# Estimating the Effect of Redistricting on Minority Substantive Representation

David Epstein[*]
Columbia University

Michael C. Herron[**]
Dartmouth College

Sharyn O'Halloran[***]
Columbia University

David Park[****]
George Washington University

This article applies modern Bayesian roll call analysis to estimate legislators' support for minority-favored policies, and to determine the likely impact of competing redistricting plans on the substantive representation of minority interests. We first provide a theory of districting and policy outcomes that points to the importance of coalition building in advancing minority policy concerns and motivates our estimation techniques. We then apply this methodology to the redistricting of the South Carolina State Senate following the 1990 census. We show that this redistricting led to more minorities being elected to office but less substantive representation.

## 1. Introduction

Section 5 of the 1965 Voting Rights Act (VRA) mandates that jurisdictions with historic patterns of racial discrimination preclear with the federal government any changes to their laws that might impact minorities' ability to participate in the political process. The standard for determining preclearance is "retrogression," meaning that the proposed change cannot be a step backward for minorities' exercise of the electoral franchise.[1] The concept of retrogression was devised for, and makes perfect sense in, cases dealing with electoral systems. If, for instance, a municipality formerly had an at-large voting system for its city council and had been forced to change to a district-based

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*Columbia University. Email: de11@columbia.edu.

**Dartmouth College. Email: Michael.Herron@dartmouth.edu.

***Columbia University. Email: so33@columbia.edu.

****George Washington University. Email: dkp@gwu.edu.

1. This standard was first developed in *Beer v. United States*, 425 U.S. 130, 140 (1976).

system, then an attempt to change back to an at-large system would harm minorities and should thus be denied preclearance.

How, on the other hand, does this principle apply to redistricting that involves comparing alternative district maps and assessing if one on the whole is more favorable toward minorities than the other? After all, if a proposed plan takes a district with 65% black voting-age population (BVAP) and creates a similar district in the area with only 55% BVAP, those 10% black voters did not disappear. Rather, they were reallocated to surrounding districts where they might have the opportunity to influence election outcomes and behaviors of other representatives. So, under what circumstances is a districting scheme retrogressive?

Until recently, the courts had emphasized the election of minority representatives as the key to retrogression: a proposed districting plan should be rejected if it would lead to fewer minorities attaining office.[2] In a major decision, however, the Supreme Court announced in *Georgia v. Ashcroft* a new set of standards for Section 5 preclearance in redistricting cases.[3] *Georgia v. Ashcroft* established the principle that, if a redistricting plan was adopted with the support of minorities and with the purpose of moving actual policy outcomes toward those favored by minority voters, it could be acceptable even if it would plausibly result in fewer minority representatives being elected. In the classic language of Hannah Pitkin (1967), minorities could trade off descriptive and substantive representation if they so desired.[4]

How can one identify expected gains (or losses) in substantive representation from a given redistricting plan? This article offers one approach to answering this question, an approach based on representatives' voting patterns: a redistricting plan increases substantive representation if it is expected to produce more votes in favor of minority-supported legislation. We show how to calculate the expected racial and partisan characteristics of a legislature for a given districting plan and how many votes the plan is likely to produce in favor of minority-supported legislation.

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2. Technically, it is not the number of minorities *per se* elected that matters but rather "candidates of choice of the minority community," who could be of any race. These usually amount to the same thing, and we will generally drop the distinction in our further discussion; nonetheless, the caveat is an important one.

3. *Georgia v. Ashcroft*, 123 S.Ct. 2498 (2003).

4. The *Ashcroft* decision was somewhat modified by the recent legislation to renew the VRA, which states that "The purpose of [the Section 5 preclearance standard] is to protect the ability of [minority] citizens to elect their preferred candidates of choice." However, this requirement has been interpreted to mean that the number of districts in which minorities have an equal opportunity of electing a candidate of choice cannot decline; within these boundaries, though, issues of substantive representation still remain. As Theodore Shaw, Director-Counsel of the National Association for the Advancement of Colored People Legal Defense and Educational Fund, stated, "It is my view that the proposed legislation does not overturn the *Georgia v. Ashcroft* ruling in its entirety. Rather, the legislation would restore, as a minimum standard, the more readily verifiable and tangible "ability to elect" principle that has long been the fundamental feature of §5 analysis, although leaving open, for further consideration, the additional aspects of participation in the political process catalogued in the *Georgia v. Ashcroft* opinion. (Shaw's testimony is available at http://www.naacpldf.org.)

We then provide an example of our method, analyzing the changes that took place in the South Carolina State Senate after the 1992 redistricting. This redistricting sought to increase the number of minorities elected to office, which it in fact did, but, we argue, at the cost of creating an environment more hostile to passing minority-supported legislation. We show that the expected negative impact could have been predicted from comparing the new districting plan to its predecessor, and that the new legislature was more fractured, more polarized, and less friendly to minority concerns than prior to redistricting.

The policy impact of racial redistricting has been addressed previously, mainly in the context of partisan impacts. The first and most influential of such studies was Brace et al. (1987), which showed that over-gerrymandering racial minorities was linked with the election of more Republicans to office. Later studies—including Hill (1995), Lublin (1997), Lublin and Voss (1998), and Karlan (2000)—investigate the possibility that the increase in majority-minority districts in the 1990s was at least partially responsible for the Republican takeover of the House following the 1994 elections. Cameron et al. (1996) and Epstein and O'Halloran (2006) investigate optimal gerrymanders to maximize minorities' substantive representation, showing that they are now generally different from those that maximize descriptive representation. And, Canon (1999) examines substantive representation from yet another angle: legislators' support for minority-sponsored legislation behind the scenes, through cosponsorship networks. We build on these prior studies by offering a systematic method for evaluating the expected impact of a proposed redistricting scheme on the votes in favor of minority-supported legislation.

The following section outlines our theoretical approach to voting, districting, and representation, and the next section describes our technique for measuring substantive representation. We then apply this technique to the South Carolina State Senate, examine pre- and post-redistricting outcomes, and consider several extensions. The final section concludes.

## 2. Theory: Redistricting and Policy Outcomes

The impact of districting on legislative policy outcomes is a two-step process. First, each district elects a representative to a legislature. Second, the set of legislators collectively produce policy. Each of the relationships implicit here—between districts and representatives and between representatives and policy—is complex in its own right. Putting them together is more complicated still. The purpose of the present section is to unpack the relationships and offer some general statements about when redistricting *can* influence policy and the conditions under which it moves policy in a direction favored by minority voters.

### 2.1 Complete Polarization

Consider the situation depicted in Figure 1(a), where the darkened circles represent voters from the majority group, the triangles represent minority voters,
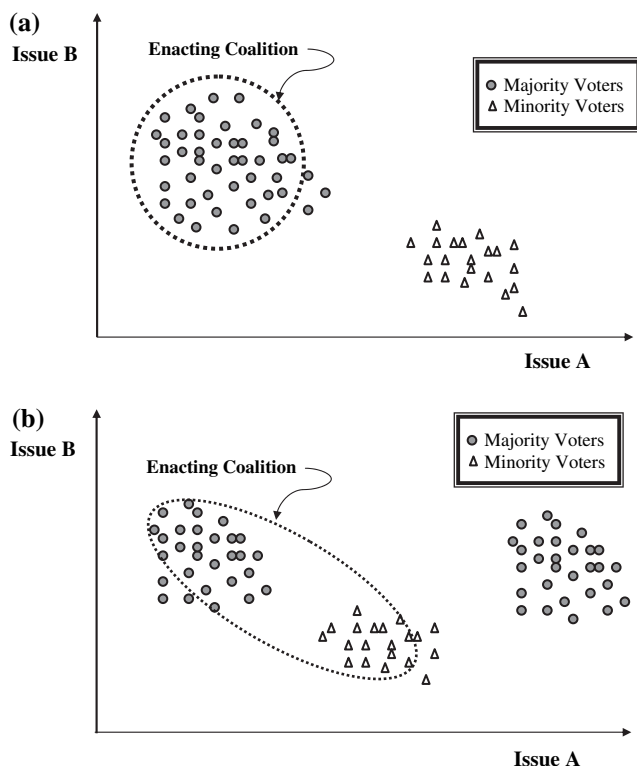
Figure 1. Alternative Scenarios for the Role of Minorities in Passing Policy: a, Bloc voting unresponsiveness to minority concerns; b, Minority voters as swing voters.

and there are two policy dimensions, A and B.[5] Issue A, for example, might represent the degree of redistribution in a tax system, whereas issue B might be the strength of civil rights laws. Assume, as shown in the figure, that the distribution of voter preferences or ideal points yields fairly homogeneous majority and minority groups who oppose each other on both issue dimensions. Further assume that legislators are elected from equally populated districts and compete for office by adopting the policy positions most preferred by their constituents. Thus, legislators' ideal points will be the dimension-by-dimension median ideal point of their constituents.

When voter preferences are polarized as in Figure 1(a), it is clear that, as long as a districting plan gives the majority group over half of the seats in the legislature,

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5. We assume here and in the remainder of the article that the minority group in question is the black community. Most of the analysis would be identical for other minority groups, such as Hispanics, but these cases present other important issues—such as lower registration rates and policy divisions within the minority community—not treated here.

the majority will be able to enact its preferred policy in both dimensions over the wishes of the minority.[6] A redistricting plan might increase the number of seats that the minority group controls in the legislature, thus boosting descriptive representation, but these representatives will then simply be outvoted in the chamber.[7]

A similar figure, in fact, can represent any policy space in which two citizen groups are polarized and vote cohesively on all issues: one could simply draw a line between the ideal points of the majority and the minority groups to yield the same, essentially one-dimensional, picture. Figure 1(a) thus represents the position of most Blacks in local Southern politics since Reconstruction, where the white majority consistently opposed the black minority on issues of public policy. In this situation, racial redistricting alone cannot secure minority voters any say over final policy outcomes.[8]

## 2.2 Incomplete Polarization

Thus, the idea that redistricting can affect policy necessarily presupposes some division within the majority community. Consider, then, Figure 1(b), where the majority finds itself split over issue A. If the split within the majority faction is large enough, then minority voters might become attractive coalition partners for one of the majority groups. In these circumstances, an electoral coalition may look something like the oval indicated in the figure, with one of the majority factions and the minority group trading-off policy concerns across the two dimensions. Figure 1(b), then, illustrates the position of Blacks as key swing voters in national politics from the late 1950s to the mid-60s, the era in which Democrats and Republicans vied for the black vote and vast strides were made on social issues important to minorities, such as voting rights, housing, and public transportation.

There are two strategies that minorities might employ to build and exploit such coalitions. The first emphasizes electing as many minority representatives as possible, thus ensuring a core of legislators heavily dedicated to minority concerns. These legislators can then bargain with representatives from other factions—say, White Democrats—in the legislature to produce policy outcomes favorable on some issues to their minority constituents.

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6. Given perfectly homogeneous minority and majority populations that are proportions $p \in \left[0, \frac{1}{2}\right)$ and $1 - p$ of the total population, respectively, a districting scheme can result in the minority's controlling anywhere from 0 to $2p$ of the seats in the legislature, so that a cohesive minority comprising only 25% of the overall population could theoretically control a majority of the legislature. As a rule, though, districting tends to diminish minorities' influence rather than increase it: the "cube law" states that on average the ratio of seats won by minority-backed candidates as opposed to majority-backed candidates will be only $\left(\frac{p}{1-p}\right)^3$, which is less than $p$. See Rae (1967) and Taagepera and Shugart (1989) for further discussion.

7. The example contained within Figure 1(a) may seem trivial, but some of the legal literature associated with voting rights assumes both that majority and minority preferences are completely polarized *and* that districting can help ameliorate problems of substantive representation. For a typical exposition in this genre see Ely (1997). For an overview of the voting rights case law see Issacharoff et al. (2002), and for a more nuanced discussion of polarization see Grofman et al. (1992).

8. This realization was one of the motivating forces leading Guinier (1995) to suggest not just alternative majoritarian voting systems, like cumulative voting, but some nonmajoritarian ones as well, including concurrent majorities.

On the other hand, it may be more effective to spread out black voters and have less influence over more districts. This shifts the weight of the coalition-building exercise to the electoral stage; minorities become part of the electoral coalition of a major party, in hopes that its representatives will include some pro-minority policies in its platform.

## 2.3 Measuring Substantive Representation

We thus have two alternative strategies for coalition building: one emphasizes legislative coalitions, whereas the other is more electorally based. In the first, electing as many minority candidates as possible is the key to building policy leverage, whereas in the second, fewer minorities may obtain office as minority voters are spread out in what are termed "influence districts." Ultimately, the relative effectiveness of these two strategies will depend on whether it is easier to logroll electorally or in the legislature.

Regardless, one can measure the success of a districting strategy from the minority voter perspective by calculating the extent to which votes cast by legislators are in the pro-minority direction. That is, both strategies noted above have the same end goal of producing legislative coalitions that pass minority-supported legislation. This standard for success is appropriate, we argue, not because one assumes that minority legislators vote only for bills that are in exact accordance with their constituents' desires, but rather because they presumably that they rationally trade off support for some bills that they marginally favor for support of other bills that more directly address key concerns. In contrast, fewer votes in support of the minority position may indicate that these legislators are being isolated and hence less influential over policy outcomes.

## 3. Data and Estimation

This section motivates our use of the South Carolina redistricting that took place after the 1990 census. We then explain the two methods that we use to study the effect of this redistricting on minority representation.

## 3.1 Background on the South Carolina State Senate

The South Carolina Senate redistricting of 1992 is a convenient case for analysis minority substantive representation: the entire state falls under the pre-clearance provisions of the VRA, and its minority voting population is composed almost entirely of Blacks, thus avoiding the complexities that arise when more than one minority group is classified as a community of interest. Furthermore, the final redistricting plan adopted for the Senate was expressly designed to increase the number of minority officeholders; notably, this plan was implemented after the Justice Department rejected an earlier redistricting plan on the grounds that it did not create sufficient numbers of majority-minority districts.[9] Finally, a state-level redistricting plan will gerrymander

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9. See *Smith v. Beasley*, 946 F.Supp. 1174 (1996), for a history of South Carolina legislative redistricting in the 1990s.
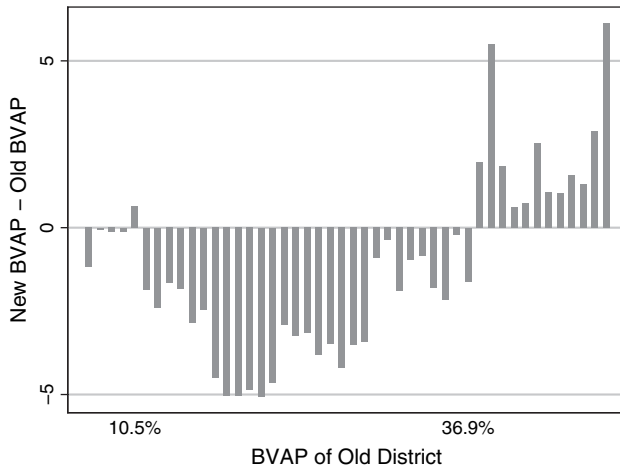
Figure 2. Change in BVAP from Old to New Plan.

an entire legislature at once; consequently, we can directly assess the impact of the plan on the overall composition of that legislature.

According to the 1990 census, 29.82% of South Carolina's total population and 26.93% of its voting-age population were black. The State Senate had 46 seats, and in the regular election cycle all senators were reelected every 4 years with no staggered terms. Between 1988 and 1994, there were 97 elections to the Senate. Of these, 46 occurred in each of the regular election cycles in 1988 and 1992, and five were special elections called to fill vacancies.

Republican candidates won 28 of the 97 elections and Democrats, 69. Of the Democratic victors, 56 were nonminority candidates and 13 were minorities; Blacks were thus elected to office in 13.4% of all elections. Twenty elections were held in majority-black districts; of these, minority candidates were elected in 11 and nonminorities in 9. In addition, there were two elections in which a minority candidate won in a district that was less than majority-minority. Minorities were elected to the Senate from districts as low as 47.7% BVAP, and districts as high as 59.9% BVAP elected nonminority senators to office.

As of the 1990 census, nine of the 46 senatorial districts contained a majority of black residents in their voting-age populations. The redistricting plan adopted in 1992, though, raised that number to 11 districts, some of which had contorted, irregular shapes.[10] The strategy behind the redistricting is illustrated in Figure 2 that arranges the districts in the old and new plans in order of increasing BVAP and shows the difference between them. The figure clearly indicates that the redistricting took black voters out of moderate BVAP districts—those with BVAPs between 10.5% and 36.9%—and reallocated them to districts with more

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10. In fact, their bizarre shapes led the federal courts to strike down Districts 29 and 37 as unconstitutional racial gerrymanders. See *Smith v. Beasley*, cited above.

black voters. This would make it easier to elect minority representatives to office but would also increase the probability of electing Republicans elsewhere.

In fact, this is exactly what happened. The elections of 1992 saw the number of blacks elected to the South Carolina Senate rise from five to seven, but it also witnessed the number of Republicans increase from 11 to 16. Before the 1992 elections, White Democrats held 30 out of 46 seats and thus commanded an absolute majority; after the elections, this number fell to 23, a bare non-majority. The purpose of the analysis here is to estimate the impact that these changes had on the substantive representation of black interests.

## 3.2 Estimating Legislator Preferences

The figures reviewed above suggest that the increase in black descriptive representation after the redistricting may have been offset by a jump in the number of Republicans elected to the chamber. To assess the net impact of these potentially opposing changes on substantive representation, we examine two features of the pre-redistricting and post-redistricting South Caroline Senate: the degree to which legislators voted with the black majority on roll calls and the extent to which the Senate median voter moved either toward the pro-minority side of the political spectrum or away from it. Broadly speaking, then, we study changes in senator preferences as a function of changes in districting maps. Our methodology is general in that it can be applied to any legislature that undergoes a redistricting process.

Social scientists have developed sophisticated methodologies in the past decade for inferring legislative preferences from roll-call voting patterns,[11] and resulting preference measures have subsequently been used in dozens of important studies. These measures are used not solely because they are assumed to capture the totality of legislators' actions; after all, constituency service, committee work, and behind-the-scenes maneuvering are key aspects of legislators' behaviors. Nonetheless, roll-call voting has been shown to be highly correlated with these others measures of representation in various contexts making it an appropriate summary measure of substantive representation. In particular, Canon (1999) shows that minority legislators do work harder behind the scenes to help further minorities' legislative agenda, but the differences between their efforts and those of other legislator types are approximately the same as the differences in roll-call voting records.

Our first perspective on South Carolina Senator voting patterns works as follows. First, we calculate for each roll call whether the majority of black representatives voted Aye or Nay. Then, we score each senator for each roll call, assigning him or her a score of one if he or she voted with the black majority and zero if against (abstentions are treated at random). Finally, we average resulting scores by district and year to produce what we term a legislator's Vote Score. This method is similar to that used by interest groups—such as Americans for Democratic Action (known popularly as the ADA), Committee

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11. See Poole and Rosenthal (1985), Bailey (2001), Martin and Quinn (2002), and Poole (2005).

on Political Education (COPE), and the Leadership Council on Civil Rights (LCCR)—in their rating scores. We can then compare average Vote Scores before and after redistricting to evaluate the impact of the districting change on black substantive representation.

The usefulness of Vote Scores applied to a hypothetical legislature depends on a number of conditions. First, the legislature must have sufficient numbers of minorities or nonminority candidates of choice to estimate adequately the minority-supported position on each roll call. Second, these legislators must vote cohesively. Third, voting in the legislature must be relatively contentious: if all or nearly all votes in a legislature were unanimous, for instance, comparative Vote Scores would be of little use.

Our second approach to estimating legislator preferences in the South Carolina Senate relies on modern Bayesian techniques. This approach, as we show below, produces standard errors for ideal point estimates, and these help determine whether Senate differences across time (pre-redistricting to post-redistricting) are statistically significant or not. Our Bayesian approach treats the South Carolina Senate as one large legislative chamber with $46 \times 2 = 92$ total legislators, one from each Senate district for the pre-redistricting and post-redistricting periods. The pre-redistricting district 1 senator is said to abstain in all post-redistricting roll call votes, and so forth for all districts. Similarly, the post-redistricting district 1 senator is said to abstain on all pre-redistricting roll call votes. Our allowing for differences between pre-redistricting and post-redistricting legislators means that legislator ideal points can change between these two periods, subject only to a few assumptions detailed below.

In particular, we employ Markov Chain Monte Carlo (MCMC) to ideal point estimation in the context of roll-call voting (e.g., Jackman 2000; Clinton and Meirowitz 2001; Jackman 2001; Clinton et al. 2004; Bafumi et al. 2005). We assume normal priors on unidimensional ideal points and normal priors on vote discrimination parameters.[12]

To identify our policy space, we assume that legislators from South Carolina Senate Districts 5, 7, 31, and 40 had the same ideal points before and after redistricting, that is, the pre-redistricting district 5 senator is assumed to have the same ideal point as the post-redistricting district 5 senator. This sort of identifying assumption is necessary so that we can compare pre-redistricting ideal points to post-redistricting ideal points. The four constant ideal point districts had minuscule BVAP changes pre-redistricting to post-redistricting, and they did not change senators either. To the extent that these legislators did actually change ideal points after redistricting, assuming that they did not probably makes our results conservative.

In addition, we constrain legislators with BVAP greater than 50% to have negative ideal points and legislators with BVAP less than 10% to have positive

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12. Our estimates were calculated using Andrew Martin and Kevin Quinn's MCMCpack library for the statistical package R; the particular function call we employed is MCMCirt1d. See http://mcmcpack.wustl.edu. Our MCMC sampler uses 1,000,000 burn-in draws followed by every 10th draw from a final set of 10,000 draws. The prior precision of ideal points is three and qualitatively similar results are produced when prior precision is one.

ideal points.[13] This imposes a natural left-right alignment on our estimated ideal points wherein politically left senators have low-valued ideal points and politically right senators high-valued ideal points. Finally, four very high BVAP districts (pre-redistricting district 42 and post-redistricting districts 19, 36, and 42) had legislators' voting records so extreme that we were unable to estimate their ideal points accurately. We dropped these legislators from our Bayesian analysis. As we show later, our main results on changes in the South Carolina Senate are robust to these omissions.

Note that our assertion that legislator ideal points are best measured in a one-dimensional policy space is not necessarily inconsistent with our earlier description of a multidimensional policy space within which trade-offs occur across different legislator groups. Indeed, it has been long recognized that the actual space in which policy resides is not necessarily the same space that ideal point estimates will identify (e.g., Snyder 1992). In our case, we can imagine three general types of roll calls: those in which all groups are in agreement (universal logrolls), those in which all Democrats vote in one direction and Republicans in the other (partisan logrolls), and those where minority legislators cast votes different from all other legislators (minority-supported issues that fail to gain overall legislative support). In this sense, our unidimensional estimates will capture the extent to which legislators fall on such a pro-minority line.

In practice, our two methods of estimating legislator preferences—Vote Scores and Bayesian ideal point estimates—should yield similar results. We calculated both these statistics using all roll calls cast in the Senate between 1990 and 1994.[14] As shown in Figure 3, there was indeed a high correlation between the two measures (to be precise, it was $-0.96$ and the negative sign of this quantity reflects the fact that large ideal point estimates are aligned so that they reflect anti-minority preferences). This serves as a consistency check in our estimates.

## 3.3 Assessing Changes in Substantive Representation

We can use our two approaches to the study of legislator preferences to understand whether a redistricting policy led to more or less substantive representation for black South Carolinians, as follows. First, we use univariate-ordered probit analysis to calculate the probability of different types of

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13. Accordingly, pre-redistricting districts 19, 21, 30, 32, 36, 39, and 45 and post-redistricting districts 17, 21, 30, 32, 39, and 45 are constrained to have negative ideal points. Similarly, pre-redistricting districts 1, 2, 6, and 23 and post-redistricting districts 1, 2, 6, 8, 23, and 33 are constrained to have positive ideal points. Among the four constant ideal point districts, district 5 is constrained to have a negative ideal point and district 40 a positive ideal point.

14. A total of 903 votes cast in the Senate between 1990 and 1994 were analyzed through the recorded votes listed in the index of the *South Carolina Senate Journal*. All recorded votes associated with a roll call were included as were all votes over substantive policy matters not contained in the index, for example, veto overrides. Of these, 364 votes were unanimous, leaving 539 for the statistical analysis.
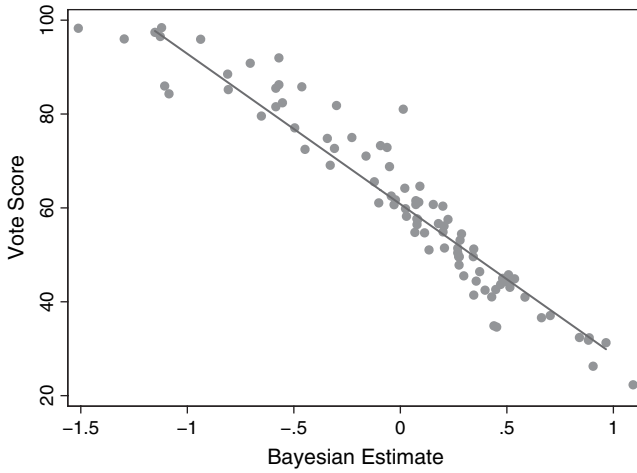
Figure 3. Bayesian Ideal Point Estimates versus Vote Scores.

legislators being elected for a given BVAP. For $K$ different types of legislators, we have

$$\Phi^{-1}\left(\sum_{i=1}^{k} p_i\right) = \alpha_k + \beta \times \text{BVAP}, \tag{1}$$

where $\Phi(\cdot)$ is the cumulative standard normal distribution and $k = 1, \ldots, K$. We divide legislators into three types: Republicans, White Democrats, and Black Democrats, and so we use equation (1) to estimate the probability that each type is elected for a given level of BVAP.

We then calculate the expected voting behavior of a given type of representative based on the BVAP in her district:

$$E(\text{VS}) = \text{VS}(\text{BVAP}, \theta), \tag{2}$$

where VS is a legislator's Vote Score and $\theta$ is the type of representative. To diminish the impact of outliers, it is appropriate to use robust linear regression techniques for this step, after which one can compare the estimated relationship to a nonparametric lowess curve to check for structural breaks or other nonlinearities.

Finally, we calculate the expected Vote Score in a new legislature as

$$E(\text{VS} \mid \text{BVAP}) = \sum_{\theta} \text{Prob}(\theta \mid \text{BVAP}) \times E(\text{VS} \mid \text{BVAP}, \theta). \tag{3}$$

That is, the expected Vote Score for a district with a given level of BVAP combines the probability that each type of representative will be elected, given the district BVAP, and their subsequent expected voting patterns, given both BVAP and their type. Calculating equation (3) for each district in a proposed

redistricting plan gives the expected profile of the new legislature. The new median can then be compared to that of the existing legislature to check for expected increases or decreases in substantive representation.

To evaluate the effect of redistricting on substantive representation using our Bayesian ideal point estimates we focus primarily on chamber medians. In particular, our MCMC sampler produces 1000 simulated South Caroline Senates where, as we noted earlier, a single such Senate includes pre-redistricting and post-redistricting legislators linked by four Senate districts that are assumed to have constant ideal points in the pre-redistricting and post-redistricting periods. For each simulated Senate, we calculate the difference between post-redistricting and pre-redistricting median ideal points, and this gives us 1000 median differences. We can then perform inference on median differences by examining the tails of the distribution of these differences and in particular seeing if most of the distribution of our differences lies above or below zero.

Our 10,000 simulated legislators also produce estimates of individual legislator ideal points. We can compare these to district BVAP levels to see how the relationship between BVAP and preferences changed after the 1992 redistricting policy was implemented. We can also consult distributions of ideal points to consider whether legislative polarization changed after redistricting.

## 4. Results

We now use estimated legislator preferences, derived via Vote Scores and Bayesian methods, to examine the impact of the 1992 redistricting plan on the South Carolina Senate. We first discuss the extent to which the overall composition of the Senate was affected by the redistricting. We then determine how well the methods described in the previous section could have anticipated these changes. Finally, we analyze the impact of the redistricting on polarization within the Senate and on the composition of winning legislative coalitions.

### 4.1 Changes in Aggregate Preferences

Figure 4 displays histograms of Vote Scores before and after redistricting. As shown, and consistent with the redistricting strategy illustrated earlier in Figure 2, there are more legislators at the extremes of the distribution post-redistricting and fewer in the middle.

In particular, the average Vote Score dropped after redistricting from 63.5 to 61.2, a modest fall of 3.8%. The median Vote Score fell from 60.7 to 55.5, or 9.4%. Of these two, the former indicates the expected percentage of legislators who would vote with the minority on roll calls, whereas the latter gives the position of the key swing voter in the legislature, since it is only by generating a majority of votes that legislation can pass. If we recalculate Vote Scores using only those votes on which black legislators were unanimous (either for or against), the pattern is even more pronounced: a drop in mean from 65.6 to 60.1 and a drop in median from 61.2 to 54.9.
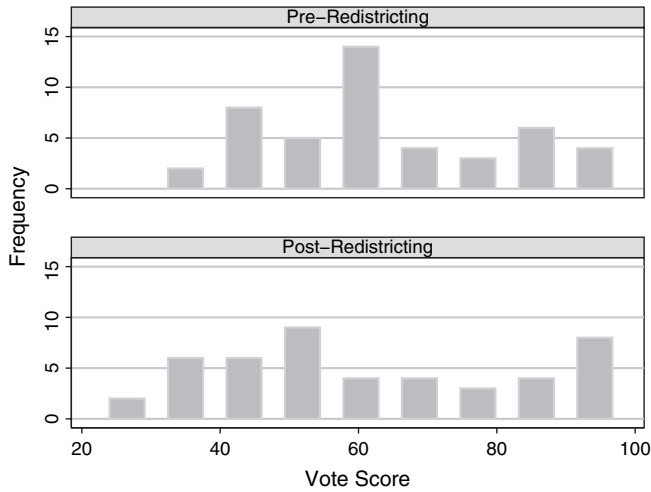
Figure 4. Histograms of Vote Score Distributions, before and after Redistricting.

Turning now to our Bayesian ideal point estimates, across 1000 simulated legislatures the average pre-redistricting to post-redistricting change in chamber medians was 0.16, where the average pre-redistricting was 0.04 and the post-redistricting was 0.20. That is, according to our ideal point estimates, the Senate median moved in a politically right direction after redistricting. Moreover, this change is statistically significant at the 0.05 level. To see this, we considered the 0.025 tail of a histogram of median differences, and the left tail was 0.061, that is, above zero. The standard deviation of our 1000 median differences was 0.051, and this translates to a *t*-statistic of approximately 3.14. Figure 5 graphs estimated ideal points before and after redistricting along with chamber medians in each period.

Recall that we dropped four high BVAP districts from our Bayesian analysis due to extreme roll-call voting records in these places. In light of this, suppose that we append one extremely left-leaning legislator to our pre-redistricting ideal points and three extremely left-leaning legislators to post-redistricting ideal points. This will move chamber medians in a leftward direction, but its effect on pre-redistricting to post-redistricting median differences is prima facie ambiguous. Based on our augmented chamber, though, we recomputed chamber medians and pre-redistricting to post-redistricting median differences, and we find that our primary conclusion, that the South Carolina Senate moved rightward after redistricting, does not change.

What drove the aggregate preference change in the Senate? Did legislators of different types act differently in the post-redistricting legislature compared to how they behaved earlier? We investigated this question from a number of different angles. Figure 6 shows box plots of each type of senator, before and after redistricting, with little variation at all. Moreover, Figure 7 shows linear regressions of Vote Score and Bayesian ideal point estimates on BVAP before (pre) and
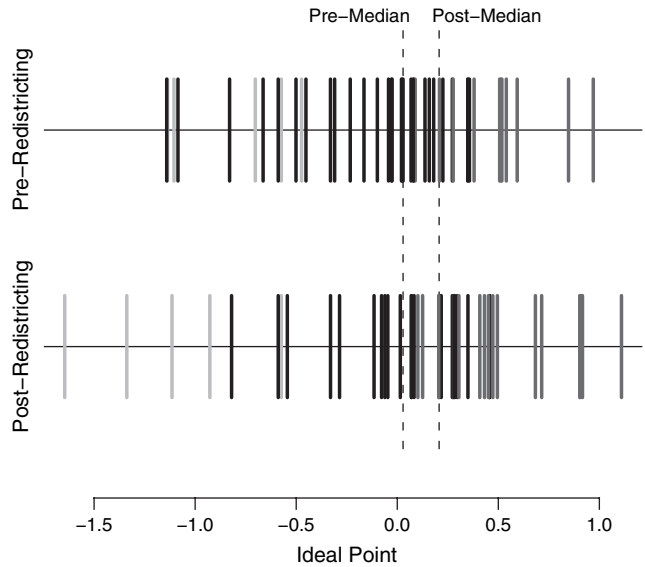
Figure 5. Estimated Ideal Points of Legislators before and after Redistricting. Gray lines denote the locations of Republican Senators; dark lines are for White Democrats; and alight lines are for Black Democrats.

after (post) redistricting. The only notable features of this graph are the slightly higher Republican ideal points after redistricting and the steeper pre-redistricting Black Democrat curves, although the small number of observations makes this latter result less compelling. Finally, we regressed Vote Score on legislators' race and party, the BVAP in the district, and pre- or post-redistricting. As Table 1 shows, only the redistricting variable was insignificant.
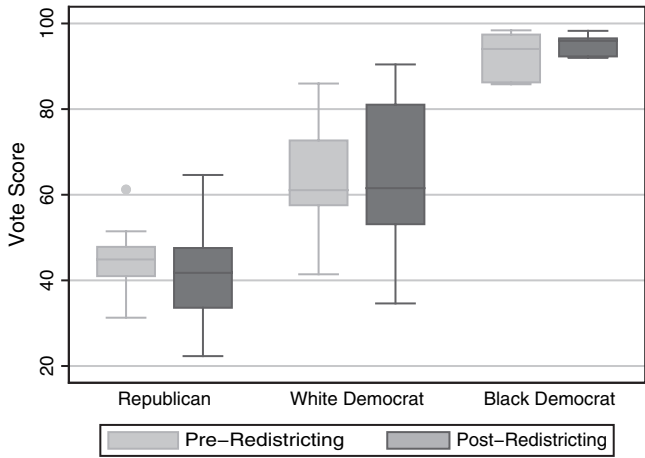


Figure 6. Box Plots of Vote Scores, by Type of Representative, before and after Redistricting.
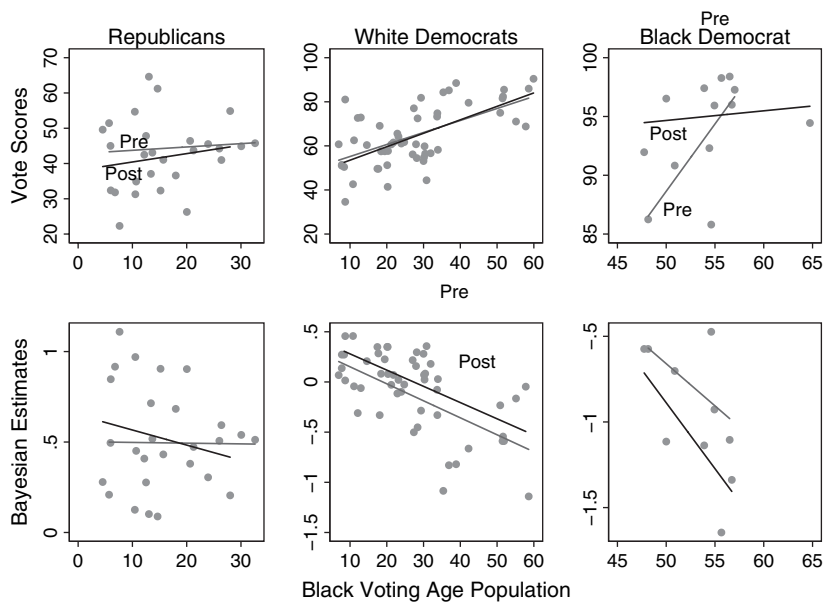
Figure 7. Relation between BVAP and Voting Patterns, by Type, before and after Redistricting.

From these results, we conclude that the difference in the pre- and post-redistricting Senates did not lie in changing behaviors of any particular type of representative. Rather, it must have come from changes in the overall composition of the legislature. A quick look at the numbers in Table 2 confirms this.

As shown in panel (a) of the table, Republicans had an average Vote Score roughly 20 points below the mean, whereas Black Democrats were 30 points above the mean. Thus, a redistricting plan that had a 3-to-2 trade-off—that is,

Table 1. Vote Score Regression Results

| Variable | Coefficient (SE) |
|---|---|
| Pre-redistricting | 0.317 |
| | (2.110) |
| Black | 15.515** |
| | (3.906) |
| Democrat | 15.656** |
| | (2.622) |
| BVAP | 0.522** |
| | (0.089) |
| Intercept | 34.326** |
| | (2.524) |
| $n$ | 92 |
| $R^2$ | 0.757 |
| $F_{4,87}$ | 67.618 |

Note ** = 0.05 significance level.

Table 2.  Average Vote Scores and Ideal Points By Senator Type

| Time Period | Republican | White Democrat | Black Democrat | Total |
|---|---|---|---|---|
| (a) Vote scores | | | | |
|   Pre-redistricting | 44.500 | 64.700 | 92.700 | 63.500 |
|   Post-redistricting | 41.400 | 64.600 | 95.100 | 61.200 |
| (b) Ideal points | | | | |
|   Pre-redistricting | 0.495 | −0.144 | −0.798 | −0.060 |
|   Post-redistricting | 0.532 | 0.009 | −1.120 | 0.072 |

resulted in the election of three extra Republicans for every two extra Black Democrats—would leave the overall chamber average unchanged. As mentioned above, though, the price of two new Black Democrats in 1992 was six new Republicans, and this lowered the expected Vote Score for legislature as a whole. Panel (b) of Table 2 has similar implications using ideal points from our Bayesian analysis.

### 4.2 Predicting Changes in Substantive Representation

To see how well our methodology would have predicted these changes in legislators' ideal points, we must first estimate the probabilities that different types of legislators are elected and the relation between a district's BVAP and its legislator's voting behavior, as in equations (1) and (2). The outcomes from these analyses are illustrated in Figure 8.

The left-hand panel shows the estimated probability of electing each type of representative at different levels of BVAP, based on elections prior to 1992. The results are intuitive: at first, Republicans (Rep) are the most likely to gain office, then White Democrats (WD), and finally Black Democrats (BD) at high levels of BVAP. The right-hand panel shows the relation between BVAP and Vote Scores for each type of representative, along with a lowess line. As illustrated, a robust linear fit works well in all cases. Qualitatively similar results are obtained if we use Bayesian ideal point estimates instead of Vote Scores.
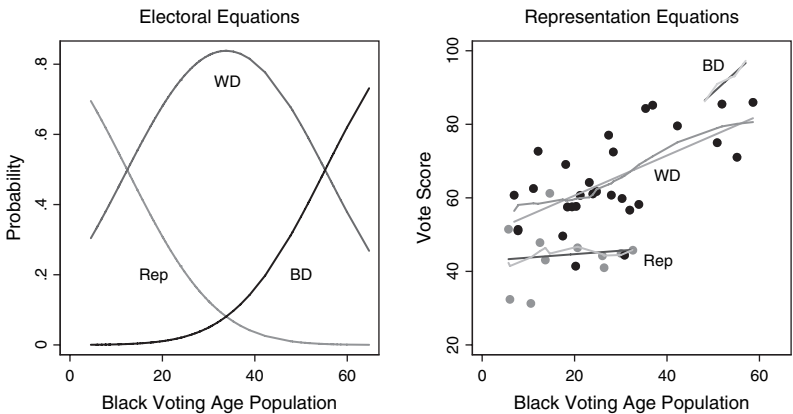


Figure 8. Representation and Electoral Equations.

Table 3. Hits and Misses, Predicting Type of Senator

| | Expected Type | | |
|---|---|---|---|
| Actual Type | Republican | White Democrat | Black Democrat |
| Republican | 7 | 9 | 0 |
| White Democrat | 4 | 17 | 2 |
| Black Democrat | 0 | 4 | 3 |

Table 4. Predicted and Actual Vote Scores by Senator Type

| | Mean Vote Score | |
|---|---|---|
| Type | Predicted | Actual |
| Republican | 52.6 | 41.4 |
| White Democrat | 64.9 | 64.6 |
| Black Democrat | 88.2 | 95.1 |

Using these estimates, what should the redistricting have produced? We apply equation (3) to the electoral and representation equations and derive expected Vote Scores for each new district. In the aggregate, the predictions matched reality quite well: the actual mean Vote Score was 61.2, as compared to a predicted value of 62.8, and the median was 55.5, as compared to a prediction of 57.3.

Digging a little deeper, consider errors in predicting the types of senators elected and the Vote Scores given legislator types. As Table 3 shows, the predicted election results were fairly accurate but with some variation due in large part to the number of districts with toss-up Republican/White Democrat or White Democrat/Black Democrat races.[15] In the end, these errors should more or less even out, so that the predicted and actual mean Vote Scores are close, as noted above.

Investigating further, we inspect predicted and actual Vote Scores in the post-redistricting Senate, given the actual type of senator elected. Table 4 shows that the Vote Scores for White Democrats were almost exactly as predicted. But the Republicans' scores were less than expected, whereas the Black Democrats had scores that were higher than expected. This indicates that, in the new legislature, Black Democrats voted even more cohesively than before, whereas Republicans voted in greater numbers against the positions taken by the minority representatives.

### 4.3 Polarization and Winning Coalitions

This serves as a good transition to examining the impact of the redistricting on polarization and voting patterns within the Senate. The theory we presented

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15. There were 12 races in which the probability of a Republican versus White Democrat was between 40% and 60%, and 7 races where the same held for White Democrat versus Black Democrat.

Table 5. Average Distance from Median Winning Coalition Ideal Point to Median Type Ideal Point, Pre- and Post-Redistricting

| Type | Average Distance | |
|---|---|---|
| | Pre-redistricting | Post-redistricting |
| Republican | 0.47 | 0.49 |
| White Democrat | 0.13 | 0.15 |
| Black Democrat | 0.74 | 1.09 |

earlier posits that Vote Scores serve as a good proxy for the extent to which other legislators will support Black Democrats on roll calls. Since Vote Scores fell post-redistricting, we would predict an overall less favorable environment for minority legislators in their attempts to form coalitions to pass legislation.

Our first result on polarization, from Table 4, shows some indications that Republicans and Black Democrats were more in opposition to each other after redistricting. Indeed, the average BVAP in White and Black Democrats' districts rose slightly, whereas in Republican districts it fell from 18.1% to 14.2%. On average, then, Republicans had fewer black constituents to represent. Overall polarization in the legislature increased as well, with the distance between the median Republican and Black Democrat ideal points rising from 1.21 units pre-redistricting to 1.58 afterward. Voting patterns also polarized; the correlation between Black Democrat and Republican votes fell from −0.16 to −0.33 in the post-redistricting Senate.

Did this polarization lead, in the end, to policies less favored by minority constituents? Measuring policy outcomes is always difficult, but one indication is the composition of winning coalitions. Table 5 shows average distances from median ideal points among members of winning coalitions on roll calls to median ideal points of each legislator type. As the table indicates, outcomes were the same distance from the Republican and White Democrat ideal points and further from Black Democrats.

Finally, regarding actual policy outcomes, strong evidence suggests that the situation worsened from minorities' point of view. Senator Darrell Jackson, for instance, testifying about the impact of the redistricting before the US District Court in *Smith v. Beasley*, said "It's about more than just the license plates," meaning that he, like many other African-American legislators, ran for public office for more than just the free parking that came with the job. Even though a historic number of African-Americans had been elected to the South Carolina General Assembly, he testified, their ability to enact legislation seemed to have diminished as they found themselves outvoted time and again by an unsympathetic coalition of Republicans and White Democrats. He noted that the black community had suffered a number of policy defeats on important issues, including the state flag, a Civil War memorial to black soldiers, and school funding. In the end, he admitted, the same districting plans that promoted the election of minorities to office had also resulted in the election of more conservative representatives in surrounding areas.

## 5. Conclusion

This article presented two theoretically motivated measures of substantive representation in a study of minority legislators in a hypothetical legislature. We detailed how our measures can be calculated from a record of legislators' roll call votes, and how that can be used to project the expected change in substantive representation from a proposed redistricting scheme.

We then applied our technique to the South Carolina Senate and showed that black substantive representation fell after the 1992 redistricting. Moreover, this change could have been predicted from the previously available data, and it resulted in a more polarized Senate, less friendly overall to minority policy concerns. This is a notable result because it conflicts with the fact that, after the 1992 redistricting, there were more black members of the South Carolina Senate than before. Our results thus highlight a noncomplementary aspect of descriptive and substantive minority representation.

We hasten to add that our results do not imply that the 1992 redistricting plan should have been disallowed on the grounds of its decreases black substantive representation. Indeed, minority voters may well choose a plan that trades off less substantive for more descriptive representation without violating any legal norms[16] The important point, though, is that the *Georgia v. Ashcroft* decision gives them the opportunity to do the opposite as well, to agree to fewer minority representatives but greater overall influence on policy. The techniques presented here thus provide a possible yardstick for measuring when a proposed plan will be expected to meet this objective and raise minority substantive representation.

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16. The 1992 plan was overturned not on these grounds, but because its numerous bizarrely shaped districts ran afoul of the *Shaw v. Reno* standard. (*Shaw v. Reno*, 509 U.S. 630 (1993).)

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