

# Heterogeneity and Representation Reconsidered: A Replication and Extension

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This paper replicates and extends the article “Heterogeneity and Representation: The Senate and Free Trade” which appeared in the *American Journal of Political Science* (42: 524-544) in which Michael Bailey and David W. Brady argue that legislative representation is dyadic. Constituency matters in homogeneous states but is less important in heterogeneous ones. The implication is that scholars who fail to disaggregate states by heterogeneity conflate the two distinct types of representation that occur and reach conflicting results. We replicate the authors’ statistical analysis and confirm their results. However, disaggregating the votes used as the dependent variable shows important differences. While the results for homogeneous states remain the same, the results for heterogeneous states change. More specifically, constituency influence varies across votes. We suggest that the limited finding for dyadic representation only in homogeneous states is premature. The results seem as likely to stem from measurement problems as from differences in the representation process. The authors’ conclusions are likely understated. The real impact of accounting for heterogeneity is probably even larger than the authors suggest.

## 1 Introduction

An understanding of the manner in which elected representatives reflect constituents’ preferences is central in evaluating to democracy efficiency. In an important article, Bailey and Brady (1998) suggest that constituent influence on trade issues varies depending on the heterogeneity of a legislator’s constituency.<sup>1</sup> Specifically, the authors find that in homogeneous states constituency self-interest variables drive senatorial behavior. Homogeneous states produce less diverse constituency cues and, hence, clearer signals to their representatives. In these states, senators vote in agreement with the dominant constituency cue. However, the authors find a less clear role for constituency in heterogeneous states. In heterogeneous constituencies, senators are more likely to be given conflicting cues. Since a senator cannot simultaneously vote in accordance with conflicting cues, they are more likely to vote on the basis of their own ideology. Bailey and Brady conclude that dyadic representation occurs-- constituents in homogeneous districts receive representation, constituents in heterogeneous districts who do not share the legislator’s ideology, are less well represented.<sup>2</sup>

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<sup>1</sup> We thank Michael Bailey for both his data and his exceedingly helpful comments. We would also like to thank David Karol, and Vince Hutchings for their comments on this paper.

<sup>2</sup> The term dyadic representation refers to the idea that legislators directly represent the preferences of their states and districts (e.g. Weissberg 1978, Hurley 1982). However, one implication of Bailey and Brady’s results is dyadic in that it occurs directly in homogeneous states and indirectly in heterogeneous ones. In this paper, we rely exclusively on the former description.

In this paper we replicate the authors statistical analysis and confirm their results. However, the authors' findings depend on their aggregation of individual trade votes into indices. Disaggregating the votes used as the dependent variables show important differences. We argue that the finding that constituency influence is less important in heterogeneous constituencies results partly from vote aggregation. When the votes are disaggregated, constituency variables are more important in heterogeneous constituencies than the authors analysis suggests. Consequently, a finding for dyadic representation only in homogeneous states, a direct implication of Bailey and Bradys' statistical results is premature. Indeed, the authors' conclusions are likely understated.

This replication proceeds as follows: first, we summarize Bailey and Bradys' methods and conclusions. Then we replicate their statistical results and identify a potential problem with their dependent variable. Extending these results, we show that their findings may depend on the construction of their dependent variables. We conclude that since there is no theoretical justification for the operationalization of their dependent variable, their findings are premature.

## **2 Heterogeneity and Representation Reviewed**

Examining why constituency variables are typically insignificant in roll call voting studies, Bailey and Brady (1998) fill an important void in the congressional voting literature. Bailey and Brady suggest the reason is that constituency effects are easier to determine in some situations than others. Specifically, they suggest that constituency effects are easier to discern as opinion within the legislator's re-election constituency becomes unified. Thus, as the number of conflicting cues within the legislator's re-election constituency increases, it becomes difficult to discern the impact of constituency. To test this expectation, Bailey and Brady use Senate votes on international trade: the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT). They form an index of support for both NAFTA and GATT (i.e., the two votes on NAFTA form one index while the three votes on GATT form a second index). Since these issues received great publicity and there are state-wide variables that reflect the probable impact of trade on constituencies that are likely part of a senator's re-election constituency, they offer a good opportunity to examine the impact of constituency on senatorial voting.

Bailey and Brady (1998) test the hypothesis that the impact of constituency on legislator behavior is easier to discern the more unified the legislator's re-election constituency, in two ways. First, since some constituencies are traditionally associated with certain political parties, one should expect a model that interacts the party specific constituency with party will find that the interactive effect matters. Bailey and Brady's results offer strong support for this hypothesis. While some constituency variables, as well as senator ideology and party are important in explaining both NAFTA and GATT votes, the addition of an interaction term between party and constituency (union strength and party affiliation) is significant in explaining GATT votes and close to significance on NAFTA votes. Additionally, the interactive model has better "fit" for both NAFTA and GATT than the corresponding additive model.

Bailey and Brady (1998) also test the impact of constituency on senatorial voting on trade issues by running separate analyses for homogeneous and heterogeneous states. Since greater constituency diversity is likely to result in less unified constituency cues, the impact of constituency should be easier to discern in homogeneous than heterogeneous states. This expectation is largely confirmed. Among constituency variables, only union strength is more significant in the heterogeneous model than the corresponding homogeneous model. Additionally, the greater significance of union strength in the heterogeneous model only occurs on NAFTA. For GATT, all constituency variables are more significant in the homogeneous model. For both NAFTA and GATT, most of the constituency

variables are not close to attaining significance in the more heterogeneous states. By contrast, in the heterogeneous models, senator ideology and party affiliation are more important than in the corresponding homogeneous model.

These results are very important for the legislative voting literature. They suggest that constituency variables will be significant when we account for the diverse groups to whom legislators appeal. Alternatively, constituency effects are likely to be ‘drowned out’ when we treat constituency monolithically.

We think it is important to replicate Bailey and Brady’s results since the impact of constituency can be quite nuanced. By using a theoretically driven interactive model and estimating the model over different levels of constituency disagreement, Bailey and Brady have greatly advanced legislative roll call analysis. However, by aggregating the votes that form the dependent variable, as opposed to estimating results for each individual vote, Bailey and Brady may lose an important opportunity to see how constituency influences legislator behavior. Even if this work confirms Bailey and Brady’s original results, we will be much more certain of their results.

### 3 The Replication

We began by obtaining the data from the authors. The authors ran their analysis using SST. Unfortunately, we were unable to use this software package. We ran our analysis using Stata 7.0. Based on our results, this difference was not meaningful, though it resulted in slightly different output than used by the authors. More specifically, the ordered probit output varies across software. While SST estimates a constant and fixes a cut point, Stata fixes the constant and estimates all cut points. Consequently, we were unable to validate the authors cut point and constant estimates.

However, given the striking similarity of the results we produce we doubt that these estimates are inaccurate. With only one exception, after accounting for rounding, we obtained virtually identical parameter estimates for all variables in each of authors’ models. Only once did a parameter estimate or z statistic meaningfully differ. The difference appears in the first table of the Bailey and Brady article (1998: 533) titled “Effects of Constituency Characteristics, Party and Ideology on Voting Patterns”. The dependent variable in the model is an index of votes on GATT.

**Table 1. Comparison of Reported and Replicated Ordered Probit Parameter Estimates.**

	Original	Replication
State Exports	80.64 (1.75)	80.74 (1.75)
Change in Imports	-668.94 (.59)	-69.20 (.60)
Employment in Non-Tradables	18.01 (2.72)	18.04 (2.72)
Percent Union	20.96 (2.95)	20.99 (2.96)
Democrat	1.57 (2.18)	1.58 (2.18)
Chamber of Commerce Rating	.04 (3.59)	.04 (3.59)
Constant	-18.00 (1.88)	
Threshold 1	.58 (5.79)	18.02 (2.89)
Threshold 2	.99 (8.26)	18.61 (2.98)
Threshold 3		19.02 (3.04)
Log Likelihood	-82.01	-82.01

Z statistics in parentheses.

Table 1, below, compares the authors' analysis to ours. The only meaningful difference is seen in the change in imports variable. They report a coefficient of  $-668.94$  while we obtain a result of  $-69.2$ . Our z statistic is virtually identical to theirs. Since our standard errors are approximately equal it appears this discrepancy is likely the product of a typographical error.

Overall, our results confirm those of the authors. In no case do the tiny differences between estimates alter any of the conclusions in the paper. Further, since the cut points and constant are relatively unimportant to the substantive analysis of the paper, we are not concerned with our inability to verify these results.

#### **4 Extension: The Perils of Roll Call Vote Aggregation**

Bailey and Brady (1998) examine two votes on the North American Free Trade Agreement (NAFTA): the vote on the main NAFTA trade bill and the vote on the NAFTA side agreements concerning labor and environmental protections (NSA). They combine both votes into one index scored as follows: 0 for voting "no" on both votes; "1" = voting "yes" on one vote and voting "no" on the other vote; ; and "2" for voting "yes" on both votes. They handle the three votes on the General Agreement on Trade and Tariffs (GATT) in the same manner. Since there are three votes on GATT (Fast Track Authorization – FTA, the Budget Waiver Vote – BW and the main GATT bill) scores range from 0 (voting "no" on all three) through 3 (voting "yes" on all three). Generally, votes are aggregated to increase their statistical power and reliability. Consequently, aggregated roll call vote indices should, statistically, be more powerful and reliable than single vote models. Additionally, Poole and Rosenthal's (1997) finding that almost all votes load on one dimension appears to further strengthen the case for aggregating votes.<sup>3</sup>

However, vote aggregation poses several potential problems for legislative analysis. First, legislators themselves do not make voting decisions in this way (Fenno 1973, Bianco 1994). Instead, legislators consider votes on an individual basis (Bianco 1994). The particular nuances of a legislator's decision may vary across votes. Attempts to determine the influence on the aggregate conflate the multiple influences on individual decisions.

Second, the aggregation of votes is problematic even on bills that are substantively quite similar. Specifically, there may be multiple ways of obtaining the same score on a scale of votes despite having very different preferences about the outcome or the passage of the bill. That is to say that legislators with very different preferences may appear as though they have the same ones. For example, the authors' aggregation of votes on NAFTA leads to the mistaken conclusion that Trent Lott (R-Mississippi) and Barbara Boxer (D-California) have identical trade preferences. In fact, these two rivals disagree even here. While they both score '1' on the index of NAFTA votes, they actually opposed each other on both the main NAFTA bill and the NSA.

Third, vote aggregation may affect the substantive conclusions we draw about representation. A growing field of research demonstrates that legislators appeal to subconstituencies (Fiorina 1974, Fenno 1978, Bishin 2000). The aggregation of votes may lead scholars to conflate the preferences of these distinct groups across issues. For instance, Barbara Boxer appealed to both environmentalists by voting in favor of the Side Agreements, and to unions by opposing the main bill. Conversely, Lott seemingly appealed to business interests on both votes by supporting NAFTA and opposing the side agreements. Estimates of the preferences of either subgroup are less likely to be significant predictors of the trade index under these conditions.

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<sup>3</sup> However, simply because roll call votes share an underlying ideological relationship does not mean that votes are either influenced solely by ideology or that the influences on all votes are the same. Indeed, if this were the case we would expect the authors to aggregate all legislation considered in the 103<sup>rd</sup> senate to maximize reliability and power. For a discussion of this and related issues, see Weissberg (1974).

In homogenous states this is less of a problem, as constituents' preferences do not vary (by definition).

Fourth, once we recognize a role for subconstituencies it becomes very difficult to theoretically justify construction of vote indices. In the NAFTA example, the side agreements legislation appears directly related to the same bill. However, even here, important differences between legislators emerge. Given such differences, vote aggregation seems almost capricious. Decisions about the inclusion and exclusions of votes form an index seem to be made on an ad hoc basis. Indeed, examination of the Republican party leadership web site identifies 27 trade votes that occurred in the 103<sup>rd</sup> senate. Without substantial investigation, there is little reason to justify the precise construction of these indices.<sup>4</sup>

If vote aggregation leads to mistaken inference, then we should observe differences in the substantive findings when the votes are disaggregated. More specifically, if vote aggregation is unimportant we expect to find that the influences on each of the individual votes are the same as on the aggregated votes. To investigate this proposition, we use the same independent variables and apply the classification of states as being either homogeneous or heterogeneous (Bailey and Brady 1998: 536). Table 2 shows the results of probit models run on each of the votes comprising the NAFTA index in both homogenous and heterogeneous states.<sup>5</sup>

**Table 2. Models of Senate Voting on NAFTA.**

	Homogeneous Models			Heterogeneous Models		
	Combined Model	NAFTA	NSA	Combined Model	NAFTA	NSA
Constant		-50.44* (-2.44)	-26.18* (-2.04)		6.59 (.51)	-17.00 (-1.17)
Average Exports	224.42** (2.94)	304.55* (2.55)	190.35* (2.29)	-62.38 (-.66)	-119.07 (-.946)	57.98 (.47)
Average Import Change	-323.81** (-2.31)	-354.69 (-2.02)	-331.71* (-2.05)	484.20 (1.35)	599.00 (1.15)	182.93 (.43)
Non-Tradeables	36.57** (2.64)	54.80* (2.33)	28.92* (2.00)	-2.88 (-.27)	-12.74 (-.95)	15.63 (1.07)
Union Percentage	37.31' (1.70)	20.13 (.75)	40.98' (1.78)	-47.26** (-2.88)	-32.55' (-1.74)	-44.15* (-2.06)
Party * Union	-46.01 (-1.51)	-59.51' (-1.69)	-2.75 (-.07)	17.64 (.99)	4.73 (.21)	15.89 (.62)
Democrat	1.91 (1.61)	2.58' (1.77)	.332 (.238)	2.95* (2.16)	3.14* (2.05)	3.50 (1.50)
Ideology	.012 (.85)	.023 (1.43)	.004 (.25)	.061** (3.38)	.067** (-3.04)	.052' (1.92.)
Threshold #1	33.81 (2.75)			.204 (.019)		
Threshold #2	34.51 (2.80)			1.72 (.16)		
Log likelihood	-37.62	-21.17	-22.21	-31.25	-18.04	-14.22
N	49	49	49	49	49	49

Z statistics in parentheses.  
'p<.10, \*p<.05, \*\* p<.01

As the results in Table 2 indicate, the combined models show results from the NAFTA vote index used by Bailey and Brady. The homogenous models are consistent with Bailey and Brady's results that show a large constituency role.

<sup>4</sup> This web site is found at <http://www.senate.gov/~rpc/rva/home>.

<sup>5</sup> The combined models replicate Bailey and Brady's ordered probit results. In addition models are run for each of the component votes of the scale used by Bailey and Brady. NAFTA refers to the main NAFTA bill which passed the Senate 61-38. NSA refers to the rejection of the Stevens Amendment (73-26) on the side agreements pertaining to NAFTA. Homogenous refers to the model run on states ranked below Maine (the 25 most homogenous) on the Sullivan diversity index. This is identical to the coding performed in Bailey and Brady. See Bailey and Brady (1998) footnote 8. Similarly, the heterogeneous models are run using data on the 25 states ranked most diverse on the Sullivan index.

However, examination of the heterogeneous models gives pause to Bailey and Brady's results.

On NAFTA, the combined model generates results consistent with the hypothesis of unclear constituent effect. Party and ideology clearly matter here, though there is an unexpected constituent effect as increased unionism is associated with support for free trade. However, analysis of the component votes suggests that the results are not uniform across votes. On the main NAFTA bill only party and ideology are significant. Percent union is not significant by conventional standards.<sup>6</sup> However the story is reversed on the Side Agreements vote. Contrary to expectations, percent union is the *only* variable that significantly influenced legislators.<sup>7</sup>

In Table 3 we see the estimates for GATT according to state diversity. Overall, GATT results are more consistent with the finding that constituency effects matter in homogeneous states but not in heterogeneous states. However, the results are not overwhelming.

**Table 3. Models of Voting on GATT.**

	Homogeneous Models				Heterogeneous Models			
	Combined Model	GATT	Budget Waiver	Fast Track	Combined Model	Budget Waiver	GATT	Fast Track
Constant		-54.74* (-2.19)	-119.09* (-2.40)	-149.94 (-1.63)		7.20 (.50)	12.38 (.80)	-51.51 (-1.53)
Average Exports	426.17** (3.20)	317.16* (2.29)	640.00* (2.35)	1046.4 5* (1.67)	-81.54 (-.80)	-115.81 (-.964)	-166.88 (-1.28)	99.87 (.47)
Average Import Change	-315.92* (-2.00)	-163.84 (-.99)	-342.45 (-1.34)	- 1482.8 6* (-1.93)	272.84 (.85)	300.05 (.78)	349.71 (.88)	533.11 (.48)
Non-Tradeables	85.24** (3.06)	62.31* (2.13)	133.19* (2.34)	157.82 (1.63)	-6.40 (-.48)	-13.82 (.91)	-18.06 (-1.09)	37.65 (1.28)
Union Percentage	94.64* (1.69)	47.63 (.98)	103.42 (1.61)	700.38 (1.19)	28.10 (.56)	18.54 (.46)	15.91 (.38)	56.11 (.27)
Party * Union	-118.25* (-2.01)	-54.85 (-1.05)	-160.31* (-2.37)	-751.80 (-1.24)	-16.34 (.32)	-5.55 (-.13)	-1.24 (-.02)	-49.10 (-.23)
Democrat	1.43 (1.09)	.152 (.11)	3.40* (1.91)	9.00 (1.32)	5.73** (3.23)	4.24* (2.30)	3.80* (2.09)	13.42* (1.82)
Ideology	.004 (.28)	.003 (.20)	.013 (.72)	.027 (1.00)	.090** (3.91)	.067** (2.68)	.061* (2.44)	.214* (2.18)
Threshold #1	74.62 (3.13)				.666 (.052)			
Threshold #2	75.52 (3.16)				1.35 (.107)			
Threshold #3	76.11 (3.18)				1.86 (.147)			
Log likelihood	-32.20	-18.59	-13.69	-6.63	-32.54	-18.31	-17.24	-6.82
N	46	49	49	46	49	50	50	49

Z statistics in parentheses.  

<sup>6</sup> Though it is significant using a one tailed test appropriate here due to our expectation that increased unionism ought to be associated with opposition to NAFTA.

<sup>7</sup> A disturbing result is that party is improperly signed (and often significant) throughout the analysis. Substantively this coefficient suggests that Democrats are more likely to support free trade. This most likely results from the regression inconsistency detailed by Herron (2001).

Among homogenous states, comparison of the GATT index and its component votes suggests that the results of the ordered probit do a poor job identifying the factors that influenced legislators on the individual votes. Two important observations stand out. First, the average import change variable is statistically significant in the GATT index, but is not significant in *any* of the three component votes.<sup>8</sup> A similar problem affects the party and union interaction term. Here, the variable is insignificant on the main GATT bill, and the Fast Track legislation, reaching significance only on the Budget Waiver, where the sign appears to be wrong.

Second, the GATT index poorly reflects its component bills in the homogenous model. The index most poorly reflects the Fast Track legislation, where none of the variables in the model attain statistical significance despite expectations. Despite these inconsistencies, in none of the individual votes is party or ideology a significant influence on legislators' behavior. Consequently the GATT results for homogenous states speak more to the inappropriateness of aggregating votes than they do to the degree of dyadic representation.

In contrast to the homogenous models, the heterogeneous GATT models are generally consistent with expectations. In this case, the aggregate model reflects the individual votes well. The party and ideology variables significant in the combined GATT model are also significant, or nearly so, in each of the three component votes. Examination of these four models shows variation in only one case. The only curiosity here is that the party and union variables appear to be incorrectly signed in each of the four heterogeneous models examined. On three of the four votes, being a Democrat significantly increases the probability a senator will support free trade. In sum, in heterogeneous states the GATT results are consistent with both the expectations and observations based on the aggregated votes.

## 5 Conclusion

The results of our reanalysis of Bailey and Brady's data suggest that Bailey and Brady's finding for dyadic representation in homogenous constituencies is likely understated. As our extension shows, at least in some cases, vote aggregation conceals constituency effects in heterogeneous states.

A tradeoff exists between the increased statistical power offered by multi-vote dependent variables and the context preserved by single vote dependent variables. However, it is important to recognize that aggregation of individual votes changes the substantive phenomena being studied. Consequently, the increased reliability and power associated with aggregation is accompanied by a *loss* of information concerning the context in which the legislation is passed. Since representation scholars are interested in identifying the conditions under which democracy is most efficient, we believe the cost of increased power does not justify aggregation.

It is also likely that other measures used in the authors' paper bias the results against a finding for constituency. In particular, scholars have long recognized the problems using both dichotomous measures of party (e.g. Fiorina 1974, Herron 2001) and vote based ideology measures in studies of legislators' roll call votes (Jackson and Kingdon 1992). Despite a large literature identifying these problems (e.g. Carson and Oppenheimer 1984, Hall and Grofman 1990, Bianco 1994) as this study shows, scholars still use these measures. However, recent advances in our understanding of representation suggest a distinct, though related, answer to the issues addressed herein.

An alternative explanation is that the conflicting results seen in the literature may be the product not of different types of representation, but of measurement error introduced by scholars failure to account for the precise subconstituency to whom

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<sup>8</sup> However it does come very close on the Fast Track bill ( $p < .052$ ).

legislators appeal. In homogenous districts and states, estimates of constituency influence that fail to account for subconstituency may be less biased and more accurate since there is relatively little variation among the citizenry. However, in heterogeneous states, estimates of constituency preference may contain much greater measurement error since legislators are forced to make hard choices about which groups' preferences to represent. If legislators adopt the position advocated by one group over that of another, rather than selecting some median position between them (e.g. Fiorina 1974), then use of average district data, like that used in this study, may introduce measurement error into estimates of constituency preference. Such error will be worse in heterogeneous states than in homogenous ones and is consistent with the results seen in the analysis performed herein. It also suggests that conflicting results in the literature stem from variable mismeasure rather than substantively distinct types of representation. Differences between the constituencies legislators and scholars see lead to measurement problems that may attenuate the influence of constituency in representation studies.

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