

TABLE A1 Continued

Survey Questions						
			Correlation			
Cultural	Annenberg Code	Percentage Missing	item-test	item-rest	inter-item	alpha
Expand efforts to prevent job discrimination against gays	cbl05	4%	0.50	0.36	0.13	0.65
Expand efforts to prevent job discrimination against women	cbm02	56%	0.36	0.20	0.15	0.67
Should allow school prayer	cbt03	57%	0.48	0.33	0.14	0.65
Test Scale					0.14	0.68

Appendix B

This appendix presents the first-stage regression models for the 2SLS model presented in Table 3 of the article. The endogenous, instrumented variables are incumbent spending and challenger spending. The excluded instruments are lagged (i.e., the last election, 1998) incumbent spending and challenger party spending (for use of lagged spending as an instrument, see Bartels 1991; Basinger and Ensley 2007; Gerber 1998; Green and Krasno 1988). Note that the coefficient for lagged incumbent spending is statistically significant for the incumbent spending model and lagged challenger spending is significant for the challenger spending model. Further, the partial R^2 and the F-test of the joint significance of the two excluded instruments pass the conventional thresholds; thus, there is evidence that instruments are strong enough to construct reliable instruments for challenger and incumbent spending. The models were estimated in STATA 8.2 using the IVREG2 procedure written by Baum, Schaffer, and Stillman (2003).

TABLE A2 First-Stage Regressions for Table 3

	Challenger Spending		Incumbent Spending	
Independent Variable	Coef.	SE	Coef.	SE
Complexity	1.03	1.25	0.54*	0.33
Republican Incumbent	7.06**	3.24	0.04	0.91
Social Welfare	2.47	1.92	1.73**	0.63
Republican Incumbent × Social Welfare	−3.29	3.43	−1.58	1.05
Cultural	−0.02	1.21	−0.01	0.37
Republican Incumbent × Cultural	−0.05	2.21	−0.33	0.59
Partisanship	1.11**	0.54	−0.21	0.17
Republican Incumbent × Partisanship	−2.02**	0.83	0.01	0.23
Sullivan Index	21.53*	11.41	7.00**	2.97
Social Welfare Roll Call	1.41	1.04	0.35	0.34
Republican Incumbent × S.W. Roll Call	−0.67	1.64	−0.56	0.47
Cultural Roll Call	−0.96**	0.46	−0.15	0.16
Republican Incumbent × Cult. Roll Call	0.93	0.74	0.43*	0.23
Challenger Quality	1.04**	0.24	0.29**	0.07
Freshman	0.05	0.36	0.01	0.10
Lagged Incumbent Spending	0.42**	0.20	0.70**	0.10

continued

TABLE A2 Continued

	Challenger Spending		Incumbent Spending	
Independent Variable	**Coef.**	**SE**	**Coef.**	**SE**
Lagged Challenger Spending	0.30**	0.08	−0.03	0.03
Constant	−8.39	5.12	3.03**	1.51
N	272		272	
R^2	0.38		0.53	
Tests of Instrument Strength				
Partial R^2	0.13		0.41	
Partial *F*-test	18.2**		42.6**	

Data weighted by the number of respondents per House district. Entries are coefficients estimates with heteroskedasticity-robust standard errors.

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