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Spatial Polarisation of Presidential Voting in the United States, 1992-2012: the 'Big Sort' Revisited.

Much has been written in recent years about the claimed polarisation of the US electorate, with substantial differences as to whether there has been greater spatial polarisation, at several geographical scales, over recent decades. To assess the veracity of those alternative views, a bespoke data set showing percentage support for the Democratic Party's presidential candidates at the County, State and Divisional scales has been analysed using a robust, statistically-based measure of polarisation/segregation. The ecological results provide clear and compelling evidence of a trend towards greater polarisation across the nine Census Divisions, across the 49 States within those Divisions, and across the 3077 Counties within the States – with strong evidence that the differences over time at the last of those scales are highly statistically significant. Within those general trends, polarisation has been greater in some States than others and also within some States more than others – identifying additional geographies calling for further research.

Key Words: presidential voting, United States, polarisation, spatial scale

Introduction

Much has been written in recent years about the claimed polarisation of the US electorate. This has two, largely separate, components. The first is *ideological polarisation*, with claims that individuals are becoming more polarised in their attitudes on a range of economic, social and cultural issues, changes that are reflected in their support for the two main political parties. The second is *spatial polarisation*, which focuses on the geography of support for those parties – and which is the main focus of the present paper. Spatial polarisation – the growing concentration of support for the Democratic Party in some parts of the United States and for the Republican Party in others – can be independent of ideological polarisation (on which latter there is much debate: see Fiorina et al., 2008a, 2008b; Layman et al., 2006; Abramowitz and Saunders, 2008; Levendusky, 2009a). The geography of support can change without any alteration to any underpinning ideological differences between supporters of the two parties. But is that geography changing? This paper addresses that question only, seeking to establish more firmly than in other studies whether that is the case and, if so, to establish a research agenda exploring the processes that have brought the changes about. An empirical claim has been made; we evaluate its veracity as a preface to further research on why there have been major recent changes to the county's macro- and meso-scale electoral geographies.

Spatial Polarisation: the 'Big Sort'

Recent arguments regarding spatial polarisation were stimulated by the publication of Bishop and Cushing's (2008) *The Big Sort*, which claimed that 'Over the past thirty years, the United States has been sorting itself, sifting at the most microscopic levels of society … Between 4 and 5 percent of the population moves each year from one County to another – 100 million Americans in the past decade' (p.5). These moves necessarily involve decisions

not only about impersonal characteristics of the destinations being considered but also about the nature of potential neighbours, with the claim that 'Those are now political decisions, and they are having a profound effect on the nation's public life'. People are choosing, it is claimed, to move to neighbourhoods with whose residents they share many features of their lifestyles, and these are reflected in their political choices – at their most basic, whether they vote Democrat or Republican. People have not been explicitly deciding where to live on the basis of their potential neighbours' electoral pre-dispositions, but the massive volumes of migration have involved movers being increasingly careful to select neighbourhoods dominated by households and families like themselves. This in turn has meant growing socio-economic-cultural segregation, which in its turn has resulted in greater political polarisation.[1]

Bishop and Cushing's (2008) portrayal of the geography of that increased polarisation – the outcome of the assumed processes – was based on neither extensive nor intensive statistical analysis. At its core was a single comparison of voting Democrat or Republican at two presidential elections (1976 and 2004), at the County scale. Each County was classified into whether or not it was won by a landslide at the relevant election – defined as whether one party's candidate defeated the other's by 20 percentage points or more. The percentage of voters living in such 'landslide Counties' increased from 26.8 at the first date to 48.3 at the second, which Bishop and Cushing (2008, 10-11) interpreted as an 'increasing polarisation of American communities' culminating with just under half of the electorate living in places where there was, in effect, no contest. (The Afterword – pp.305-310 – in the 2009 edition of the book found no change at the 2008 election.)

Because of unequally-sized electorates across Counties, however, this comparison understated what was shown on their maps: at the 1976 election, 38 per cent of the Counties had 'landslides', whereas in 2004 more than 60 per cent did – not surprisingly the larger (mostly metropolitan) Counties were more heterogeneous and less likely to produce a landslide victory for either candidate. Both elections (Carter versus Ford in 1976, and Kerry versus Bush in 2004) were close nationally, giving strength to their argument that residential sorting over those three decades was responsible for the greater polarisation. At the County scale, urban areas were becoming less polarised than rural areas, however, which undoubtedly accounts for their further finding that 'Republican Counties tended to become more politically segregated than Democratic Counties' (p.44; see also Scala et al., 2015).

Apart from data on the number of 'landslide Counties', Bishop and Cushing's analysis – characteristic of most journalism – focused on anecdotal and qualitative rather than rigorous quantitative evidence to sustain their case. They did, however, report some analyses of census and polling data, finding that when comparing 'strongly partisan' Republican and Democratic Counties the former had: more married people; more high earners; more white residents; and more people who went to church weekly and identified as Evangelicals (pp.47-48). Further comparisons of County data across four censuses (1970-2000) found that strongly Democratic Counties had greater increases in the percentages of their populations with degrees and who were foreign born than strongly Republican Counties; the latter, on the other hand, gained more church members and white residents than their strongly Democratic counterparts.

Critique

The Big Sort has attracted a range of critiques. Abrams and Fiorina (2012), for example, identified major shortcomings in both its portrayal of polarisation and the processes adduced

to account for the observed patterns. With regard to the portrayal, their criticisms drew attention to Bishop and Cushing's:

- use of Presidential election voting data, rather than voting for candidates at State or Congressional elections, 'to avoid the effects of different candidates or changing voting districts' (Bishop and Cushing, 2008, 9): Abrams and Fiorina (2012, 203) argued instead that 'far from minimizing the effects of different candidates, reliance on presidential voting returns maximizes the effect of different candidates' and may not reflect local attitudes more generally – as in Montana in 2004, won by George W. Bush in the presidential contest but by the Democratic candidate in the concurrent gubernatorial election;
- use of data for two elections only – 1976 and 2004 – as evidence of greater polarisation, on the well-established grounds that choice of the start- and end-dates for a period can considerably impact on the observed trends (on which see Taylor, 1988); and
- use of information on the number of 'landslide County' wins (by a margin of twenty percentage points or more) as their indicator of growing polarisation: using other measures, they show that 'Counties in the United States have become increasingly politically heterogeneous, not increasingly homogeneous' (Abrams and Fiorina, 2012, 205).

Abrams and Fiorina (2012, 205-206) are cautious in their conclusions, however:

> Do the preceding analyses prove that political residential segregation is not occurring? No. That is not our position. We are simply pointing out that Bishop's sweeping argument about geographical political sorting has little or no empirical foundation.

They reiterated this position in another paper (Fiorina and Adams, 2008, 576), citing Klinkner and Hapanowicz's (2005, 5) conclusion that 'While there might be a slight increase in political segregation, it is still in line with historical trends and is not anything unexpected' and another by Nunn and Evans (2006) which found 'increased spatial polarization of party identification, liberal-conservative ideology, and confidence in government institutions, but perhaps surprisingly, in view of Bishop's argument, not in voting behavior' (Fiorina and Abrams, 2008, 576). Similarly, looking at long-term trends up to 2004, Glaeser and Ward (2006) rejected five 'myths' about US electoral behaviour, among them that the two parties have become geographically more segregated and that political divisions are growing. Certainly their data for the period 1860-1976 show little more than trendless fluctuation, but the index of dissimilarity between the distribution of Democrat and Republican votes (their Figure 2) indicates a substantial and steady increase from 1976 on – by 2004 it had almost doubled. Because of their focus on the long-term, this aspect of their findings is not commented upon, nor taken into account in their conclusion that 'Democrats and Republicans are not more geographically segregated in the past' (Glaeser and Ward, 2006, 33). If they had been focusing on recent decades, they may have concluded otherwise – that Bishop and Cushing, who did focus on recent decades only, were right!

The current paper explores whether an alternative approach can provide a rigorous empirical foundation to the case for greater polarization, given that other analyses have sustained the Bishop-Cushing argument. Myers (2013, 59), for example, succinctly concluded his spatial analysis of 150 Texan Voter Tabulation Districts that: 'between 1996 and 2010, the geographical bases of the political parties in Texas have continuously diverged … [as] a result of progressively higher-than-average changes in Republican partisanship across broad but lightly-populated swaths of east and central Texas, as well as by progressively lower-than-average changes in Republican partisanship in the most urban parts

of the state' – patterns that he believes characterise other southern States (e.g. McKee, 2008). Focused more directly on the *The Big Sort*'s argument, Sussell (2013) similarly found that Californian voter registration data indicated growing polarisation at the census block and tract plus County scales, and Kinsella et al. (2015) provided comparable evidence using micro-scale data for a single city – Cincinnati; across the country, Morrill et al. (2011) found increased polarisation at the county scale between metropolitan and non-metropolitan areas between the 2004-2008 presidential elections.

Regarding the role of selective migration as a source of such sorting, Cho et al. (2013, 866) showed 'not only that the relocation patterns of a significant subset of the population exhibit geographic sorting by a number of neighbourhood characteristics … [but additionally that] partisanship is also considered in selecting a relocation destination' (see also Gimpel and Hui, 2015, and McDonald, 2011, but also Nall and Mummolo, 2013). Wing and Walker (2010) analysed the degree of spatial polarisation at one election and spatial scale only, and associated this with the clustering of like-minded people, but the conclusion – p. 282 – that their hypothesis that 'polarization of the U.S. electorate has occurred over space and is attributable to a process of local entrenchment, whereby a variety of social forces amplify county populations' propensity to vote Republican or Democratic' is sustained by inferring change from a single cross-sectional study only.

This paper only addresses the first of the two main components of Bishop and Cushing's argument, that there has been spatial polarisation in voting at US presidential elections over recent decades. This is an empirical question and, as detailed below, is addressed using a newly-developed analytical procedure designed explicitly to measure the degree of polarisation/segregation in spatial patterns at a nested range of scales. If the hypothesis of greater polarisation is sustained, then future work will need to address the second component of their argument – that the increased polarisation has resulted from selective migration. The final section of the paper suggests directions for such research, including alternative hypotheses.

The research reported here is not, therefore, concerned with patterns of individual behaviour, nor does it make inferences about that behaviour. The argument addressed – and expressed as a formal research question/hypothesis in the next section – is that a very large number of individual behavioural decisions combine to result in an altered aggregate pattern. Our concern here is whether that pattern exists. If it does, questions are posed regarding the suggested reason for its emergence.

Data and Method

Of Abrams and Fiorina's three major criticisms of the empirical base for the spatial trends 'assumed' by Bishop and Cushing, two can be substantially countered. To address the arbitrary nature of start- and end-points, instead of comparing two years only we use a time series, comprising data for not only the start- and end-points but for all intermediate years, in this case those with presidential elections. (Details of the data set are outlined in Appendix 1.) The arbitrariness of the choice of the two end-points remains valid (although 2012 is the last for which data are available), but if a clear trend can be identified over the period then a claim for greater polarisation has a much firmer foundation. Secondly, we use as our basic measure the percentage voting Democrat in each County at each presidential election (where the denominator is [Democrats + Republican] following the argument in Gelman – 2008 – that it is less affected than total votes cast by excluding support for third and other parties,

especially Perot[2]). While support for the Democratic Party's candidates both waxed and waned during the period analysed here (1992-2012) this does not impact on our chosen measure of polarisation (introduced below) which focuses on variance (around the overall level of support at any one date) rather than any absolute measure of difference.

Regarding Abrams and Fiorina's third criticism, we accept that presidential voting may not reflect other aspects of political attitudes held by a County's residents, and thus the picture we provide is partial only – as would be any other. The advantage of using this measure of the electoral character of an area's population is that it is universal; all Counties participate in the election and the two main parties contested all States at each election. House of Representatives elections are more frequent, but a substantial number of Congressional Districts are uncontested, and not every State requires, and thus publishes data on, voter registration. It may be that electors vote very differently across separate State and County (and other) contests held on the same day (the well-known phenomenon of 'split-ticket voting': Burden and Kimball, 2004), but that does not necessarily mean that the pattern of voting for the presidential party is an 'anomaly'; voting for another office at State or County level may reflect local issues or candidatures and hence be the 'anomaly', for example. Voting for the president is comparable over both place and time and is thus the chosen focus for the current analysis.

The basic question addressed here is:
Did spatial polarisation in voting for president increase across the United States between 1992 and 2012, inclusive?
However, we do not address it at a single scale. Many analyses have used the State as the basic spatial unit (e.g. Gelman, 2008) and found clear evidence of polarisation (as did Abramowitz and Saunders, 2008); similar trends can be found at coarser scales. This is clearly indicated by the descriptive data in Table 1, which shows variations over time in the number of votes cast for the Democratic Party candidate (Clinton in 1992 and 1996; Gore in 2000; Kerry in 2004; and Obama in 2008 and 2012) as a percentage of the total votes cast for the Republican and Democratic Party candidates combined. The data refer to all Counties (or County-equivalents: see Appendix 1) in 49 States in the nine Census Divisions (with Alaska and the District of Columbia excluded because they are not divided into County or 'County-equivalent' districts).

There are very consistent trends for four of the parameters of those distributions over the six elections at each of the three scales. The minimum percentage voting Democrat fell (to just one-third of its 1992 figure by 2012 at the County scale), and the maximum increased, resulting in a greater range of values. The means varied, reflecting the relative popularity of the two parties; the Democrats performed best, at each scale, in the four elections won by Clinton and Obama, and worst in those won by G. W. Bush for the Republicans. But the standard deviations increased over time – more than doubling at the Divisional scale – as did the coefficients of variation (the standard deviation expressed as a percentage of the mean).

These descriptive data clearly suggest that there was spatial polarisation in support for Democratic Party candidates for the US presidency over the 1992-2012 period, at each of three spatial scales. But, as was early recognised in studies of spatial segregation (Duncan et al., 1961), any measure of segregation at one scale necessarily incorporates – to an unknown extent – segregation at a higher scale. (This argument is generalised and stressed by Tranmer and Steel, 2001.) Thus, for example, if there is increased segregation at the State scale this will necessarily be observed also at the County scale when it is measured across all States. By

measuring segregation separately at both scales, however, its relative importance at each cannot be determined – the intensity of segregation at the State scale is included in the measure for the County scale. We need a method that takes this multi-scalar nature of the segregating process into account in order to address the expanded version of our research question:

> *Did spatial polarisation in voting for president increase across the United States between 1992 and 2012, inclusive, independently at each of three scales – County, State and Census Division?*

As with any analysis using aggregate data for spatial units, the Modifiable Areal Unit Problem (MAUP; see Manley, 2014) issue can be raised. Clearly this division of the United States into 3,077 Counties, nested within 49 States, nested within 9 Census Divisions is only one of a very large number of possible realisations wherein the tens of millions of US voters at the six elections studied could be organised – and it may be that for some of the potential other realisations different patterns might be observed. One clear defence of our approach is the pragmatic one that these are the data that exist and, as in so many studies of large population aggregates, researchers have little alternative but to accept the limitations of what is available: such research is necessarily constrained by what is possible. The smallest spatial units – the Counties (and County-equivalents) – are fixed and though it would certainly be very desirable to use smaller units, perhaps more akin to the districts and neighbourhoods that are used by individuals and households when making residential-location decisions – as in the localised studies by Kinsella et al. (2015), Myers (2013), and Sussell (2013) – such data are not available on a national scale. In seeking to establish the existence of nation-wide patterns, therefore, data availability precludes the exploration of micro-scale patterns alongside those at the macro- and meso-scales undertaken here.

There is, however, a further defence for using the County within State within Division nested hierarchy of areas deployed here. The former two sets of spatial units are not arbitrary divisions of the country when it comes to the study of election results. They are important parts of the spatial matrix within which elections are organised, not least by the political parties and their candidates' campaigning organisations; studying the pattern of voting within those units is thus doing so within the spatial structure of the elections themselves. Further, the Census Divisions are also not arbitrary divisions of the country: as Elazar's (1984) classic study shows, they reflect the country's historical geography, including its differing politico-cultural ideologies. Whilst accepting arguments regarding the MAUP and the provisional nature of any analyses conducted using data for a single spatial realisation only, therefore, the framework within which those here were conducted and are reported is a realistic one for testing the research question set out above. In short our focus of interest is the changing degree of segregation for a fixed, unchanging meaningful spatial classification (Counties and States), as the areas have not been fundamentally been modified or re-zoned over the time period studied.

The Measurement of Polarisation/Segregation

We measure polarisation here as segregation. There is a very large literature on this – particularly with regard to residential patterns, especially of ethnic groups – using a wide range of indices, many of which, such as the well-known indices of dissimilarity and segregation, are in effect measures of variance at a particular spatial scale (Leckie et al., 2012).

Several studies of residential segregation have identified its multi-scalar nature (e.g. Fowler, 2015) and explored both measures of spatial decomposition for particular indices (Reardon et al., 2000; Voas and Williamson, 2000; Johnston et al., 2003; Fischer et al., 2004; Parisi et al., 2011) and ways of mapping/measuring segregation at different scales (Lee at al., 2008; Reardon et al., 2008, 2009; Östh et al., 2014; Clark et al., 2015). All have added substantially to our appreciation of segregation patterns – and, in some cases, to the underlying processes – but suffer from two disadvantages. First, their measures are descriptive only; they lack any inferential basis, and so provide no formal evaluation of whether one index value is larger than another. Secondly, they do not take into account Duncan et al.'s (1961) important argument that any measure of segregation at a particular scale – that of the County, say – must also incorporate that of any larger area in which those Counties are nested – such as States in the US context.

Precise measurement of the degree of segregation/polarisation must therefore formally explore its multiscalar nature; the degree of segregation expressed at any one scale should be nett of its intensity at any coarser scales. A method for doing this, based in multilevel modelling procedures with Bayesian statistical properties, has recently been developed (Jones et al., 2015; Manley et al., 2015a, 2015b; Johnston et al., 2016). Its index of segregation – the Median Rate Ratio (MRR) – shows its level at each scale net of the larger scales within which the smallest observation units are nested. Those MRRs have associated asymmetric Bayesian credible intervals (CIs), with which assessments of the robustness of differences between pairs of values can be made.[3]

Studies of ethnic residential segregation employing the MRR to date have reported analyses of multi-group situations (Jones et al., 2015, Manley et al., 2015a, 2015b); they compare the distributions of more than two ethnic or occupational groups in the cities analysed and the formal modelling treats their distribution as the outcome of a Poisson process. For the current study of polarisation we are dealing with binary categorisations – Democrat and Republican voters – and so the modelling assumes that their distributions are the outcome of a Binomial process. The relevant output from this is not the MRR, therefore, but rather the Median Odds Ratio (MOR: Larsen and Merlo, 2005). The modelling produces an estimated MOR for each election year, at each scale; it is a measure of polarisation at that scale, net of any polarisation at the next highest scale and net of Binomial variation occasioned by a varying denominator.

MOR values are interpreted in the same way as odds ratios obtained from binary logistic regressions – they are a measure of the average (median) difference between two values; an odds ratio of 1.40, for example, indicates that one value is 40 per cent larger than the other. MORs are, as the use of the term Median in the title indicates, a summary of all of the possible odds ratios. For example, take one Census Division. For each of its constituent States, the modelling for election year *x* produces an estimate of the Democratic vote percentage. Odds ratios can then be calculated as the ratio between the highest and lowest modelled percentages for two States selected at random from within that Division. The median of all those possible ratios is thus the average value; it is a statement of the average (median) difference between the estimated ratios between States within that Division, and the MOR is the average difference between States within each Division across all Divisions. The larger the MOR, therefore, the greater the average difference between the modelled Democratic vote percentages within States in that year.

As the MOR is an average, the distribution from which it is drawn has other parameters, and the variance can be used to derive Credible Intervals (CIs) for each estimated MOR value. CIs are interpreted in the same way as confidence intervals in classic inferential statistics except that, as they are based on Bayesian models, they are potentially asymmetrical. The CIs enclosing 95 per cent of all estimated values are reported along with each MOR here, and used to assess whether any one MOR value is significantly different from another (at the 0.05 probability or better) – which can be determined by whether the two sets of CIs overlap.

We apply this method (full details of which are in Jones et al., 2015) to a bespoke data set giving the percentage of the votes for the Democrat and Republican candidates that were cast for the former at each presidential election from 1992 to 2012, inclusive, for 3,077 Counties (or the equivalent unit), nested within the forty-nine States and the nine Census Divisions.[4] (Alaska and the District of Columbia are excluded because they lack any finer-scale units.) The goal is to establish whether there were statistically significant changes in the level of polarisation at each of those scales over the period and, if so, to essay possible explanations for them.

Polarisation in Voting Democrat, 1992-2012

Figure 1 shows the trend in the MOR values at each of the three scales over the six elections, together with the associated CIs, and the full details of the modelled values are in Table 2.

The dominant conclusion to be drawn from the figure and the associated data is that there is very clear and strong evidence of growing, and substantial, polarisation in the geography of the percentage voting Democrat at all three scales. At the Divisional scale, the MOR increased over the two decades from 1.20 to 1.55 (i.e. by 29 per cent); at the State scale, the increase – net of the increased polarisation at the Divisional scale – was less (from 1.21 to 1.36 – an increase of 12 per cent); and at the County scale there was a 14 per cent increase. At each election, polarisation was greatest at the County scale and – after 1992 – least at the State scale. Nevertheless, the MOR at the latter scale for 2012 indicates that between States within Divisions on average the percentage voting Democrat in one was 36 per cent larger than in another; at the County scale, between Counties within States the median percentage voting Democrat in one was 69 per cent greater than in another.

The CIs are, unsurprisingly given the differing numbers of observations, widest at the Divisional and narrowest at the County scale. With the former, therefore, it cannot be concluded that there was a statistically significant increase in the degree of polarisation between each pair of elections, or indeed that polarisation was significantly greater in 2012 than it was twenty years earlier. Nevertheless, the trend is clear. The gap between the Divisions with the greatest and least Democratic support was 10.69 percentage points in 1992 (the Mountain Division had the lowest value and New England the highest) and 20.66 points in 2012 (between the East South Central and Pacific Divisions). In other words, this is not a trendless fluctuation but consistent year on year increase.

At the State scale – where again the number of observations is relatively small (49) and the CI spreads fairly large (though much less so than at the Divisional scale) – polarisation increased only slowly across the first five of the elections; the increase in the MOR between 1992 and 2008 was just eight points, and it then grew by seven points between

2008 and 2012. There was only one statistically significant difference, between 1992 and 2012. At the former of those elections, Democratic support differed by only 25.8 points between the lowest (Utah) and highest (Massachusetts) values; at the latter the gap between Utah and Hawaii was 46.3 points.

Compared to the situation at those macro-scales, there is no doubt regarding the statistical significance of the inter-election differences at the meso-(County) scale. The CI spreads in Table 2 indicate no significant difference between the patterns in 1992 and 1996, but from then on there is a significant difference between every pair of elections at the 0.05 probability level or better. Bishop and Cushing's conclusion is clearly confirmed by this more rigorous analysis: the United States' electorate became spatially more polarised at the County scale across those two decades.

Polarisation Between and Within States

The MOR analyses reported in Figure 1 and Table 2 provide clear evidence of polarisation of the US electorate during the 1992-2012 period at the County scale. But was that trend consistent across all States, or was it greater in some than others? Table 3 gives the coefficient of variation (CV) across their constituent Counties (or County equivalents) for each State in 1992 and 2012, plus the absolute and relative change in those two values. The States are ordered according to the size of the absolute change in their CV values.

The differences across the States are very substantial, from a 30.39 point increase in Texas at one extreme to a decrease of 2.96 in Hawaii at the other. All but two of the 49 States had increases in their CV, but with clear geographical variations in the extent of the change. It was least, on average, in the northeast; none of the New England, Mid-Atlantic and East North Central States had a CVChange value exceeding 10.0 (their means were 1.6, 4.3 and 3.4 respectively), whereas all of the Mountain Division States had a change value exceeding 12.0 (a mean of 17.1), as also did all States but one in the West South Central Division (mean, 18.8: the exception was Oklahoma). Most of the States in the first three groups – those with least change – are among those that traditionally give the Democrats greatest support (their mean percentages voting Democratic rather than Republican were 57.5, 54.4 and 53.0 in 1992 and 60.6, 56.9 and 52.9 in 2012); those in the Mountain States on average gave least support to the Democrats (47.8 per cent in 1992, 42.2 per cent in 2012), whereas those in the West South Central Division shifted most in their support over the two decades (52 per cent Democrat on average in 1992 and 1996 but only 39 per cent in 2008 and 2012). In general, therefore, it appears that Bishop and Cushing's conclusion that recent polarisation was greater among Republican- than Democratic-supporting areas is borne out.

These changes can be formally modelled (see Appendix 2) by fitting a four-level model with Divisions, States, Counties and voters modelled simultaneously, which produces MOR values for each spatial unit, net of the national trend for each year and net of Binomial variation. Figure 2 shows those trends at the Divisional scale – i.e. between States within Divisions. In 1992, the difference between the largest and the smallest MOR was 0.48 (1.22 for New England and 0.74 for Mountain); twenty years later, it was 1.19 (1.80 for New England and 0.71 for West South Central; the value for the Mountain Division then was 0.72). There is clear evidence of a divergence – of polarisation as argued by Bishop and Cushing – with the MORs for both New England and the Pacific regions increasing substantially over the two decades, while those for the East and West South Central regions moved substantially in the opposite direction.

To explore the significance of that polarisation between Counties within States, a separate two-level model was fitted for each State.[5] The output from this is subject to a Wald test of whether the level of polarisation was greater in 2012 than 1992, using a chi-square test of difference in the variances on the logit scale. Table 4 shows the size of those differences, with their associated chi-square values and probability levels for each State. The States are ordered according to the size of the differences, and they are split into three groups: the largest, comprising 29 of the 49 States, are those in which the difference significantly widened – i.e. there was significantly greater between-County polarisation in percentage voting Democrat within the State over the six elections. There is a second group of 17 States where there was no significant trend over time; and finally there were three – geographically clustered – States (Kentucky, Tennessee and West Virginia) where polarisation decreased significantly across the six elections. As with the descriptive data in Table 3, therefore, some clear geographical patterns emerge. All six New England States are in the group for which there was no statistical difference in the degree of polarisation over time, for example. Other Divisions are characterised by considerable variation, however, not least East South Central which contains not only the two States experiencing the greatest between-County polarisation but also two of the three where the trend was in the opposite direction – albeit much less pronounced (the differentials for Tennessee and Kentucky were -0.069 and -0.085 respectively, whereas those for Alabama and Mississippi were 0.552 and 0.495).

Figure 3 shows these MOR values graphically for States that had significant changes (*p* less than or equal to 0.05) over the period 1992-2012. Most States experienced significantly increased segregation between the starting and end dates with only three having less segregation at the end than at the start. This not only provides clear evidence sustaining the argument promoted in *The Big Sort* but also shows that polarisation was greater in some States than others. Thus whereas in 1992 the range of MOR values was between 1.4 and 1.7, twenty years later it was 1.4-2.4 – a tripling of the gap between the most (Alabama) and the least (West Virginia) polarised states.

Closer examination of the intensity of polarisation within individual States identifies very clear differences both between and, in some cases, within the Divisions. The three Divisions in the country's Northeast (East North Central, Mid Atlantic, and New England) show very little, if any, change in the levels of within-State polarisation, for example; and the three Mid-Atlantic States show only a marginal rise. By way of contrast, all of the States in the two western Divisions (Mountain and Pacific) show increased between-county polarisation over the six elections. The other four Divisions are characterised by greater internal variation, with some States displaying substantially increased polarisation and others virtually none. This bifurcation is clearest in East South Central – the MOR values doubled in Alabama and Mississippi, but changed hardly at all in Kentucky and Tennessee – but is also apparent in the other three: greater polarisation in Texas, for example, compared with virtually none in Oklahoma within the West South Central Division; greater polarisation within Maryland but none in West Virginia within the South Atlantic Division; and similarly within the West North Central Division, greater polarisation in both North and South Dakota but very little in Minnesota. Thus in some parts of the USA there has been little, if any, polarisation at the within-State County scale (notably in the northeast), whereas in some (notably in the west) polarisation has characterised all States, and in the south and the upper Great Plains it has been a feature of some States but not others. Spatial polarisation of the US electorate has itself been spatially polarised.

So Why the Big Sort, and Why More in Some Parts of the USA Than Others?

The rigorous statistical approach to segregation/polarisation adopted here has given strong support to the argument advanced in *The Big Sort*: over the two decades and six elections between 1992 and 2012 there has been greater spatial polarisation in the percentage voting for the Democratic Party candidates at presidential elections, at all three spatial scales analysed.[6] Further, as the previous section has stressed, that polarisation has not occurred with the same intensity across the nine census Divisions of the United States, across the constituent States within each of those Divisions, and across the constituent Counties within each of those States. By answering one geographical question, the results have posed more – why those variations, at separate scales, within the United States?

Addressing those questions will be the subject of further research. Bishop and Cushing (2008) argued that people with different characteristics were clustering together more than in the past – and that this is reflected in their electoral behaviour and thus the polarisation observed here. Such clustering, their brief ecological analyses suggested, is linked to differences across Counties in income levels, educational qualifications, religious observance and affiliation, ethnicity, immigration and household structures. If that linkage is in any way causal, then there should have been greater spatial polarisation of those – and perhaps other – groups over the same period.

Such sorting, if it has occurred, is unlikely to offer a full answer to the greater polarisation in voting behaviour. Bishop and Cushing argue that people who cluster together, talk together, which leads to what others have identified as 'conversion by conversation' (Pattie and Johnston, 2001) – an example of the classic neighbourhood effect. Abrams and Fiorina (2012) challenged this, arguing that American neighbourhoods are not hotbeds of political conversation and that even those who do regularly converse with their neighbours rarely or ever discuss politics. And yet there is a very substantial body of research showing that the partisan composition of people's conversation networks can be a powerful influence on their political attitudes and voting behaviour (for example, Sunstein, 2009; Hopman et al, 2015) – so to the extent that such networks are spatially structured (and most people are likely to have face-to-face conversations with residents in the same County as themselves) then they are likely to contribute to the polarisation trends identified here. The result of such processes may well be, as Levendusky (2008, 2009a, 2009b; Levendusky et al., 2008) argues, that as local social networks become increasingly dominated by one partisan position – either pro-Democrat or pro-Republican – so voters are increasingly less likely to encounter alternative viewpoints and to be cross-pressured in the development of their political attitudes and voting behaviour, especially when the cues coming from political elites – as between the two parties in the US Congress – are also increasingly polarised. As Levendusky (2009b, 13) puts it, 'Microlevel conversion provides the building block for aggregate polarization'.

Further, those spatially-focused conversation networks do not exist outwith any external stimuli. Weak ties will link them to other networks, with the potential of new influences being introduced (Granovetter, 1973) and in addition political parties and others actively seek to influence their attitudes and behaviour (such as Political Action Committees). These, too, are increasingly spatially sophisticated in their campaigning strategies, focusing most energy and resources on people in areas where they think victory is feasible (Mitchell et al., 2015) – and there is plenty of evidence that such intensive campaigning is effective (e.g. Brady and Johnston, 2006). Such effective campaigning can accentuate the emerging polarisation with, for example, greater turnout among Democratic supporters in Counties

where the party campaigns more intensively (more campaigners on the ground; more money raised and spent), which are likely to be those Counties where Democratic support is already strong. And, as Mellow and Trubowitz (2005) suggest, greater polarisation can have important impacts on the country's governance; as has been apparent during the eight years of Barack Obama's presidency, an increasingly polarised country is reflected in an increasingly polarised Congress, which creates increased difficulties for a president – of either party – to achieve bipartisan support for substantial policy change.

There are, therefore, strong alternative hypotheses offering explanations for the spatial patterns observed by Bishop and Cushing (2008) and verified through the statistical analyses reported here. According to their arguments and qualitative findings, the observed polarisation over recent decades has resulted from increasingly-selective migration: people of different socio-economic and -demographic types have clustered together to a greater extent than previously – a pattern that some analyses of migration patterns and voting behaviour have identified (e.g. Cho et al., 2013; McDonald, 2011). A consequence of the aggregation of such individual-level behaviour should be greater spatial polarization of those groups that Bishop and Cushing identify as central to such migration-stimulated sorting processes – those differentiated by income, educational qualifications, religious affiliation and observance, ethnicity, immigrant status and household structures. Analyses similar to those reported here, using census data, are needed to evaluate whether that is the case.

Even if there is evidence of greater socio-economic and -demographic spatial polarization, however, and recent research on one of its components (ethnicity) suggests less not greater segregation over recent decades (Glaeser and Vigdor, 2012), this may not offer a full explanation for the observed polarization. Instead, social processes operating within the more socially-polarized informal and formal networks, encouraged by the geography of parties' campaigning efforts, may result in the increasingly-polarized voting behaviour reported here. People do not move to be with people who think and vote like them; instead they move to areas where the majority opinion converts them to think and vote like their neighbours – a hypothesis that should be central to a research agenda built on the empirical foundations established here.

Conclusions

A substantial piece of journalistic investigation suggested a major change to the electoral geography of the United States over the last three decades. Several academic commentators have dismissed this portrayal, arguing that more rigorous data analyses falsify the argument. That position has been in turn rejected here. Using a recently-developed statistical procedure for modelling spatial patterns at multiple scales, it has produced strong evidence that between 1992 and 2012 there was substantially, and statistically significant, greater polarisation in the pattern of voting for the Democratic Party's presidential candidates across the country's nine Divisions, across the 49 States within those Divisions, and across Counties within the States. In terms of voting for president, the United States was more polarised in 2012 than it was just two decades earlier – though across the States the polarisation was much greater in some than others. That polarisation has been reported here at the macro- and meso-spatial scales of Census Division, State and County. Other studies have identified similar patterns at micro-scales – within individual Counties and Cities – but the absence of comparable data for the entire United States has meant that such local patterning could not be incorporated into the present study of national patterns. More

investigations at those micro-scales can amplify the macro- and meso-scale patterns so clearly demonstrated here.

Whereas some research questions are clearly based in existing theories, building on previous research findings, many others are posed by observations – in much human geography, for example, by mapped patterns that call for explanations, once the veracity of the patterns has been established. The findings reported here with regard to the country's electoral geography fall within that latter category. Statistical analyses have confirmed impressionistic accounts of changes to the electoral geography of the United States: there is clear evidence of significant spatial polarisation of support for the country's two main political parties across recent presidential elections. This finding raises many important questions as to its origin – why has the polarisation occurred? The initial arguments were that, as like people tend to vote the same way, and like people tend to cluster together, then such clustering increases greater polarisation in voting patterns is the consequence. But the geographical variation uncovered here suggests that a more complex set of processes is in operation, setting an agenda for a substantial programme of future research. Not only do we need further exploration of why that polarisation has occurred, therefore; research must also explore why it is spatially variable, being much more characteristic of some parts of the country than others.

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Appendix 1

The data set deployed here was compiled by Clark Archer, Fred Shelley and Bob Watrell largely from information collected from State Election Commission, Secretary of State, or other official web sites for each State. They aggregated township votes to Counties for several New England states, combined independent cities and Counties in Virginia, summed Liberal and Democratic, and Conservative and Republican votes in New York and some other States. For 1992 and 1996 some of the data came from newspapers or other sources.

Whereas most of the data circulating on the Internet derives from "preliminary" results rather than final "certified" results, which are not available for some time after an election (December to February) for many States and Counties, and because different States have different criteria for "certified" votes, spoiled ballots, etc. exact matches with other sources are not very likely, but the differences should not be large. In 2012, for example, the "Final Certified" numbers collected through early February 2013 from State Election Commission, Secretary of State, etc. web sites showed Obama getting about 2% more votes nationally than earlier reports based on "preliminary" tallies of votes published in the *New York Times* and elsewhere shortly after the election. The trends in geographical patterns displayed and analysed here are thus unlikely to be contaminated in any way.

Appendix 2

The form of the multilevel model used in the analysis for the County analysis for each State (shown in Figure 3) is as follows – here limited to just three years to save space:

$$ProbabilityDem_{ij} \sim Binomial(Voters_{ij}, \pi_{ij})$$

$$E(logit(\pi_{ij})) = \beta_1 x_{1ij} + \beta_2 x_{2ij} + \beta_3 x_{3ij} + (u_{1j} x_{1ij} + u_{2j} x_{2ij} + u_{2j} x_{3ij})$$

$$\begin{bmatrix} u_{1j} \\ u_{2j} \\ u_{3j} \end{bmatrix} \sim N\left(0, \begin{bmatrix} \sigma^2_{u1} & & \\ \sigma_{u1u2} & \sigma^2_{u2} & \\ \sigma_{u1u3}\sigma_{u2u3}\sigma^2_{u3} & & \end{bmatrix}\right)$$

$$Var\left(ProbabilityDem_{ij} | \pi_{ij}\right) = \frac{\pi_{ij}(1-\pi_{ij})}{Voters_{ij}}$$

Where $ProbabilityDem_{ij}$ is the observed response variable, the proportion of voters *i* in County *j* that voted Democrat and $Voters$ is the denominator of the Democrat plus Republican voters. The log of the odds of voting Democrat, $logit\ (\pi_{ij})$, is modelled as a function of the fixed effects where x_{1ij} is a separately coded dummy variable with a 1 for 1992, 0 otherwise; x_{2ij} is a separately coded dummy variable with a 1 for 1996, 0 otherwise and so on; and β_1 is the overall logit for the typical County in 1992 , while β_2 is the equivalent for 1996; and so on. In the random part of the model there is a variance-covariance matrix at level 2 for Counties. The terms on the main diagonal are the variances with σ^2_{u1} being the variance of the level 2 County departures (u_{1j}), from the fixed effects in 1992 and is a measure of the degree of polarization in that year. Similarly σ^2_{u2} is the variance of the County differentials in 1996 (u_{2j}) while σ_{u1u2} is the covariance of the County differentials in 1992 and 1996. At level 1 there is a single variance term and this is assumed to follow a Binomial distribution. In this two-level model there is exactly the same set of units – the Counties – at level 1 and level 2; that is, each level 2 unit has exactly one level 1 unit. This views the proportions at level 2 as consisting of replicated binary responses for *individual*s at level 1. This use of a pseudo-level is fully explained in Brown et al. (2005) and allows the separation of the variance into exact Binomial at level 1 and over-dispersion at level 2 whose variance is the measure of polarization – the summary of the differences between Counties in excess of that expected from a Binomial with a varying denominator. The model used for the analysis of Divisions, States and Counties requires two additional variance-covariance matrices at the Division and State level.

It is worth stressing that exactly the same results would have been obtained if individual binary outcome data with a value 1 for voting Democrat and 0 for Republican had been analysed (Subramanian et al., 2001). In short, had we disaggregated the tabulation on which the analysis are conducted we could have implemented the same model: however, as there is no information lost between the individual row by row version and the tabulation we used, we adopted the more efficient (in terms of storage and run-time) modelling of proportions strategy Consequently, this multilevel approach transcends the dilemma of the atomistic and ecological fallacies (Subramanian et al., 2009) in that we have simultaneously modelled the probability of individual voting and the extent to which it varies ecologically from place to place. This ecological variation in the individual vote is our measure of segregation and the variance at the higher level is calculated net of level 1 'individual' variation.

Notes

[1] Of course, some movers have more choice than others because of their income and wealth and ability to compete in housing markets. Those with constrained choices are necessarily restricted to certain housing market segments only, and increasingly these will be populated by people like themselves.

[2] Ross Perot won 18.9 and 8 per cent of the popular vote respectively in the 1992 and 1996 presidential elections.

[3] Other studies (e.g. Reardon et al., 2000; Fischer et al. 2004) have looked at nested patterns of segregation using Thiel's entropy measure of segregation but those applications include no measure of the statistical significance of differences over space and/or time, which is an important and original feature of the MOR measure deployed here. One frequently criticised aspect of many segregation studies is that they are, in one sense, aspatial since they take no account of the relative location of the spatial units analysed – hence work introducing spatial autocorrelation measures into segregation studies. The method deployed here does take spatial clustering into account, however, as the ratios for smaller units are calculated within the next-level units where they are nested (as set out in more detail in Manley et al., 2015a).

[4] On the nature of the data set, see Appendix 1.

[5] There are major differences between States in the number of smaller divisions – South Dakota has just three, for example, and Massachusetts 254 – raising potential MAUP issues that will be addressed in further research.

[6] Which is not to claim that those are the only scales at which polarisation occurred. They may well have been within-County polarisation in at least some Counties – probably mainly those in the country's metropolitan areas. Analysis of these requires finer-grained data than we have available, and which could not be obtained for all Counties, requiring separate analyses of different States (as in Myers, 2013).

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Table 1. Parameters of the distributions of the percentage voting Democrat at the 1992-2012 US presidential elections, at the Division, State and County scales

	Minimum	Maximum	Mean	Standard Deviation	Coefficient of Variability
Division					
1992	47.7	58.4	53.1	3.9	7.3
1996	47.0	64.7	54.4	5.8	10.7
2000	41.0	60.3	49.6	7.1	14.3
2004	39.3	58.6	48.1	7.0	14.5
2008	41.5	61.8	52.6	7.8	14.8
2012	39.9	60.6	50.9	8.1	15.9
State					
1992	36.3	62.1	51.9	6.1	11.7
1996	38.0	69.0	53.2	7.5	14.1
2000	28.3	65.7	47.6	8.9	18.7
2004	26.7	62.7	46.4	8.6	18.5
2008	33.4	73.0	51.6	9.6	18.6
2012	25.4	71.7	49.3	10.5	21.2
County					
1992	10.8	86.5	49.6	11.2	22.6
1996	11.8	89.3	49.5	11.7	23.6
2000	6.9	88.0	41.1	12.2	29.7
2004	7.2	87.2	39.0	12.6	32.3
2008	5.0	90.0	42.1	14.0	33.2
2012	3.5	94.0	39.1	14.9	38.1

Table 2. The estimated Median Odds Ratios (MORs), with their associated credible intervals (CIs),
for voting Democrat at the 1992-2012 US presidential elections,
at the Division, State and County scales

	Division			State			County		
Year	LowCI	MOR	HighCI	LowCI	MOR	HighCI	LowCI	MOR	HighCI
1992	1.12	1.20	1.34	1.17	1.21	1.27	1.47	1.48	1.50
1996	1.16	1.27	1.48	1.20	1.25	1.32	1.47	1.49	1.50
2000	1.22	1.39	1.69	1.22	1.28	1.35	1.51	1.53	1.54
2004	1.23	1.41	1.75	1.22	1.27	1.34	1.55	1.56	1.58
2008	1.29	1.51	1.93	1.23	1.29	1.36	1.60	1.62	1.64
2012	1.30	1.55	2.02	1.29	1.36	1.47	1.69	1.69	1.73

Table 3. The coefficients of variation (CVs) for voting Democrat at the 1992 and 2012 US presidential elections across Counties within States, and changes in those coefficients. (The States are ordered according to the absolute value of change between the two elections.)

State	Division	CV1992	CV2012	CVChange	CV%Change
TX	WSC	26.26	56.65	30.39	115.71
UT	MOU	36.97	62.41	25.44	68.83
AL	ESC	23.42	48.63	25.21	107.68
WY	MOU	21.86	45.38	23.51	107.56
GA	SA	17.81	40.99	23.18	130.12
LA	WSC	14.01	36.56	22.56	161.03
AR	WSC	12.22	30.67	18.45	150.94
KS	WNC	22.54	40.38	17.84	79.15
ND	WNC	18.96	36.41	17.45	92.03
MT	MOU	23.19	40.42	17.24	74.34
MS	ESC	23.94	40.01	16.07	67.15
ID	MOU	27.51	42.66	15.15	55.09
OR	PAC	16.23	31.23	15.00	92.39
AZ	MOU	13.25	27.83	14.58	110.11
NV	MOU	20.23	34.69	14.45	71.44
SD	WNC	23.58	37.71	14.13	59.95
CO	MOU	22.46	36.07	13.61	60.58
FL	SA	17.71	31.24	13.53	76.44
NM	MOU	22.47	35.25	12.78	56.87
DE	SA	10.00	22.16	12.16	121.55
MO	WNC	14.35	25.47	11.13	77.57
MD	SA	22.70	33.01	10.31	45.43
NE	WNC	27.49	37.78	10.29	37.44
IL	ENC	14.15	23.33	9.18	64.85
WA	PAC	14.31	23.46	9.15	63.93
CA	PAC	17.65	26.42	8.77	49.72
NC	SA	19.62	27.97	8.35	42.58
VA	SA	18.88	26.03	7.15	37.85
TN	ESC	19.25	26.27	7.02	36.46
SC	SA	20.34	26.11	5.77	28.36
PA	MA	20.97	26.54	5.56	26.52
NJ	MA	16.32	21.42	5.10	31.21
MA	NE	9.50	14.18	4.69	49.32
OK	WSC	24.28	28.22	3.94	16.22
KY	ESC	23.56	27.36	3.80	16.14
MN	WNC	11.39	15.01	3.62	31.78
WI	ENC	14.40	17.78	3.39	23.51
IA	WNC	14.80	17.77	2.97	20.04
ME	NE	5.12	7.60	2.48	48.44
NY	MA	18.82	21.12	2.29	12.18
OH	ENC	20.96	22.88	1.92	9.16
IN	ENC	19.67	21.27	1.60	8.15
WV	SA	18.03	19.47	1.45	8.02
RI	NE	4.32	5.70	1.38	31.95
MI	ENC	13.83	14.96	1.13	8.17

NH	NE	9.34	10.39	1.04	11.17
VT	NE	7.31	7.91	.61	8.29
CT	NE	8.18	7.86	-.32	-3.94
HI	PAC	6.97	4.02	-2.96	-42.41

Key to Divisions: NE – New England; MA – Mid-Atlantic; SA- South Atlantic; ENC – East North Central; WNC – West North Central; ESC – East South Central; WSC – West South Central; MOU – Mountain; PAC – Pacific.

Table 4. The modelled differences in the changing variances over time across Counties within States,
with their associated chi-square values and probabilities of differing significantly from zero.
(The States are ordered according to the size of those modelled differences.)

State	Division	Diff	Chi	p	State	Division	Diff	Chi	p
AL	ESC	0.552	19.4	0.00	IL	ENC	0.075	6.7	0.01
MS	ESC	0.495	27.5	0.00	NJ	MA	0.209	6.3	0.01
TX	WSC	0.361	44.9	0.00	WY	MOU	0.267	4.3	0.04
GA	SA	0.357	41.5	0.00	IO	WNC	0.029	4.2	0.04
LA	WSC	0.339	18.7	0.00	AZ	MOU	0.279	3.2	0.07
CO	MOU	0.297	17.4	0.00	UT	MOU	0.254	2.1	0.15
SD	WNC	0.297	18.4	0.00	NE	MOU	0.247	2.7	0.10
ND	WNC	0.280	15.4	0.00	DE	SA	1.324	0.0	0.87
CA	PAC	0.238	18.3	0.00	PA	MA	0.063	1.8	0.18
FL	SA	0.203	13.7	0.00	VT	NE	0.038	1.1	0.30
LS	WSC	0.141	16.8	0.00	MA	NE	0.032	0.4	0.53
NY	MA	0.126	13.8	0.00	RI	NE	0.032	0.2	0.69
NM	MOU	0.400	11.0	0.00	NH	NE	0.029	0.3	0.58
OR	PAC	0.265	11.7	0.00	ME	NE	0.024	0.4	0.53
MT	MOU	0.228	11.9	0.00	MN	WNC	0.023	3.1	0.08
AK	WSC	0.130	11.5	0.00	OH	ENC	0.032	0.2	0.66
NC	SA	0.108	10.8	0.00	CT	NE	0.002	0.0	0.96
NE	MOU	0.106	12.1	0.00	MI	ENC	-0.004	0.1	0.82
WA	PAC	0.135	8.7	0.00	IN	ENC	-0.013	0.4	0.53
MD	SA	0.495	8.1	0.01	HI	PAC	-0.038	0.0	0.92
VA	SA	0.107	7.8	0.01	OK	WSC	-0.079	3.1	0.08
ID	MOU	0.236	7.1	0.01	TN	ESC	-0.069	4.2	0.04
SC	SA	0.132	6.9	0.01	KY	ESC	-0.085	4.9	0.03
WI	ENC	0.062	7.1	0.01	WV	SA	-0.112	6.2	0.01
MO	WNC	0.051	6.9	0.01					

Key to Divisions: NE – New England; MA – Mid-Atlantic; SA- South Atlantic; ENC – East North Central; WNC – West North Central; ESC – East South Central; WSC – West South Central; MOU – Mountain; PAC – Pacific.

Captions

Figure 1. The modelled MOR values for the polarisation of voting for the Democratic party's presidential candidates, 1992-2012, with their associated CIs, by Division (left), by State within Division (centre), and by County within State within Division (right).

Figure 2. Differences from the national trend by Division.

Figure 3. The MORs for between-County polarisation in voting for the Democratic party's presidential candidates, 1992-2012: each State modelled separately.

Figure 1. The modelled MOR values for the polarisation of voting for the Democratic party's presidential candidates, 1992-2012, with their associated CIs, by Division (left), by State within Division (centre), and by County within State within Division (right).

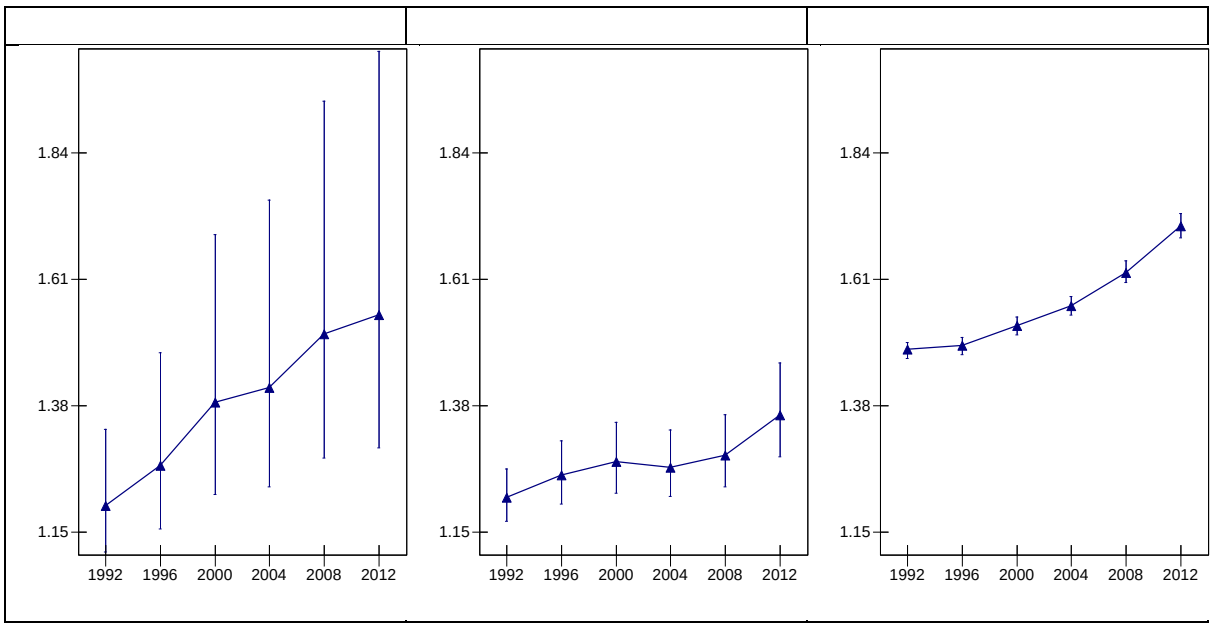

Figure 2. Differences from the national trend by Division.

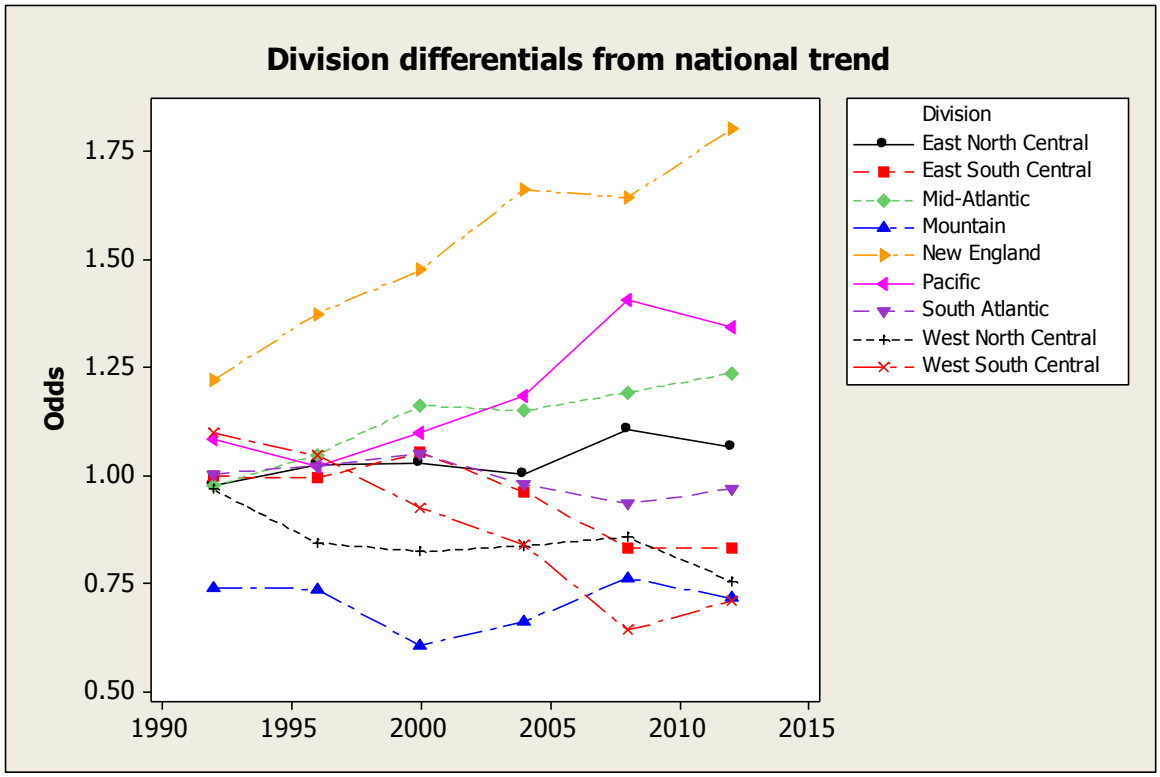

Figure 3. The MORs for between County polarisation in voting for the Democratic party's presidential candidates, 1992-2012: each State modelled separately