

Online Appendix for:  
Insights from the Blinder-Oaxaca Decomposition on  
Polarization in the US Senate

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## Appendix A. Full Decomposition Equation

$$\begin{aligned}
Pol_t - Pol_{t-1} &= (\overline{Leg}_{Rt} - \overline{Leg}_{Dt}) - (\overline{Leg}_{Rt-t} - \overline{Leg}_{Dt-t}) \\
&= ((\alpha_{Rt} + \beta_{Rt}\overline{All}_{Rt} + \gamma_{Rt}\overline{Copart}_{Rt}) - (\alpha_{Dt} + \beta_{Dt}\overline{All}_{Dt} + \gamma_{Dt}\overline{Copart}_{Dt})) - \\
&\quad ((\alpha_{Rt-1} + \beta_{Rt-1}\overline{All}_{Rt-1} + \gamma_{Rt-1}\overline{Copart}_{Rt-1}) - \\
&\quad (\alpha_{Dt-1} + \beta_{Dt-1}\overline{All}_{Dt-1} + \gamma_{Dt-1}\overline{Copart}_{Dt-1})) \\
&= (\alpha_{Rt} - \alpha_{Rt-1}) - (\alpha_{Dt} - \alpha_{Dt-1}) + \\
&\quad (\beta_{Rt}\overline{All}_{Rt} - \beta_{Rt-1}\overline{All}_{Rt-1}) - (\beta_{Dt}\overline{All}_{Dt} - \beta_{Dt-1}\overline{All}_{Dt-1}) + \\
&\quad (\gamma_{Rt}\overline{Copart}_{Rt} - \gamma_{Rt-1}\overline{Copart}_{Rt-1}) - (\gamma_{Dt}\overline{Copart}_{Dt} - \gamma_{Dt-1}\overline{Copart}_{Dt-1}) \\
&= (\alpha_{Rt} - \alpha_{Rt-1}) - (\alpha_{Dt} - \alpha_{Dt-1}) + \\
&\quad (\beta_{Rt}\overline{All}_{Rt} - \beta_{Rt-1}\overline{All}_{Rt-1}) - (\beta_{Dt}\overline{All}_{Dt} - \beta_{Dt-1}\overline{All}_{Dt-1}) + \\
&\quad (\beta_{Rt}\overline{All}_{Rt-1} - \beta_{Rt}\overline{All}_{Rt-1}) + (\beta_{Dt-1}\overline{All}_{Dt} - \beta_{Dt-1}\overline{All}_{Dt}) + \\
&\quad (\gamma_{Rt}\overline{Copart}_{Rt} - \gamma_{Rt-1}\overline{Copart}_{Rt-1}) - (\gamma_{Dt}\overline{Copart}_{Dt} - \gamma_{Dt-1}\overline{Copart}_{Dt-1}) + \\
&\quad (\gamma_{Rt}\overline{Copart}_{Rt-1} - \gamma_{Rt}\overline{Copart}_{Rt-1}) + (\gamma_{Dt-1}\overline{Copart}_{Dt} - \gamma_{Dt-1}\overline{Copart}_{Dt}) \\
&= (\alpha_{Rt} - \alpha_{Rt-1}) + (\alpha_{Dt-1} - \alpha_{Dt}) + \\
&\quad (\beta_{Rt}\overline{All}_{Rt} - \beta_{Rt}\overline{All}_{Rt-1}) + (\beta_{Rt}\overline{All}_{Rt-1} - \beta_{Rt-1}\overline{All}_{Rt-1}) + \\
&\quad (\gamma_{Dt-1}\overline{All}_{Dt-1} - \gamma_{Dt-1}\overline{All}_{Dt}) + (\gamma_{Dt-1}\overline{All}_{Dt} - \gamma_{Dt}\overline{All}_{Dt}) + \\
&\quad (\gamma_{Rt}\overline{Copart}_{Rt} - \gamma_{Rt}\overline{Copart}_{Rt-1}) + (\gamma_{Rt}\overline{Copart}_{Rt-1} - \gamma_{Rt-1}\overline{Copart}_{Rt-1}) + \\
&\quad (\gamma_{Dt-1}\overline{Copart}_{Dt-1} - \gamma_{Dt-1}\overline{Copart}_{Dt}) + (\gamma_{Dt-1}\overline{Copart}_{Dt} - \gamma_{Dt}\overline{Copart}_{Dt}) \\
&= (\alpha_{Rt} - \alpha_{Rt-1}) + (\alpha_{Dt-1} - \alpha_{Dt}) + \\
&\quad \beta_{Rt}(\overline{All}_{Rt} - \overline{All}_{Rt-1}) + (\beta_{Rt} - \beta_{Rt-1})\overline{All}_{Rt-1} + \\
&\quad \beta_{Dt-1}(\overline{All}_{Dt-1} - \overline{All}_{Dt}) + (\beta_{Dt-1} - \beta_{Dt})\overline{All}_{Dt} + \\
&\quad \gamma_{Rt}(\overline{Copart}_{Rt} - \overline{Copart}_{Rt-1}) + (\gamma_{Rt} - \gamma_{Rt-1})\overline{Copart}_{Rt-1} + \\
&\quad \gamma_{Dt-1}(\overline{Copart}_{Dt-1} - \overline{Copart}_{Dt}) + (\gamma_{Dt-1} - \gamma_{Dt})\overline{Copart}_{Dt}
\end{aligned} \tag{1}$$

Equation 1 starts with the difference between polarization at period  $t$  and polarization at period  $t - 1$ . The right hand side of the first line of the equation simply substitutes in for these two terms. The next step of Equation 1 follows directly from Equation 3 in the article.

The third step simply rearranges the terms.

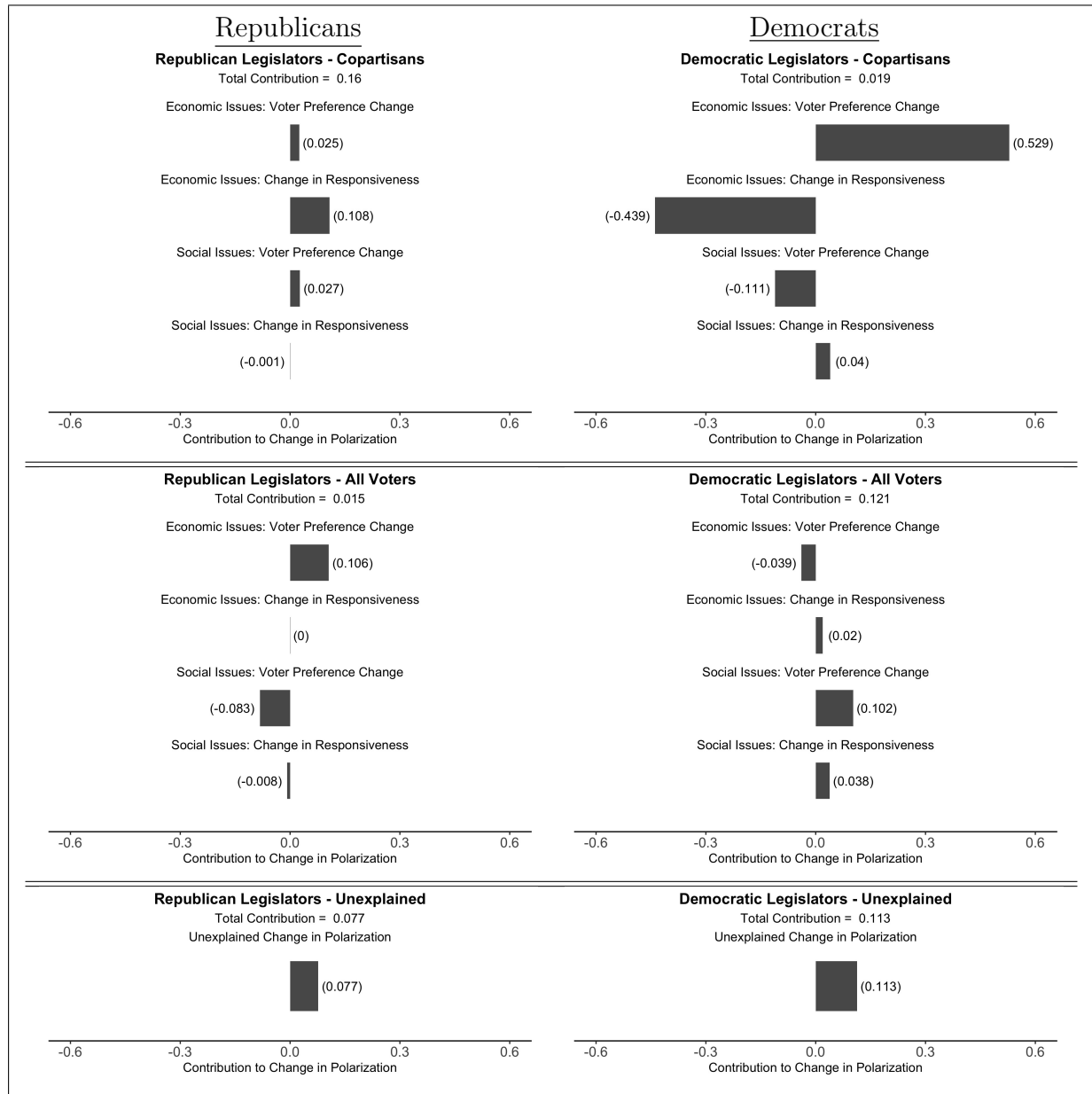
The fourth step of Equation 1 adds and subtracts the exact same terms from the right hand side of the equation. (This includes all of the following additions:  $(\beta_{Rt}\overline{All}_{Rt-1} - \beta_{Rt}\overline{All}_{Rt-1})$ ,  $(\beta_{Dt-1}\overline{All}_{Dt} - \beta_{Dt-1}\overline{All}_{Dt})$ ,  $(\gamma_{Rt}\overline{Copart}_{Rt-1} - \gamma_{Rt}\overline{Copart}_{Rt-1})$ , and  $(\gamma_{Dt-1}\overline{Copart}_{Dt} - \gamma_{Dt-1}\overline{Copart}_{Dt})$ ) The equality hold because these are the exact same terms and so they cancel each other out (i.e., it is equivalent to adding 0 to the right hand side of the equation). The fifth step simple rearranges the terms. The final step of Equation 1 pulls the common terms out.

## Appendix B: Results with a 10 Year Window, 1947-56 Versus 2005-14

In the paper, I pooled the data into twenty year periods to reduce noise when estimating the basic representation relationship. As a robustness test, I performed the decomposition pooling the data into ten year periods instead (1947-1956 versus 2005-2014). The results are presented in Figure 1 and confirm the main findings in the paper:

- Republicans have become more responsive to their copartisans on economic issues and this has increased polarization.
- Democratic partisans in the electorate have become more liberal on economic issues but this did not increase polarization because Democratic Senators become less responsive to their base on economic issues.
- The general electorate for Republican senators have become more conservative on economic issues and more liberal on social issues. These moves cancel each other out such that there was no net effect on polarization.
- The general electorate for Democrats has become more liberal on social issues which led to an increase in polarization.

Figure 1: The Contributing Factors to Increases in Polarization, 1947-56 versus 2005-14



## Appendix C: Results using the Nokken-Poole scores

As I noted in the paper, I use the DW-Nominate scores (McCarty et al. 1997) because they cover the time period I study and they have been used in the existing literature on polarization. Because I am speaking to the existing literature I wanted to use the same scores that have been used in the bulk of that literature. However, as a robustness check, I also replicated the results using the ideal estimates produced by using the procedure by Nokken and Poole (2004). The main results of using the Nokken-Poole estimates for Senators' ideal points are presented in Figure 2.

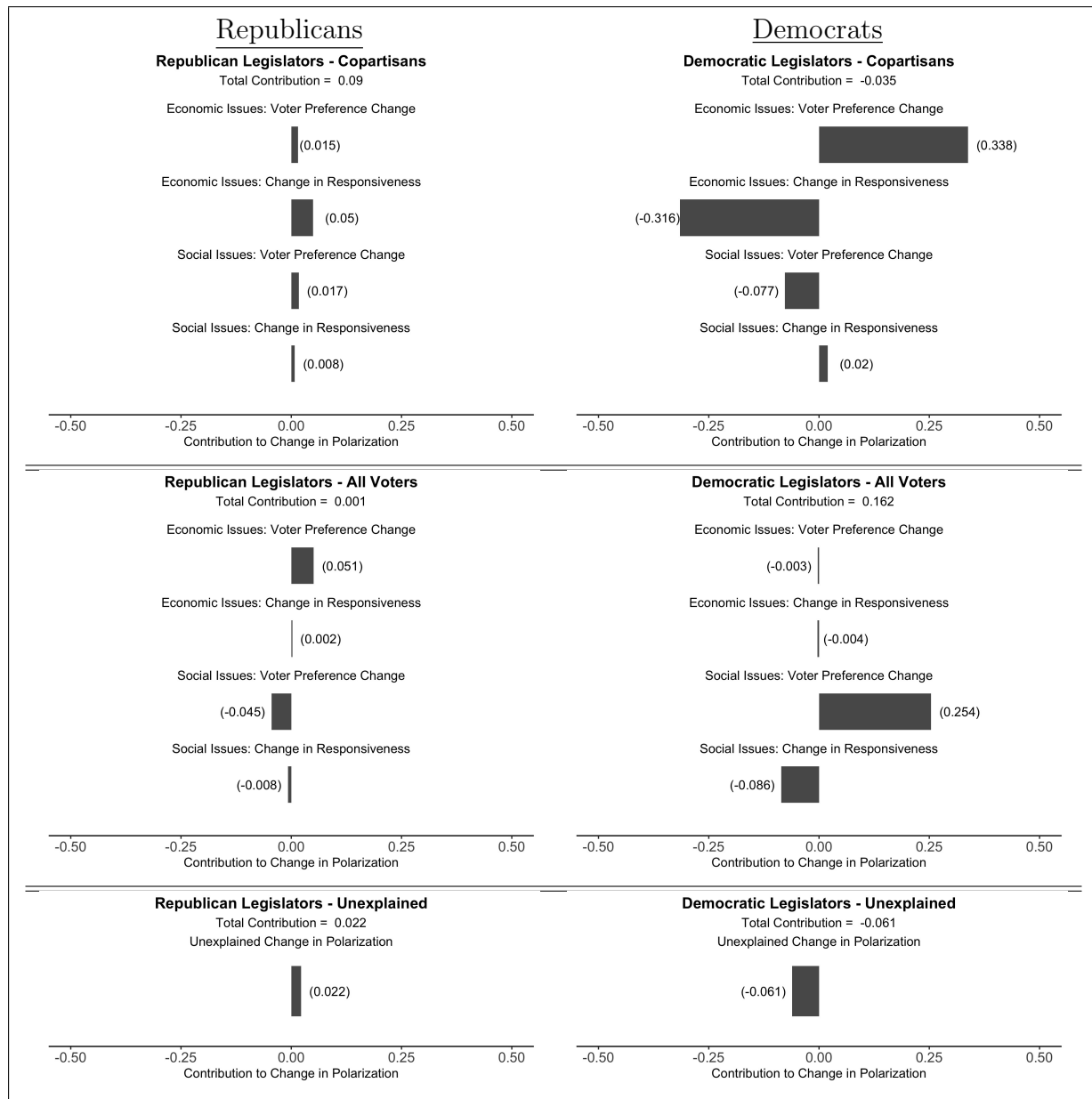
Using the Nokken-Poole scores produces one difference: In Figure 2 the unexplained portion is negative for Democratic legislators, whereas it was positive when using the DW-Nominate scores (see Figure 4 in the article). It is not clear why this change occurs, which is not completely surprising because this is the part of change in polarization that is unexplained by the model. Reassuringly, the main findings that relate to the different components of the model all replicate, namely:

- Republicans have become more responsive to their copartisans on economic issues and this has increased polarization.
- Democratic partisans in the electorate have become more liberal on economic issues but this did not increase polarization because Democratic Senators become less responsive to their base on economic issues.
- The general electorate for Republican senators have become more conservative on economic issues and more liberal on social issues. These moves cancel each other out such that there was no net effect on polarization.
- The general electorate for Democrats has become more liberal on social issues which led to an increase in polarization.

## Appendix D: Results by Decade

In this appendix I present the over time changes in the factors affecting polarization. I did this by first dividing the data into seven decade-long periods: 1947-56, 1957-66, 1967-76,

Figure 2: The Contributing Factors to Increases in Polarization, Nokken-Poole Scores

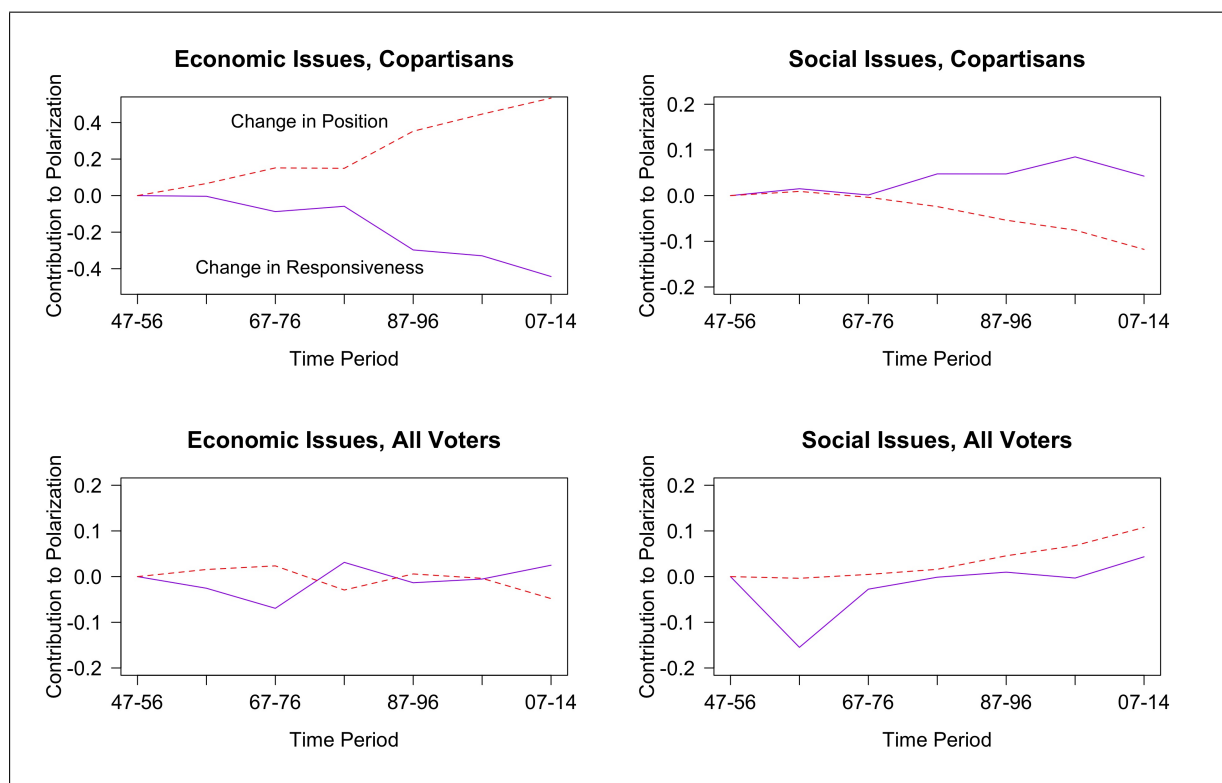


1977-86, 1987-96, 1997-2006, and 2007-2014. I then used 1947-56 as the baseline period and calculated the decomposition in every other period relative to that baseline time period. This allows us to see the general trends over time.

Figure 3 gives the results for the Democratic senators and Figure 4 gives the results for the Republican senators. In both graphs there are four panels. Each panel corresponds to a

group of voters (copartisans or all voters) and a set of issues (economic or social). The red, dashed line in each panel gives the contribution to polarization that comes from changes in voters' position and the purple, solid line gives the contribution to polarization that comes from changes in responsiveness to those positions.

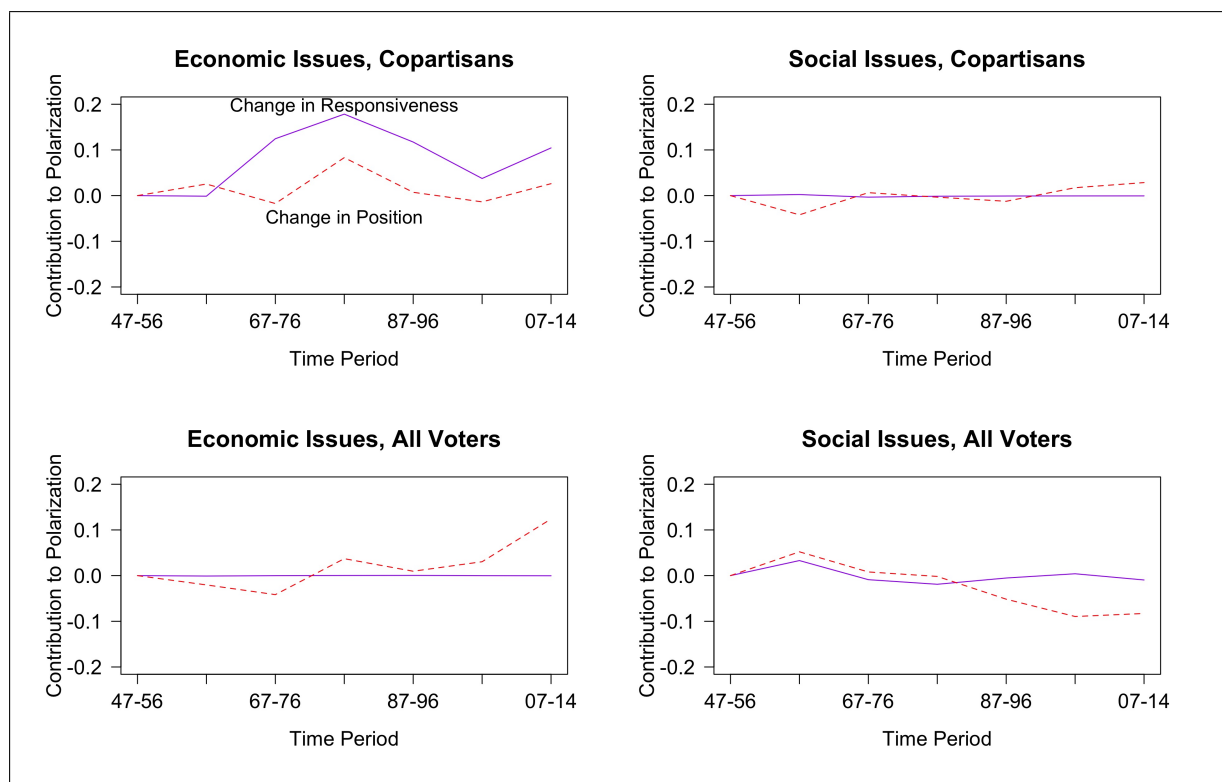
Figure 3: Over Time Contributors to Polarization: Democratic Senators



The results of Figures 3 and 4 confirm the main points observed in the paper. First, the top-left panel of Figure 3 shows that as the Democratic base become more liberal (which would normally increase polarization), the senators became less responsive to those positions. These forces cancelled each other out. This panel also suggests that these trends increased most sharply in the late 1980s and early 1990s.

Second, the bottom-right panel in Figure 3 shows that on social issues, the general electorate for Democratic senators has become more liberal causing these senators to move towards the left. Most of this movement has occurred since the 1990s.

Figure 4: Over Time Contributors to Polarization: Republican Senators



Third, the top-left panel of Figure 4 shows that Republican senators have become more responsive to their copartisans' positions. This pattern started in the mid-1960s and is responsible for an increase in the overall level of polarization.

Finally, the bottom two panels in Figure 4 show how the general electorate has changed in Republican Senators' states. On social issues these voters have become more liberal, a change that on its own has worked to decrease polarization (see the bottom-right panel). This move began in the mid-1980s. However, this change has been offset by a slight movement in the conservative direction on economic issues (see the bottom-left panel). These competing forces have offset each other.

## References

McCarty, Nolan, Keith T. Poole, and Howard Rosenthal. 1997. *Income Redistribution and*



*the Realignment of American Politics*. Washington, D.C.: AEI Press

Nokken, Timothy P., and Keith T. Poole. 2004. "Congressional Party Defection in American History." *Legislative Studies Quarterly* 29(4): 545-568.