Measuring Geographic Polarization: Theory and Long-Run Evidence*

Ethan Kaplan, *University of Maryland*
Jörg L. Spenkuch, *Northwestern University*
Rebecca Sullivan, *University of Maryland*

January 2019

Abstract

We document the evolution of geographic partisan polarization in the American electorate. Our analysis begins by proposing seven theoretical properties that are intuitively desirable for a summary measure of voter polarization. We then formally prove that a variance-like index is the only measure that satisfies all desiderata. Using this index, we provide evidence that spatial cleavages have increased dramatically since the mid-twentieth century—consistent with the Big Sort hypothesis. At no point since the Civil War have partisans been as clustered *within* the boundaries of individual states as today. Nonetheless, even when geographic polarization is measured at the precinct level, differences across communities tend to be significantly smaller than differences within. In this sense, the American electorate continues to be more diverse within than across areas.

*We thank Daniel Kolliner for excellent research assistance. We have also benefited from helpful comments by Morris Fiorina, Jim Gimpel, Marc Hetherington, Greg Martin, Pablo Montagnes, Cody Tuttle, Haishan Yuan and audience members at the 2018 APSA Annual Meeting. Any mistakes, however, are our own. Correspondence can be addressed to Kaplan at `kaplan@econ.umd.edu`, Spenkuch at `j-spenkuch@kellogg.northwestern.edu`, or Sullivan at `rebeccasullivan97@gmail.com`.

1 Introduction

According to journalists and pundits, ordinary Americans are not only divided in their allegiance to one of the two major parties, but partisan divisions also manifest themselves across space. Republican supporters live in "red," rural states, while Democrats reside in "blue," urban areas along the coasts. In fact, in a bestselling popular-science book, journalist Bill Bishop argues that Americans have become so clustered in like-minded communities that the resulting spatial fissures are tearing us apart (Bishop 2008).

More specifically, Bishop's *Big Sort* makes three claims. (1) There has been a large increase in the geographic clustering of partisans. (2) This increase has been driven, in part, by intentional sorting based on individuals' lifestyles and political preferences, and (3) the resulting homogeneity of communities has lead to ideological inbreeding and thus exacerbated the ongoing polarization of the electorate.

While Bishop's claims struck a cord with a large lay audience—even former President Bill Clinton recommended it—within academia, his assertions have been received with great skepticism. Although there exists broad consensus that American legislators are more polarized now than at any point in more than a century (Theriault 2008, Jensen et al. 2012, McCarty et al. 2016, Gentzkow et al. 2017), scholars continue to disagree on whether voters themselves have been polarizing as well (see, e.g., Ansolabehere et al. 2006, Abramovitz and Saunders 2008, Levendusky 2009, Fiorina et al. 2010). In addition, the *very* basis of Bishop's argument, i.e., the claim that partisans are living in more like-minded communities today than in years past, has been questioned due to a lack of sound empirical support. In the words of Fiorina (2017), "the arguments and analyses in *The Big Sort* are flimsy, ranging from anecdotal to impressionistic" (see also Abrams and Fiorina 2012).

In this paper, we contribute to the ongoing debate about divisions within the American electorate by documenting trends in geographic polarization over long periods of time. That is, we empirically assess the claim that partisans are increasingly clustered across space. We thus focus on the first of the three claims made in Bishop's book. Following previous authors (e.g., Hopkins 2010, Abrams and Fiorina 2012, Martin and Webster 2018), we refer to this phenomenon as "geographic polarization." To better understand why geographic polarization is related to but ultimately distinct from polarization in preferences or ideology, consider Figure 1. The figure depicts two states, each of which consists of two towns. In state 1, "R" and "D" voters have perfectly sorted. In state 2, however, partisans are equally distributed across towns. Although the aggregate distribution of voters is the same, state 1 is geographically polarized, whereas state 2 is not. In state 2, differences in partisanship manifest themselves *within* rather than across communities.

[Figure 1 about here.]

To date, some of the best evidence for or against the arguments in the *Big Sort* comes from studies asking whether citizens choose where to live based on politics (McDonald, 2011; Gimpel and Hui, 2015; Mummolo and Nall, 2017; Martin and Webster, 2018). In other words, most previous scholarship speaks to claim (2) and to some degree claim (3) of Bishop (2008). Much less work has been done to directly assess whether voters are, in fact, more geographically polarized than in the past. Moreover, the little evidence that does exist is, for the most part, based on state-level differences and without a principled way of drawing comparisons over time (e.g., Glaeser and Ward 2006, Hopkins 2017). Glaeser and Ward's (2006) assertion that partisan segregation is one of the big myths of American electoral geography is, therefore, about as speculative as the *Big Sort* hypothesis itself.

In fact, two recent studies based on detailed voter-registration records do present evidence of partisan clustering. Brown and Enos (2018) use a snapshot from 2017 to show that, today, Democrats and Republicans are nearly as segregated as racial minorities. Sussell (2013) relies on data from California spanning the period from 1992 to 2010. His results suggest that partisan segregation increased noticeably during this time.[1]

[1] Specifically, Sussell (2013) computes isolation and segregation indices using partisan registration rates as well as presidential election returns. Eleven of his twelve measures of partisan segregation increased during this period, with rates of growth ranging from 2.1% to 23.1%.

Our analysis goes beyond the extant literature in a number of ways. First, we ask how, on theoretical grounds, geographic polarization *should* be measured. To this end, we show that a variance index is the only measure that satisfies a set of intuitively desirable criteria and allows us to decompose overall polarization into differences across and within communities. As a result, the variance index lets us consistently compare polarization across areas with how internally polarized the respective communities are. Second, we analyze geographic polarization going all the way back to 1856, the first presidential election with both a Democratic and Republican candidate. Such a long horizon is useful for putting recent trends into perspective. Third, we focus on the entire country rather than a particular state. Fourth, in addition to computing the degree of county-level polarization for presidential elections, we conduct a similar analysis at the level of the electoral precinct, and for elections to the House of Representatives. Fifth and last, we study geographic polarization in presidential primaries. This allows us to measure polarization *within* the base of each party and thus net of partisanship.

Our analysis unearths a rich set of previously unknown facts. Specifically, we find that, within states, partisan geographic polarization has increased approximately five fold between its nadir in 1976 and the most recent presidential election in 2016. Surprisingly, since the 1970s, our measure of within-state geographic polarization is nearly perfectly correlated with Poole and Rosenthal's (1997) well-known index of polarization in the U.S. House ($\rho = .95$). Regardless of whether we measure within-state polarization at the county or precinct level, the data reveal a dramatic increase in spatial differences—especially over the last five election cycles. Geographic polarization within states is currently at a historic high.

Polarization across states has also risen, and we are currently at levels that have not been seen in more than fifty years. Nonetheless, our findings show that partisan divisions across states were substantially larger in the early parts of the 20th century and before the Civil War.

The recent increase in geographic polarization is not limited to presidential elections. In fact, in elections to the House of Representatives, we see a comparable upward trend *within* congressional districts. When we analyze Democratic and Republican presidential primaries, however, we find little evidence of rising geographic polarization. In fact, within each party's base, geographic divisions along ideological lines are minimal. Our analysis thus reveals geographic sorting on partisanship but not on ideology conditional on partisan affiliation.

Finally, though we document a dramatic rise in spatial polarization over the last few decades, all of our results imply that differences between individuals within counties or precincts are, on average, many times greater than differences across space. At the same time, we emphasize that it is difficult to say how much geographic polarization is "too much." Current levels are high by historical standards, and there simply does not exist enough evidence on the causal effect of geographic cleavages on democratic outcomes to speculate about potential consequences.

By developing a theoretically grounded measure of geographic polarization and by documenting the recent increase therein, our analysis paves the way for research on a number of important questions. For instance, are spatial divisions in the electoral landscape a cause or a consequence of elite polarization? Does the clustering of like-minded partisans lead to better or worse representation? Does it cause legislative dysfunction? Does partisan sorting create ideological echo chambers—as asserted by Bishop (2008)—or is it irrelevant for the evolution of voters' views and preferences? On theoretical grounds the answers to these questions are inherently ambigous. What our analysis establishes is that, today, partisans are more geographically clustered than at any time in recent memory.

In independent, simultaneous work, Darmofal and Strickler (forthcoming) also present time-series evdience on long-run geographic polarization. An important difference between their approach and ours is that they rely on Bishop's (2008) concept of "landslide counties" to measure geographic polarization. As previously pointed out by Abrams and Fiorina (2012) and Klinkner (2004a; 2004b), using landslide counties to assess changes in geographic polarization is theoretically problematic because the results can be highly dependent on arbitrary definitional figures (see below). As a consequence, some of Darmofal and Strickler's substantive conclusions differ greatly from ours. While they find that "the percentage of the voting public living in heavily or landslide partisan counties in the twenty-first century is well within a normal historical range" (p. 83), we show that, when properly measured, current levels of geographic polarization are very high by historical standards.

2 Measuring Geographic Polarization: Theory

Gentzkow (2016) notes that there are many ways to define polarization, and much of the scholarly disagreement on whether the American electorate has polarized stems from different ways of looking at the same question. Unfortunately, most extant measures of geographic polarization have an *ad hoc* quality. Bishop (2008), for instance, calculates the share of voters living in "landslide counties," i.e., counties in which one party achieved a victory margin of at least 20%. Abrams and Fiorina (2012) criticize this measure for being arbitray and vague, and Klinkner (2004a; 2004b) shows that small definitional changes lead to as much as a 25% reduction in the number of voters in such counties. Issues like these beg the question, how *should* voter polarization be measured, especially when we are interested in drawing comparisons across space?

In what follows, we propose seven properties that a good measure of voter polarization ought to possess. The first six of them are desirable for any polarization index, while the last property is tailored to the the problem of measuring geographic polarization, which requires us to consistently compare polarization at different levels of spatial aggregation. We then prove that there exists one and only one index that satisfies all desiderata.

To be clear, there is a vast literature in economics that axiomatically derives different indices (see, e.g., Shorrocks 1984; Esteban and Ray 1994; Cowell 2010). Our contribution is to recognize that the mathematical structure of measuring polarization is very similar to that of measuring inequality. We can, therefore, build upon prior work, particularly Bosman and Cowell (2010), and bring some of its insights to bear on our question.

Readers familiar with this previous literature might wonder, why not rely on the well-known index developed by Esteban and Ray (1994)? Here is why. Esteban and Ray assume that the population of interest can be partitioned into internally homogenous groups. They then measure polarization as a function of each group's size and the difference in preferences between them. The problem with applying this approach to the measurement of spatial polarization is that geographic areas like states, counties, and even electoral precincts are not internally homogenous. Hence, to measure polarization across areas we cannot use Esteban and Ray's index "off the shelf", i.e., without imposing further assumptions. In addition, and perhaps more importantly, their index cannot be consistently decomposed into across- and within-group polarization. That is, even if we are willing to assess polarization across space by looking at, say, the mean or median member of each state—as we do below—we would still not be able to rely on their seminal work to determine whether cleavages across states are large or small relative to divisions within the respective states. Since this is an important objective of ours, we choose to derive a novel measure of geographic polarization by stipulating the seven porperties that this measure must posses in order to be useful for our purposes.[2]

Mathematical Preliminaries.—In order to focus solely on the problem of measuring geographic polarization, we assume that the researcher observes a valid proxy for voters' ideology or partisanship.[3] Formally, let there be n individuals, whose preferences are characterized by $\mathbf{x} = (x_1, ..., x_n)$. We use $\bar{x} = (1/n)\sum_{i=1}^{n} x_i$ to denote the mean of $\mathbf{x}$, while $\bar{\mathbf{x}}$ is an $n \times 1$ vector with $\bar{x}$ in every position.

Definition. A polarization index is a function P that assigns a real number to any vector of preferences $\mathbf{x}$, i.e., $P : \mathbb{R}^n \to \mathbb{R}$.

[2] As a technical matter, Esteban and Ray's (1994) index satisfies our first six axioms but not Axiom 7. In addition, Esteban and Ray's measure is a partial rather than a complete ordering. Our variance index is unique up to a scalar multiple, and it constitutes a complete ordering.

[3] In our empirical application, we use electoral returns to proxy for the partisanship of voters.

Desirable Properties.—Any measure of voter polarization ought to have a well-defined and easily interpretable baseline. Our first axiom, therefore, states that measured polarization should be equal to zero when all voters have identical preferences.

Axiom 1 (normalization)**.** $P(\mathbf{x}) = 0$ *whenever* $x_i = x_j$ *for all* i, j.

In addition, a polarization index should be robust to changes in the political environment that cause voters to become *uniformly* more liberal or conservative. As commonly understood, polarization refers to a divergence of preferences rather than the extremity of their mean. Hence, Axiom 2 requires that uniform changes in voters' preferences have no effect on P.

Axiom 2 (translational invariance)**.** $P(\mathbf{x} + \mathbf{c}) = P(\mathbf{x})$ *for any* $\mathbf{c} = (c, ..., c) \in \mathbb{R}^n$.

Since we are concerned with voter rather than elite polarization, we also think it desirable that all individuals receive equal weight. That is, conditional on the *distribution* of preferences, measured polarization should not depend on who holds which views (Axiom 3).

Axiom 3 (anonymity)**.** $P(\mathbf{y}) = P(\mathbf{x})$ *whenever* $\mathbf{y}$ *is simply a permutation of* $\mathbf{x}$.

Nor should it matter how many individuals there are (Axiom 4). In particular, an exact doubling of the population maintaining the distribution of preferences should not impact the index.

Axiom 4 (population independence)**.** $P(\mathbf{x}, \mathbf{x}) = P(\mathbf{x})$.

Independence of population size is important for directly comparing differently-sized groups of voters. By imposing Axiom 4, we ensure that our conclusions about the evolution of polarization across space and time are solely due to changes in the distribution of voters' preferences rather than differences in population size.

Our next axiom requires that small changes in preferences lead only to small changes in measured polarization.

Axiom 5 (continuity)**.** *P is continuous in every element of* $\mathbf{x}$.

To see the main implication of this property, note that continuity fails for all indices that rely on cutoff values to classify states, counties, or any other group of voters. Threshold-based indices are theoretically problematic because substantively minor differences between voters across space or time may give the (false) impression of large differences in the degree of polarization. Ansolabehere et al. (2006), for instance, argue that categorizing states as either "red" or "blue" obscures the fact that most of America is actually "purple." Klinkner (2004a; 2004b) makes a similar point when he criticizes Bishop's (2008) measure of "landslide counties." He even demonstrates that small changes to the cutoff used to define "landslides" have a big effect on the results. By contrast, a continuous measure of polarization is immune to such problems.

An important additional requirement is that as voters' preferences diverge, measured polarization increases.

Axiom 6 (spread responsiveness)**.** *If* $\mathbf{x} = (x_1, x_2)$ *with* $x_1 \leq x_2$ *and* $\mathbf{x}' = (x_1 - c, x_2 + c)$ *for some* $c > 0$*, then* $P(\mathbf{x}') > P(\mathbf{x})$.

In words, Axiom 6 deals with the minimal case of an electorate of only two individuals.

If the ideological distance between the two increases (without changing the mean), then measured polarization must go up. Any index that does *not* satisfy this property is an inherently flawed measure of polarization.[4]

In our view, Axioms 1–6 are not controversial. They are desirable for any polarization index. Our last axiom may be more contentious. Yet, it is crucial for assessing the importance of geographic divisions.

According to the Big Sort hypothesis, Americans increasingly cluster in politically like-minded communities. As in the example in Figure 1, even absent any macro-level differences in overall polarization, voters today might be living in more homogenous communities than just a few decades ago. Conversely, the American electorate as a whole might have become more polarized without cleavages across space widening. Hence, assessing the *Big Sort's* core claim involves a comparison of differences across and within communities. Put differently, we need to be able to disentangle communities becoming more or less alike from changes in how internally polarized the respective groups of voters are. Further, absent a commonly accepted definition of "community," we need to be able to *consistently* do so at different levels of spatial aggregation. Suppose, for instance, that, according to P, voters within every single electoral precinct in some state have become more polarized over time, without differences across precincts having decreased. Then if we use to P to asses polarization in the state as a whole, it should also indicate rising polarization on the state level. Axiom 7 ensures that this is the case.

Axiom 7 (decomposability)**.** *There exists a nonnegative weighting function ω such that (i)* $\underbrace{P(\mathbf{x}, \mathbf{y})}_{overall\ polarization} = \underbrace{\omega(\bar{x}, \bar{y}, n_x, n_y)P(\mathbf{x}) + \omega(\bar{y}, \bar{x}, n_y, n_x)P(\mathbf{y})}_{weighted\ within-group\ polarization} + \underbrace{P(\bar{\mathbf{x}}, \bar{\mathbf{y}})}_{across-group\ polarization}$ *for all* $\mathbf{x} \in \mathbb{R}^{n_x}$ *and* $\mathbf{y} \in \mathbb{R}^{n_y}$*, and (ii)* $\omega(\bar{x}, \bar{y}, n_x, n_y) + \omega(\bar{y}, \bar{x}, n_y, n_x) = 1$.

[4] We define Axiom 6 in terms of two voters so that it is straightforward to say whether polarization should be increasing or descreasing. With three or more individuals, it is possible for an increased spread between one pair of individuals to coincide with a decline between other pairs, in which case it is *a priori* unclear whether polarization should go up or down.

Intuitively, the axiom stipulates that a useful measure of geographic polarization ought to be decomposable into an across- and within-group component. In our application, the former measures the degree of geographic polarization, i.e., differences across, say, states, counties, towns, or neighborhoods, etc., asumming that every member of a particular community was the same as its average member. The latter is a weighted average of the polarization within each group of voters.

As a technical matter, we restrict ω to be an *arbitrary* function of mean preferences as well as groups' sizes. We further require that all weights be non-negative and sum up to one. This last condition ensures that, if there are no mean differences across communities, then society as a whole shall not be deemed more (less) polarized than its most (least) polarized subgroup.

A Unique Index.—We view each of the properties in Axioms 1–7 as desirable for an index that is being used to document geographic divisions over time. Given these axioms, we can formally prove that there exists a uniquely good measure.

Proposition 1. *A polarization index satisfies Axioms 1–7 if and only if it is a scalar multiple of* $P(\mathbf{x}) = (1/n)\sum_{i=1}^{n}(x_i - \bar{x})^2$. *Since* P *corresponds to the population variance, we refer to this index as the variance index.*

In words, the proposition establishes that the variance index is the *only* measure of polarization that has all of the desired properties. *Any other index violates at least one of our desiderata.*[5]

As a corollary to Proposition 1, the weights needed to disaggregate the variance index across different groups of voters are simply the groups' population shares.

Corollary. *Suppose that* $P(\mathbf{x})$ *satisfies Axioms 1–7, then* $\omega(\bar{x}, \bar{y}, n_x, n_y) = \frac{n_x}{n_x+n_y}$.

[5]See Massey and Denton (1988) for a useful discussion of the properties of different measures of segregation, many of which may seem *prima facie* useful for measuring geographical polarization.

In the remainder of this paper, we rely heavily on this decomposition in order to assess whether Democratic and Republican supporters are more geographically clustered today than in decades past.

While Proposition 1 holds given *any* unidimensional representation of individuals' preferences or actions, it is silent on how to best gauge ideology or partisanship. As a result, comparisons between different groups of voters may well depend on the underlying measure of preferences. We, therefore, advocate that the variance index be used with the understanding that any conclusion is inextricably tied to the representation of preference on which it is based. That is, the variance index measures polarization in whatever facet of voters' preferences or actions is captured by $\mathbf{x}$.

3 Data and Methods

3.1 Mapping Theory into Data

Since we are interested in assessing the importance of the spatial cleavages over long periods of time, most of our empirical application focuses on geographic polarization in partisan voting. Naturally, votes are binary and thus do not reflect the intensity of citizens' preferences. We nevertheless focus on voting because of its central importance to democratic outcomes, and because of data limitations. Polling data, unfortunately, are scant before 1930 and rarely allow for valid inferences below the state level. If we want to contrast geographic polarization today with the divisions that existed during the New Deal or during Reconstruction, we are forced to rely on electoral returns as a proxy for voters' partisan preferences.[6]

To operationalize our theoretical insights in the previous section, consider a presidential election in which the Democratic candidate received n^D votes, while the Republican one

[6]We note that, in general elections in the U.S., there is little reason to cast strategic ballots. It is, therefore, reasonable to assume that votes proxy for partisan preferences.

garnered n^R.[7] We represent the choices of voters in this election by letting $\mathbf{x}$ be a vector with n^D ones and n^R zeros. Denoting the Democratic two-party vote share as v, it is straightforward to show that the variance index simplifies to

$$P(\mathbf{x}) = \frac{1}{n}\left[n^D(1-v)^2 + n^R v^2\right] = v(1-v), \tag{1}$$

where $n = n^D + n^R$. Based on this expression, P is minimzed when all voters back the same candidate, i.e., $v = 1$ or $v = 0$; it is maximized when the electorate is equally split, i.e., when $v = .5$.

In this context, it is important to distinguish ideological extremity from geographic partisan polarization. An area with a very high or very low Democratic vote share is likely an extreme one. For instance, in 2016 three counties had a Democratic two-party vote share below 5%: King County (TX), Roberts County (TX) and Garfield County (MT); while another sixty counties saw Democratic vote shares below 10%. On the Democratic side, in addition to the eight wards of Washington D.C., four counties had two-party Democratic vote share in excess of 90%: Prince George's County (MD), Oglala Lakota County (SD), Bronx County (NY), and San Francisco County (CA). The aforementioned places are likely some of the most partisan within the United States. They also contribute substantially to spatial polarization; yet, they are the least internally polarized because they are homogeneous in how residents voted.

By contrast, the Democratic and Republican two-party vote shares fell within 0.2 percentage points of parity in eight counties: Clark County (WA), Lorain County (OH), Winnebago County (IL), Kent County (RI), Panola County (MS), Kendall County (IL), Nash County (NC), and Teton County (ID). These were the most-polarized counties in the 2016 presidential election because they had the greatest amount of internal heterogeneity.

By itself, the variance index in equation (1) is insufficient to assess the importance of geo-

[7] We ignore votes for third-party candidates. The number of votes for these candidates is small in most, though not all, elections that we study.

graphic cleavages. To assess polarization across space we partition $\mathbf{x}$ so that each component corresponds to the electorate of a well-defined geographic unit, and apply the decomposition in Axiom 7. For example, when we measure polarization across states, we let $\bar{\mathbf{x}}_s$ be an $|n_s| \times 1$ vector with the Democratic vote share in state s in all positions, while, for each state, $\mathbf{x}_s$ is an $n_s \times 1$ vector with n_s^D ones and n_s^R zeros. We then calcuate voter polarization across states as

$$\underbrace{P(\bar{\mathbf{x}}_1, ..., \bar{\mathbf{x}}_s, ..., \bar{\mathbf{x}}_S)}_{polarization\ across\ states} = \underbrace{P(\mathbf{x})}_{overall\ polarization} - \underbrace{\sum_{s=1}^{S} \frac{n_s}{n} P(\mathbf{x}_s)}_{polarization\ within\ states} = \sum_{s=1}^{S} \frac{n_s}{n} (v_s - v)^2. \tag{2}$$

Since we are mainly interested in geographic rather than overall polarization, we often report across-state polarization relative to the overvall level, i.e., $P(\bar{\mathbf{x}}_1, ..., \bar{\mathbf{x}}_s, ..., \bar{\mathbf{x}}_S)/P(\mathbf{x})$. We refer to this ratio as the across-state polarization share and interpret it as the fraction of overall polarization that is attributable to geographic differences. If states have, indeed, become more "red" or " blue," then the across-state polarization share should have increased over time.

We can perform comparable calculations for any geographic level at which we observe electoral returns. Moreover, by repeatedly applying our decomposition to geographic units that are nested, we can assess the relative importance of geographic cleavages at different levels of aggregation. For instance, since counties are nested within states, we can further decompose equation (2) into

$$\underbrace{P(\mathbf{x})}_{overall\ polarization} = \underbrace{P(\bar{\mathbf{x}}_1, ..., \bar{\mathbf{x}}_s, ..., \bar{\mathbf{x}}_S)}_{pol.\ across\ states} + \underbrace{\sum_{s=1}^{S} \frac{n_s}{n} P(\bar{\mathbf{x}}_{1,s}, ..., \bar{\mathbf{x}}_{c,s}, ..., \bar{\mathbf{x}}_{C_s,s})}_{within-state\ pol.\ across\ counties} + \underbrace{\sum_{s=1}^{S} \sum_{c=1}^{C_s} \frac{n_{c,s}}{n} P(\mathbf{x}_{c,s})}_{pol.\ within\ counties}, \tag{3}$$

where C_s denotes the number of counties in state s, and $\mathbf{x}_{c,s}$ represents the preference profile of voters in county c in the same state. Intuitively, the first term on the right-hand side in equation (3) measures the importance of differences in voters' mean preferences across states. The second term tells us how geographically divided voters are, on average, across counties within the same state. The last term measures voter polarization within individual counties. Thus, our decomposition can be thought of as disentangling differences between individuals within the same county from differences in the average across counties within the same state, as well as mean differences across states. Below, we demonstrate that the importance of these components varies considerably over the long arc of American history.

As a practical matter, the middle term on the right-hand side of equation (3) simplifies to

$$\sum_{s=1}^{S} \frac{n_s}{n} P(\bar{\mathbf{x}}_{1,s}, ..., \bar{\mathbf{x}}_{c,s}, ..., \bar{\mathbf{x}}_{C_s,s}) = \sum_{s=1}^{S} \frac{n_s}{n} \sum_{c=1}^{C_s} \frac{n_{c,s}}{n_s} (v_{c,s} - v_s)^2,$$

where $v_{c,s}$ and v_s respectively denote the Democratic two-party vote share in county c and state s as a whole. For the most recent period, we also assess geographic polarization at the precinct level. Precinct-level data allow us to document trends in geographic polarization at a much finer scale, but only for a shorter time frame and subject to the caveat that precinct boundaries are not temporally stable. Calculating precinct- rather than county-level polarization requires nothing more than an appropriate change of indices in the equation above.

Lastly, we extend our analysis to primary elections. Looking at presidential primaries is interesting because it allows us to assess whether the parties' bases have geographically sorted along ideological lines. That is, we try to answer whether stalwart progressives (conservatives) are less likely to live near more-moderate Democratic (Republican) primary voters than in years past. By analyzing geographic polarization *within* each party's primary electorate, we speak to the extent of ideological clustering net of partisanship.

Since there are often more than two candidates in a primary, we rely on Bonica's (2014; 2016) CF scores as a proxy for the position of candidates and, by revealed preferences, the voters who supported them. Bonica (2014) scales campaign contributions to recover the ideological ideal points of candidates, including ones who did not end up getting elected.[8]

[8]There is some debate about whether strategic motivations on the part of donors confound the interpre-

The idea behind our approach is that we can learn about the ideological leanings of partisans by observing for which primary candidate they voted. The key conditions for this approach to make sense are that primary voters can choose from a sufficiently diverse set of candidates, whose perceived ideology correlates with Bonica's measure. If correct, then primary results are informative about geographical divisions within the base of each party at a particular point in time.

Note, our main results would remain *unchanged* if we scaled votes in general elections by the respective candidates' idealpoints. This is because for any two-candidate election, scaling votes corresponds to a linear transformation of $\mathbf{x}$, which simply yields a scalar multiple of the variance index. As a result, the across-area polarization shares that we report below would be exactly the same. In races with three or more candidates, this equivalence need not hold. Candidates' relative positions may affect both levels and shares of geographic polarization among primary voters.

3.2 Data Sources

We obtained county-level presidential election returns for the years 1972 through 2016 from the *CQ Voting and Elections Collection* and the remainder from ICPSR (1999). Our county-level time series starts in 1856, the first year in which both Democratic and Republican candidates competed in a presidential election. Precinct-level electoral returns come primarily from the Harvard Election Data Archive. We collect electoral returns both for presidential elections as well as elections for the House of Representatives. The precinct-level presidential election data is available from 2000 to 2016 whereas the precinct-level data on house elections ends in 2012. Unfortunately, coverage of the Harvard Election Data Archive varies significantly over time. Thus, whenever possible, we supplement the precint-level data with information form *David Leip's Atlas of U.S. Elections* and with information that we collected directly from different Secretaries of State. The latter are also used to correct a number of

tation of CF scores as legislator's ideology. Without taking sides, we simply note that, for our purposes, it is sufficient for Bonica's estimates to discriminate between ideologically extreme and more-moderate members of the same party. The available evidence suggests that they do.

anomalies in the raw data (see Appendix B for details).

In addition, we have assembled a new county-level data set with electoral returns in presidential primaries from 1968 to 2012. To this end, we digitized the written reports in Cook (2000) and Cook (2007). We complete these data with results for 2008 and 2012 from *David Leip's Atlas of U.S. Elections.* Information on state demographics come from the 2010 Decennial Census.

4 Geographic Polarization over Time: Evidence

4.1 National Time Series

We now present our first decomposition of the variance index. We begin by showing partisan polarization across states because it is the highest interesting level of spatial aggregation and because "red states" and "blue states" have received substantial attention in both the academic and popular discourse.[9] Relying on the expression in equation (2), Figure 2 computes across-state polarization for every presidential election from 1856 through 2016.[10] Black markers indicate the *share* of overall polarization in a particular year that is due to mean differences across states, while gray markers correspond to *levels* of across-state polarization. Reassuringly, shares and levels track each other very closely.[11]

[Figure 2 about here.]

More importantly, Figure 2 makes clear that, although polarization across states has more than doubled over the last half-century, state-level cleavages are not at a historic high. In

[9] Also of potential is the time series of P at the national level. Mathematically, $P = v(1 - v)$, where v denotes the two-party democratic vote share in a particular year. Appendix Figure 1 plots P for every presidential election between 1856 and 2016. Overall partisan polarization is near its theoretical maximum of .25 before 1904 as well as after 1972, reflecting the fact that most presidential races in the two-party era have been quite competitive.

[10] Note, four parties received electoral votes in the 1860 election: the Republican Party, the Constitutional Union Party, the Northern Democratic Party and the Southern Democratic Party. The Constitutional Union Party and the Northern Democratic Party received a total of 51 electoral votes, while the Southern Democratic Party garnered 72 votes. The Republican Party won 180 votes in the Electoral College. Our results for 1860 are based on votes cast for the Northern Democratic Party.

[11] In fact, the period during which there is some divergence between levels and shares is the early- to mid-20th century, when elections were less competitive and, therefore, P slightly lower.

fact, relative to 2016, polarization across states was far higher leading up the Civil War and substantially higher for most of the time from 1892 to 1924. Outside of these two periods, the 2016 presidental election was the third-most polarized across states—right after 1932 and 1940.

Interestingly, polarization across-states remained largely the same directly after the disenfranchisement of African-Americans following the withdrawal of the Northern Army from the South (1877), as well as after their re-enfranchisement due to the passage of the Voting Rights Act (1965). The lack of visible impact of the latter may, in part, be because the loyalties of both African-American and white Southeners lay with the Democratic party at the time. As a result, the expansion of the franchise did little to change the spatial distribution of partisan allegiances.

A somewhat different picture emerges when we turn from polarization *across states* to geographic polarization *within* states. Besides assessing the importance of geographic divisions at a lower level of aggregation, a benefit of measuring geographic polarization within rather than across states is that we hold fixed the competitiveness of the race as well as other electoral circumstances that might affect voters. As Figure 3 shows, within-state across-county polarization follows a long U-shaped pattern.

[Figure 3 about here.]

Within individual states, the least geographically polarized presidential elections were in the 1960s and early- to mid-1970s. It was precisely during this time period, following the passage of the Civil Rights Act, that Southern Democrats started to realign with the Republican Party. The realignment of the South reduced differences across space relative to the widening divisions within the electorate of Southern counties. The 1964 and the 1972 presidential elections were also two of the six least competitive presidential races—right after the election of Harding in 1920, Wilson in 1912, Coolidge in 1924, and FDR in 1936.

The highest degree of within-state polarization in our data is recorded in 2016, followed closely by the election of 1856, the 2012 election and then the contentious 1860 presidential election that spawned the Civil War.[12] Our analysis, therefore, indicates that geographic polarization within states *is* currently at a historic high.[13]

Despite the (re)emergence of geographic polarization, the divisions in Figures 2 and 3 are small in comparison to the variance of partisanship within counties (i.e., $\sum_{c \in C} \frac{n_c}{n} P(\mathbf{x}_c)$). Except for three elections (i.e., 1856, 1860, and 1924), geographic polarization across states and across counties within the same state jointly accounts for less that 15% of the overall variance index, and in only one year does it amount to more than 20% (1856). Even in light of rampant disenfranchisement in the South throughout much of this period, the evidence implies that, since at least the mid-19th century, the partisanship of American voters has always varied much more within rather than across areas.

One potential explanation for this finding is that we are measuring within-state geographic polarization at the county level. As explained above, we rely on county-level electoral returns for the simple reason that the data go as far back as the existence of the Republican party. However, the average county has more than 100,000 residents, and it is conceivable that most partisan sorting occurs across towns or neighborhoods *within* a county. For this reason, Table 1 replicates our analysis at the precinct level, showing within-state across-county polarization shares in column 1 and within-state across-precinct shares in column (3). With slightly more than 1,000 registered voters on average, precincts are substantially smaller than counties, which should enable us to detect even very localized sorting.

[Table 1 about here.]

The degree of partisan sorting is markedly greater at the precinct level than at the county

[12] The results for 1856 and 1860 should be interpreted with caution, as the parties that competed in these elections were not truly national. With minor exceptions, this is not an issue for the remainder of our time series.

[13] While polarization across counties within the same state peaks in 2016, the sum of the geographic differences in Figures 2 and 3 is somewhat higher in 1856, 1868, and 1924.

level. More important, geographic polarization shows similar rates of growth irrespective of the level of aggregation. In other words, the trend towards greater partisan sorting is also borne out on the more-localized precinct level.

For completeness, Table 1 computes average geographic polarization across precincts within the same state as well as across all precincts within the entire country. In 2000, for instance, the latter was almost 25% larger than the former (cf. columns 3 and 4). Comparing the gap between columns (1) and (2) with that between columns (1) and (3) additionally suggests that there is more partisan sorting across precincts within the same state than there is across state lines. Our results, therefore, imply that differences between "red" and "blue" states are actually smaller than differences across "red" and "blue" precincts within the same state.

Unfortunately, precinct-level data are only available as of the 2000 election, and only for a subset states. In particular, we have data for 28 states (including Washington, D.C.) in the 2000 general election, for 42 states in 2004, 46 in 2008, 45 in 2012, and 49 in 2016. To demonstrate that the patterns in Table 1 are not an artifact of the varying panel structure, in column 5 we present results for a balanced panel of 27 states (plus Washington, D. C.) that we observe throughout. Reassuringly, the degree of spatial polarization evident in the unbalanced panel is similar to that in the balanced one. This suggests that the trends in Table 1 are not due to the entry of highly polarized states into our sample, but are instead reflective of the fact that spatial polarization is a national phenomenon. Thus, all pieces of evidence tell a similar story. Geographic polarization has been increasing over the last half-century and strongly so in recent years. Yet, spatial cleavages pale relative to differences within even the smallest of geographical units.[14]

One possible explanation for increasing geographic polarizaton among voters is that turnout patterns have changed over time. For such a theory to explain our findings it would need to be the case that turnout by Democrats increased in Democratic party strongholds,

[14]For easy comparison, Appendix Figure 2 combines the time series from Figures 1 and 2 as well as Table 1 in one graph.

while that of Republicans increased in predominantly Republican areas. If correct, then our results would only document geographic polarization among actual voters, but not among citizens more generally. Although the former might be interesting in and of itself, we address this potential concern in two complementary ways.

First, we regress the change (from one election to the next) in within-state across-county polarization on the percentage change in turnout in the same state. Over the entire period from 1856 to 2016, there is a weak relationship between the two variables. Though the estimated coefficient is statistically significant, it is small and negative ($\beta = -.003$, $p = .006$). For the more recent period of rising polarization (i.e., from 1976 onwards), we do obtain a larger magnitude negative and statistically significant estimate ($\beta = -.009$, $p = .000$).[15] While lower turnout is associated with more geographic polarization, the resulting coefficient is at least one order of magnitude too small to explain the rise in the within-state across-county share. For example, the first percentile of negative percentage changes in turnout is -0.788. A decline of this magnitude would lead to a .007 increase in our measure. Given that the actual rise in within-state across-county polarization is greater than .07 during the post-1976 period. Moreover, during the time period of most rapid increase of geographic polarization, we have seen an increase not a decrease in turnout. We thus conclude that changes in overall turnout cannot explain our findings.

It could, of course, be the case that turnout changed differentially for Democratic and Republican supporters, and that these changes offset each other. In order to assess the plausibility of this explanation, we follow Sussell (2013), and turn to voter registration data from the state of California. Specifically, we collected these data for 2006, 2008, 2011 and 2017, and, for each year, compute within-state across-precinct polarization among registered Democrats and Republicans.[16] The results are presented in Appendix Table 1. Reassuringly,

[15]If Republican supporters are more likely to be marginal voters in areas where the Democrats are dominant, while Democrats are more likely to be marginal voters in counties where the Republican party is dominant, then such a negative relationship may be expected. Exactly this is shown in Fujiwara et al. (2016).

[16]In doing so, we disregard a significant number of independent and third-party voters. As a robustness check, we have replicated the analysis assuming that these individuals' partisan preferences are located at

we see an increase in geographic polarization of about 25%.

4.2 Geographic Polarization State-by-State

The times series evidence presented above implicitly averages across states. In principle, it is possible that some states experience very high levels of geographic polarization, whereas others see almost none. In order to investigate heterogeneity across states, we return to our county-level election data and compute across-county polarization shares separately for each state. To conserve on space, Figure 4 reports results for four different elections: 1860, 1972, 2012 and 2016.[17]

[Figure 4 about here.]

The 1860 presidential election is a definite outlier. Virginia (47.36%), New Jersey (27.14%) and Missouri (23.77%) accounted for almost all of the variance in electoral returns.[18] All other states except for Maryland (10.13%) had within-state across-county polarization shares below 10%.[19] By contrast, in 1976, mean differences across counties accounted for more than 10% of within-state polarization only in Washington, D.C. (15.32%). Out of all other states, only New York (5.22%) had an across-county polarization share greater than 5%. By 2012, within-state across-county polarization had risen to more than 5% in 32 states and Washington, D.C., of which nine saw shares greater than 10%. The states with the highest across-county shares were Maryland (14.70%), Georgia (14.36%), Mississippi (11.83%) and Louisiana. (10.61%)—all of which are Southern. Four years later, spatial divisions within states increased, on average, further. Fifteen states had across shares greater than 10%. The five geographically most-polarized states in 2016 are Maryland (18.27%), Georgia (17.42%),

the midpoint between Democrats and Republicans and obtained qualitatively equivalent results.

[17] For a tabular presentation of the same results, see Appendix Table 2.

[18] Of course, in the mid-19th century, a much smaller number of people lived in the U.S., and an even smaller number were eligible to vote—only white males in most states.

[19] A number of southern states are absent from our data because the Republican party was not on the ballot.

Missouri (15.29%), New York (13.47%), and Illinois (13.32%).

Looking at the evidence, three clear patterns emerge. (1) The rise in polarization across counties reflects a broad-based phenomenon that is apparent in all states. (2) At any given point in time, there are considerable differences across states, and (3) higher levels of geographic polarization are present in the South.

What explains these differences? To provide some preliminary answers to this question we turn to the 2010 Decennial Census and calculate, for each state, the across-county variance in median household income, educational attainment (as measured by college graduation), the share of whites and blacks, and the share of urban households. We then regress these variables on our measure of geographic polarization within each state in 2016. Table 2 presents the results. Remarkably, all five factors together explain nearly 60% of the variation in our data. Looking at the explanatory power of each variable in isolation, we see that states with a higher level of geographic sorting on partisanship are, first and foremost, states with high degrees of racial clustering, with more sorting on education, and (to a lesser degree) sorting on income. In fact, within-state clustering of African-Americans and whites respectively explains 43.0% and 39.2% of the between-state differences in geographic polarization. Surprisingly, urban-rural differences appear to be the least important predictor—though we stress that the correlations in Table 3 should not be interpreted as causal.

[Table 2 about here.]

4.3 Geographic Polarization in House Elections

Abrams and Fiorina (2012) caution against using presidential elections to gauge geographic polarization. In their view, candidate personalities exert such a large influence as to make votes an unreliable indicator of partisanship. Although we share some of their reservations, we note that presidential elections are the only ones with a fully national race and thus electorate. If we want to compare polarization across constituencies we should at least hold the set of candidates fixed. Failing to do so would risk that differences in the personalities of candidates across races confound our estimates. Moreover, the presidency is substantively important. Whether or not voters' views of individual candidates are reflective of their attitudes towards the respective parties, geographic cleavages in presidential elections are interesting in their own right.

We further note that the time series above exhibit clear overall trends—so much so that a simple quadratic polynomial in time can account for almost two-thirds of the variation in the time series of our within-state across-county measure of geographic polarization (cf. Appendix Figure 3). More importantly, the trends in our index correspond closely to trends in existing measures of legislative polarization based on roll-call votes and congressional speech (see, e.g., Poole and Rosenthal 1997; McCarty et al. 2016; Jensen et al. 2012; Gentzkow et al. 2017). In fact, the correlation between Poole and Rosenthal's well-known index of polarization in the House and our within-state across-county measure of geographic cleavages is 0.59 over the entire period for which both are available and 0.95 for the period after 1972 (see Appendix Figure 4 for a graphical representation). The probability of obtaining similarly high correlations by chance is essentially zero. Based on this evidence, we surmise that year-to-year differences in the personalities of presidential candidates are likely of minor consequence for our conclusions about the long-run evolution of geographic polarization.

Nonetheless, in order to ameliorate the concerns of Abrams and Fiorina (2012), we supplement our main results with evidence from elections to the House of Representatives. To maintain electoral comparability, we compute geographic polarization across precincts *within* the same congressional district. Restricting attention to a balanced panel of 27 states, we then compute within-district across-precinct polarization for each election since 2000.

[Table 3 about here.]

The results in Table 3 show an overall upward trend in geographic polarization within districts. In particular, the average across-precinct polarization share rises by 64% between

2000 and 2012 (i.e., from 0.061 to 0.100). Interestingly, some of the increase coincides with the redrawing of congressional districts. At the same time, looking only at the 2004 to 2010 period, during which there was almost no redistricting, we still observe an increase of 32%.

In sum, the rise in geographic polarization over the last few decades is neither limited to presidential elections nor to certain parts of the country. It appears to be a general phenomenon, which closely mirrors the rise of polarization in Congress.

4.4 Presidential Primaries

So far, our results speak to the evolution of geographic polarization in partisanship. These cleavages may or may not reflect spatial differences in the underlying ideology of voters. In the absence of spatially disaggregated survey measures of ideology, we turn to presidential primaries in order to assess the extent of geographic sorting on ideology net of partisanship. By revealed preferences, we can learn about the ideological leanings of individuals from their choice of primary candidate. To locate candidates on the ideological spectrum, we rely on the CF scores calculated by Bonica (2014). This is not to say that the ideological ideal points of voters and candidates coincide, only that we can learn about spatial differences in ideology by comparing different sets of primary voters who face the same candidates under the same electoral circumstances.

There are at least three clear limitations to our approach. First, the set of viable candidates changes during primary season, which potentially invalidates across-state comparisons. Second, some voters may have an incentive to support a candidate other than their most-preferred one for strategic reasons. Third, it is relatively rare for both parties to simultaneously hold competitive presidential primaries.

To address the last of these issues we conduct separate analyses for each party. To address the former two concerns, we report shares of *within-state* across-county polarization. That is, for each state, we calculate the share of the variance index that is attributable to differences across space, and report the population-weighted average in Table 4. Thus, rather than assuming that our variance index is an unbiased measure of the ideological diversity of a particular party's primary electorate—which may be difficult to justify in light of sophisticated voting—we merely require that strategic behavior does not manifest differently among constituencies in the same state (all of whom face the same candidates and are subject to the same incentives). If correct, then the results below are informative about geographic polarization along ideological lines within the base of each party.

[Table 4 about here.]

Interestingly, the numbers in Table 4 are all fairly close to zero. In fact, the average in the seven Democratic primaries is 1.90% since 1984, while that in Republican primaries is 0.92%. Moreover, we see essentially no trend in geographic polarization among Democratic primary voters. Both the 1984 and 1988 Democratic primaries were subject to larger spatial differences than the one in 2016. On the Republican side we also see little to no trend. Although the 2016 primaries were by far the most geographically polarized among Republican core supporters, spatial divisions were at their minimum just four years earlier. Overall, although some Republican primary voters supported Ted Cruz, while others voted for Jeb Bush in 2016; and despite the fact that the race between Hillary Clinton and Bernie Sanders appeared to split the Democratic base, our analysis shows that, on average, *differences across space* have been very small at least since the beginning of our time series in 1984. In other words, within the two parties' bases we see little spatial sorting on ideology. The evidence, therefore, suggests only a small role for homophily based on ideology net of partisanship.

5 Concluding Remarks

The long arc of legislative polarization has carried with it a similar arc in geographic sorting. In particular, recent times of extreme legislative polarization have also been times of high partisan clustering across space.

Our results are based on a novel approach to measuring geographic polarization. Specifically, we introduce the variance index, which is the only measure of polarization that satisfies six intuitively desirable criteria *and* can be perfectly decomposed into across- and within-group components. Relying on this decomposition, we show that there has been a steady rise in geographic partisan polarization since the early 1970s. This trend has accelerated after 2000. Current partisan cleavages across states are as high as at any time in the last fifty years, and geographic polarization within states is at an all-time high in the post-Civil War era.

Curiously, there are almost no spatial divisions within the base of each party, suggesting that geographic divisions may be driven by partisanship rather than ideology. Moreover, differences between individuals within counties or precincts are many times greater than divisions across space. For instance, mean differences across precincts account for about $\frac{1}{7}$th of the overall variance index. Hence, the American electorate continues to be more diverse within than across communities, even when the latter are narrowly defined.

Nonetheless, we stress that we do not know how much geographic polarization is "too much." By historical standards, spatial cleavages are very large, and even small amounts of geographic polarization *may* lead to legislative dysfunction and conflict, especially in a winner-take-all electoral system (see, e.g., Hopkins 2017). Further, we do not know whether geographic polarization is a cause or a consequence of polarization in Congress. Does partisan sorting have an effect on the evolution of voter views and voter preferences? Does it affect the quality of representation or the provision of local public goods? All of these questions are substantively important. Given that current levels of geographic polarization have not been seen in generations, we hope that our findings help to stimulate future research along these lines.

References

Abramovitz, A., and K. Saunders (2008). "Is Polarization a Myth?" *Journal of Politics*, 70(2): 542–555.

Abrams, S., and M. Fiorina (2012). "'The Big Sort' That Wasn't: A Skeptical Reexamination." *PS: Political Science and Politics*, 45(2): 203–210.

Aczél, J. (1966). *Lectures on Functional Equations and their Applications.* New York: Academic Press.

Ansolabehere, S., J. Rodden, and J. Snyder (2006). "Purple America." *Journal of Economic Perspectives*, 20(2): 97–118.

Barber, M. and N. McCarty (2015). "Causes and Consequences of Polarization," (pp. 15–58) in N. Persily (ed.), *Solutions to Political Polarization in America.* New York: Cambridge University Press.

Bishop, B. (2008). *The Big Sort*: *Why the Clustering of Like-Minded America Is Tearing Us Apart.* New York: Houghton Mifflin Harcourt.

Bonica, A. (2016). *Database on Ideology, Money in Politics, and Elections: Public version 2.0 [Computer file].* Stanford, CA: Stanford University Libraries. <https://data.stanford.edu/dime>

Bonica, A. (2014). "Mapping the Ideological Marketplace." *American Journal of Political Science*, 58(2): 367–386.

Bosmans, K., and F. Cowell (2010). "The Class of Absolute Decomposable Inequality Measures." *Economics Letters*, 109: 154–156.

Cowell, F. (2010). "Measurement of Inequality," (pp. 87–166) in A. Atkinson and F. Bourguignon (eds.), *Handbook of Income Distribution, Vol. 1.* Amsterdam: Elsevier.

Brown, J., and R. Enos (2018). “Partisan Segregation.” mimeographed, Harvard University. <http://bit.ly/2LhRZGm>

Cho, W., J. Gimpel, and I. Hui (2013). “Voter Migration and the Geographic Sorting of the American Electorate.” *Annals of the Association of American Geographers*, 104(4): 856–870.

Cook, R. (2000) *United States Presidential Primary Elections, 1968-1996: A Handbook of Election Statistics*. Washginton, D.C.: CQ Press.

Cook, R. (2007) *United States Presidential Primary Elections, 2000-2004: A Handbook of Election Statistics*. Washginton, D.C.: CQ Press.

Darmofal, R., and R. Strickler (forthcoming). *Demography, Politics, and Partisan Polarization in the United States, 1828-2016.* Cham, Switzerland: Springer.

Esteban, J.-M., and D. Ray (1994). “On the Measurement of Polarization.” *Econometrica*, 62(4): 819–851.

Fiorina, M. (2017). *Unstable Majorities: Polarization, Party Sorting, and Political Stalemate*. Stanford, CA: Hoover Institution Press.

Fiorina, M., S. Abrams, and J. Pope (2010). *Culture War? The Myth of a Polarized America* (3rd ed.). New York: Longman.

Fujiwara, T., K. Meng and T.Vogl (2016). “Habit Formation in Voting: Evidence from Rainy Elections.” *American Economic Journals: Applied Economics*, 8(4): 160–188.

Gentzkow, M. (2016). “Polarization in 2016.” Toulouse Network for Information Technology Whitepaper. <https://stanford.io/2yKc6bc>

Gentzkow, M., J. Shapiro, and M. Taddy (2016). "Measuring Polarization in High-dimensional Data: Method and Application to Congressional Speech," mimeographed. <https://stanford.io/2Kr3xDE>

Gimpel, J., and I. Hui (2015). "Seeking Politically Compatible Neighbors? The Role of Neighborhood Partisan Composition in Residential Sorting." *Political Geography*, 45: 130–142.

Glaeser, E., and B. Ward (2006). "Myths and Reality of American Political Geography." *Journal of Economic Perspectives*, 20(2): 119–144.

Hopkins, D. (2010). "The Geographic Polarization of American Politics." Dissertation, University of California, Berkeley.

Hopkins, D. (2017). *Red Fighting Blue: How Geography and Electoral Rules Polarize American Politics.* New York: Cambridge University Press.

Inter-university Consortium for Political and Social Research (1999). *United States Historical Election Returns, 1824-1968.* Ann Arbor, MI: Inter-University Consortium for Political and Social Research [distributor], <https://doi.org/10.3886/ICPSR00001.v3>.

Jensen, J., E. Kaplan, S. Naidu, and L. Wilse-Samson (2012) "Political Polarization and the Dynamics of Political Language: Evidence from 130 years of Partisan Speech." *Brookings Papers on Economic Activity*, Fall 2012: 1–81.

Klinkner, P. (2004a). "Red and Blue Scare: The Continuing Diversity of the American Electoral Landscape." *The Forum*, 2(2): Article 2.

Klinkner, P. (2004b). "Counter Response from Klinkner to Bishop and Cushing." *The Forum*, 2(2): Article 9.

Levendusky, M. (2009). *The Partisan Sort: How Liberals Become Democrats and Conservatives Became Republicans.* Chicago: University of Chicago Press.

Levendusky, M., and J. Pope (2011). "Red States vs. Blue States: Going Beyond the Mean." *Public Opinion Quarterly*, 75(2): 227–248.

Martin, G., and S. Webster (2018). "Does Residential Sorting Explain Geographic Polarization?" *Political Science Research and Methods*, forthcoming.

Massy, D., and N. Denton (1988). "The Dimensions of Residential Segregation." *Social Forces*, 67(2): 281–315.

McCarty, N., K. Poole, and H. Rosenthal (2016). *Polarized America: The Dance of Unequal Riches.* Boston: MIT Press.

McDonald, I. (2011). "Migration and Sorting in the American Electorate: Evidence from the 2006 Cooperative Congressional Election Study." *American Politics Research*, 39(3): 512–533.

McGhee, E., and D. Krimm (2009). "Party Registration and the Geography of Party Polarization." *Polity*, 41: 345–367.

Mummolo, J., and C. Nall (2017). "Why Partisans Do Not Sort: The Constraints on Political Segregation." *Journal of Politics*, 79(1): 45–59.

Poole, K., and H. Rosenthal (1997). *Congress: A Political-Economic History of Roll Call Voting.* New York: Oxford University Press.

Theriault, S. (2008). *Party Polarization in Congress.* New York: Cambridge University Press.

Shorrocks, A. (1984). "Inequality Decomposition by Population Subgroups." *Econometrica*, 52(6): 1369–1385.

Sussell, J. (2013). "New Support for the Big Sort Hypothesis: An Assessment of Partisan Geographic Sorting in California, 1992–2010." *PS: Political Science and Politics*, 46(4): 768–773.

APPENDIX MATERIALS

A Proofs

Lemma 1 (Bosmans and Cowell 2010)**.** *An index P satisfies Axioms 1–5, the strict Pigou-Dalton principle, and admits an aggregation function A, which is continuous and strictly increasing in its first two arguments, with $P(\mathbf{x},\mathbf{y}) = A(P(\mathbf{x}), P(\mathbf{y}), \bar{x}, \bar{y}, n_x, n_y)$ $\forall \mathbf{x} \in \mathbb{R}^{n_x}, y \in \mathbb{R}^{n_y}$, if and only if there exists some $\kappa \in \mathbb{R}$ and a continuous, strictly increasing function $f : \mathbb{R} \to \mathbb{R}$, with $f(0) = 0$, such that, for all $\mathbf{z} \in \mathbb{R}^n$,*

$$f(P(\mathbf{z})) = \begin{cases} \frac{1}{n}\sum_{i=1}^{n}\{exp(\kappa[z_i - \bar{z}]) - 1\} & if\ \kappa \neq 0 \\ \frac{1}{n}\sum_{i=1}^{n}(z_i - \bar{z})^2 & if\ \kappa = 0 \end{cases} .$$

Proof. See Bosman and Cowell (2010).

□

Lemma 2. *Axioms 3, 6 and 7 together imply the strict Pigou-Dalton principle.*

Proof. The strict Pigou-Dalton principle requires that $P(\mathbf{z}) < P(\mathbf{z}')$ whenever $\mathbf{z} = (z_1, ..., z_i, .., z_j, ..., z_n)$ with $z_i \leq z_j$ and $\mathbf{z}' = (z_1, ..., z_i - c, ..., z_j + c, ..., z_n)$ for some $c > 0$. Let $\mathbf{y} \in \mathbb{R}^n$, $\mathbf{x} = (x_1, x_2)$ with $x_1 \leq x_2$, and $\mathbf{x}' = (x_1 - c, x_2 + c)$. By Axiom 7,

$$\begin{aligned} P(\mathbf{x},\mathbf{y}) &\gtreqless P(\mathbf{x}',\mathbf{y}) \\ \omega(\bar{x}, \bar{y}, 2, n)P(\mathbf{x}) + \omega(\bar{y}, \bar{x}, n, 2)P(\mathbf{y}) + P(\bar{\mathbf{x}},\bar{\mathbf{y}}) &\gtreqless \omega(\bar{x}, \bar{y}, 2, n)P(\mathbf{x}') + \omega(\bar{y}, \bar{x}, n, 2)P(\mathbf{y}) + P(\bar{\mathbf{x}},\bar{\mathbf{y}}) \\ P(\mathbf{x}) &\gtreqless P(\mathbf{x}') \end{aligned}$$

Since $P(\mathbf{x}) < P(\mathbf{x}^{'})$ by Axiom 6, it follows that $P(\mathbf{x},\mathbf{y}) < P(\mathbf{x}^{'},\mathbf{y})$, as desired. Anonymity, i.e., Axiom 3, further ensures that the Pigou-Dalton principle is satisfied for mean-preserving spreads in arbitrary positions.

□

Lemma 3. *Suppose* $P(\mathbf{x}) = \frac{1}{q}\frac{1}{n}\sum_{i=1}^{n}\{exp(\kappa[x_i - \bar{x}]) - 1\}$ *for some* $q \in \mathbb{R}$ *and* $\kappa \neq 0$*. Then there exists no weighting function* ω *that satisfies Axiom 7.*

Proof. Our proof is in two parts. First, we show that a weighting function satisfies condition (i) of the axiom if and only if $\omega(\bar{x}, \bar{y}, n_x, n_y) = \frac{n_x}{n_x+n_y}\frac{exp(\kappa\bar{x})}{exp(\kappa[\frac{n_x}{n_x+n_y}\bar{x}+\frac{n_y}{n_x+n_y}\bar{y}])}$. We then prove that this implies $\omega(\bar{x}, \bar{y}, n_x, n_y) + \omega(\bar{y}, \bar{x}, n_y, n_x) \neq 1$ whenever $\kappa \neq 0$, which violates condition (ii).

It is easy to verify that $\omega(\bar{x}, \bar{y}, n_x, n_y) = \frac{n_x}{n_x+n_y}\frac{exp(\kappa\bar{x})}{exp(\kappa[\frac{n_x}{n_x+n_y}\bar{x}+\frac{n_y}{n_x+n_y}\bar{y}])}$ satisfies condition (i) if $P(x) = \frac{1}{q}\frac{1}{n}\sum_{i=1}^{n}\{exp(\kappa[x_i - \bar{x}]) - 1\}$. To prove that it is the only weighting function that does so, let $\mathbf{y} = \bar{\mathbf{y}}$. In this particular case, $P(\mathbf{y}) = 0$ and condition (i) reduces to $P(\mathbf{x},\mathbf{y}) = \omega(\bar{x}, \bar{y}, n_x, n_y)P(\mathbf{x}) + P(\bar{\mathbf{x}},\bar{\mathbf{y}})$. Letting $\bar{z} = \frac{n_x}{n_x+n_y}\bar{x} - \frac{n_y}{n_x+n_y}\bar{y}$ and substituting for P gives:

$$\begin{aligned}
\frac{1}{q}\frac{1}{n_x+n_y}\left(\sum_{i=1}^{n_x}\{exp(\kappa[x_i - \bar{\mathbf{z}}]) - 1\} + \sum_{i=1}^{n_y}\{exp(\kappa[\bar{y} - \bar{z}]) - 1\}\right) \quad &= \\
\omega(\bar{x}, \bar{y}, n_x, n_y)\frac{1}{q}\frac{1}{n_x}\sum_{i=1}^{n_x}\{exp(\kappa[x_i - \bar{x}]) - 1\} \quad &+ \\
\frac{1}{q}\frac{1}{n_x+n_y}\left(\sum_{i=1}^{n_x}\{exp(\kappa[\bar{x} - \bar{z}]) - 1\} + \sum_{i=1}^{n_y}\{exp(\kappa[\bar{y} - \bar{z}]) - 1\}\right) \quad &.
\end{aligned}$$

Solving this expression for $\omega(\bar{x}, \bar{y}, n_x, n_y)$ yields

$$\begin{aligned}
\omega(\bar{x}, \bar{y}, n_x, n_y) &= \frac{n_x}{n_x+n_y}\frac{\sum_{i=1}^{n_x} exp(\kappa[x_i - \bar{z}]) - \sum_{i=1}^{n_x} exp(\kappa[\bar{x} - \bar{z}])}{\sum_{i=1}^{n_x}\{exp(\kappa[x_i - \bar{x}]) - 1\}}\frac{exp(\kappa\bar{z})}{exp(\kappa\bar{x})}\frac{exp(\kappa\bar{x})}{exp(\kappa\bar{z})} \\
&= \frac{n_x}{n_x+n_y}\frac{\sum_{i=1}^{n_x} exp(\kappa x_i) - \sum_{i=1}^{n_x} exp(\kappa\bar{x})}{\sum_{i=1}^{n_x}\{exp(\kappa x_i) - exp(\kappa\bar{x})\}}\frac{exp(\kappa\bar{x})}{exp(\kappa\bar{z})} \\
&= \frac{n_x}{n_x+n_y}\frac{exp(\kappa\bar{x})}{exp(\kappa\bar{z})}.
\end{aligned}$$

This shows that $\omega(\bar{x},\bar{y},n_x,n_y) = \frac{n_x}{n_x+n_y}\frac{exp(\kappa\bar{x})}{exp(\kappa[\frac{n_x}{n_x+n_y}\bar{x}+\frac{n_y}{n_x+n_y}\bar{y}])}$ is the only weighting function that satisfies condition (i) when $\mathbf{y} = \bar{\mathbf{y}}$. Hence, there cannot exist a different weighting function that satisfies the same condition for all $\mathbf{x}\in\mathbb{R}^{n_x}$ and $\mathbf{y}\in\mathbb{R}^{n_y}$, which completes the first part of the proof.

To show that $\omega(\bar{x},\bar{y},n_x,n_y) + \omega(\bar{y},\bar{x},n_y,n_x) \neq 1$ we proceed by way of contradiction. Suppose that $\kappa \neq 0$ and $\omega(\bar{x},\bar{y},n_x,n_y) + \omega(\bar{y},\bar{x},n_y,n_x) = 1$. Plugging in our candidate solution for ω and rearranging yields the condition:

$$\frac{n_x}{n_x+n_y}exp(\kappa\bar{x}) + \frac{n_y}{n_x+n_y}exp(\kappa\bar{y}) = exp(\kappa[\frac{n_x}{n_x+n_y}\bar{x} + \frac{n_y}{n_x+n_y}\bar{y}]).$$

Since $exp(\cdot)$ is a convex function, Jensen's inequality implies that, unless $\kappa = 0$, the LHS of the expression above is strictly greater than the RHS, which produces the desired contradiction.

□

Proof of Proposition. It is straightforward to verify that the variance index satisfies Axioms 1–7 with $\omega(\bar{x},\bar{x},n_x,n_y) = \frac{n_x}{n_x+n_y}$. We, therefore, focus on proving that it is the only index that does so (up to scalar multiplication).

Since Axioms 3, 6 and 7 imply the strict Pigou-Dalton principle (cf. Lemma 2) and since the aggregation function in Axiom 7 is a special case of that in the Lemma 1, any polarization index that satisfies Axioms 1–7 must be contained in the class of indices characterized by Lemma 1. Hence, it suffices to show that, given Axiom 7, f in Lemma 1 must be an affine transformation and $\kappa = 0$.

Suppose that f is, indeed, an affine transformation and that $\kappa \neq 0$. Then, $P(\mathbf{x}) = \frac{1}{q}\frac{1}{n}\sum_{i=1}^{n}\{exp(\kappa[x_i - \bar{x}]) - 1\}$ for some constant $q \in \mathbb{R}$. From Lemma 3 we know that Axiom 7 fails in this case. It, therefore, follows that if f is an affine transformation, then $\kappa = 0$.

To show that f must be an affine transformation let $n_x = n_y$ and consider any $\mathbf{x}\in\mathbb{R}^{n_x}$

and $\mathbf{y}\in\mathbb{R}^{n_y}$ such that $\bar{x} = \bar{y}$. By Axioms 1 and 3, condition (i) in Axiom 7 reduces to $P(\mathbf{x},\mathbf{y}) = \omega P(\mathbf{x}) + (1-\omega)P(\mathbf{y})$ with (ii) $\omega = \omega(\bar{x}, \bar{y}, n_x, n_y) = \omega(\bar{y}, \bar{x}, n_y, n_x) = \frac{1}{2}$. Applying f to both sides of the equation, gives

$$f\left(P(\mathbf{x},\mathbf{y})\right) = f\left(\frac{P(\mathbf{x}) + P(\mathbf{y})}{2}\right).$$

Now, if $n_x = n_y$ and $\bar{x} = \bar{y}$, then, relying on the explicit expressions for f in Lemma 1, it is possible to show that, for any κ,

$$f\left(P(\mathbf{x},\mathbf{y})\right) = \frac{f\left(P(\mathbf{x})\right) + f\left(P(\mathbf{y})\right)}{2}.$$

We, therefore, have that $f\left(\frac{P(\mathbf{x})+P(\mathbf{y})}{2}\right) = \frac{f(P(\mathbf{x}))+f(P(\mathbf{y}))}{2}$, which is Jensen's Equality. The solutions to this functional equation are known to be of the form $f(x) = qx + s$ for some constants $q, s \in \mathbb{R}$ (cf. Aczél 1966, ch. 2, Theorem 1). Hence, f is an affine transformation, as desired.

$\square$

B Data Appendix

B.1 County-Level Election Returns

We obtained county-level presidential election returns for the years 1972 through 2016 from the *CQ Voting and Elections Collection* (`http://library.cqpress.com/elections/`) and data from 1856 to 1968 from ICPSR (1999). In a small number of cases, the Democratic or Republican party was not listed as fielding a candidate in a particular general election. We dealt with this issue on a case-by-case basis. In many of the affected state-years, the name of the party listed in the ICPSR data was slightly different for that particular year. In some cases, however, the state party did not list the national candidate, or the candidate did not qualify for the ballot for idiosyncratic reasons. We detail these exceptions below:

Rhode Island, 1856: The Republicans did not field a candidate in Rhode Island. The Democrats did and the American party ("Know-Nothing party") put up Millard Fillmore.

Tennessee, 1856: The Republicans did not field a candidate in Tennessee. The Democrats did and the American party ("Know-Nothing party") put up Millard Fillmore.

Virginia, 1856: The Republicans did not field a candidate in Tennessee. The Democrats did and the American party ("Know-Nothing party") put up Millard Fillmore.

Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Texas, 1860: The Republican party did not get on to the ballot in these 10 Southern states. Instead, the Constitutional Union party did. The Constitutional Union party, a pro-union party largely in the South arguing in favor of maintaining the union by ignoring slavery, ran a candidate, as did the Southern Democratic party.

New Jersey, 1860: NJ selected its electors before the Dempcratoc party split into the Northern and Southern Democratic parties at the South Carolina convention. NJ was a fusion state where different electors got to choose different Democratic candidates. We count all votes as votes for the Democratic party.

South Dakota, 1896: William Jennings Bryan ran as a candidate both for the Populist as well as the Democratic party. We count his votes as votes for the Democratic party.

Wyoming, 1892: Only the Populist and the Republican party ran. Grover Cleveland and the Democrats were not on the ballot. We do not include Wyoming, 1892.

Oregon, 1900: The name of the Oregon Democrat party in 1900 was the People's and Democratic party. The Republican party was called the Modern Republican party.

Nevada, 1904: The name of the Democratic party in 1904 was the Democrat and Silver party.

South Dakota, 1912: The Republican party was called the Progress Republican party.

Mississippi, 1932, 1936: The Republican party split into two factions: Go for the Lily-White faction and the Black-and-Tan faction. The national Republican party ran with the Lily-White faction as the Lily-White Republican party.

Alabama, 1964: The Alabama Democratic Party did not support the national Democratic party's nominee, Lyndon B. Johnson. Thus, the state party passed a resolution unpledging their electors. We count Alabama's votes for the Democratic party as actual Democatic votes despite their being unpledged.

Mississippi, 1964: Our data for this state year come from Wikipedia (`https://en.wikipedia.org/wiki/United_States_presidential_election_in_Mississippi,_1964`).

B.2 Precinct-Level Data

Precinct-level electoral returns from 2000 to 2012 come primarily from the Harvard Election Data Archive (HEDA; `https://projects.iq.harvard.edu/eda/home`). Unfortunately, coverage of HEDA varies significantly over time. Thus, whenever necessary, we supplement the precint-level data with information form *David Leip's Atlas of U.S. Elections* (`https://uselectionatlas.org/`). When neither source contained data for a particular state-year combination or when data anomalies existed, we directly contacted the respective Secretaries of State to either obtain the data or verify that precinct-level electoral returns were not kept for the election in question. In a few states, the lowest level of aggregation is that of the town. We use these data instead of precinct-level returns when the latter are not available. In addition, we noticed that some precincts only list votes for one party but not the other. In most cases, this is the result of one party not putting forward a candidate for the House of Representatives in a given congressional district. The remaining cases all occur in very small precincts, usually with less than a hundred votes cast total. We proceed under the assumption that these precincts happened to be unanimous due to their small size. An exact breakdown of which precincts are affected by this assumption is available upon request. In what follows, we provide a detailed, state-by-state description of the data that we use.

Alabama: All Alabama data came from the HEDA, and none had any specific issues to be resolved.

Arkansas: 2000 presidential election data came from *David Leip's Atlas of U.S. Elections*, and no 2000 House election data could be found. The rest of the election data came from the HEDA.

Arizona: 2000 presidential election data came from *David Leip's Atlas of U.S. Elections*, and no 2000 House election data could be found. Election data for 2002, 2004, 2006, 2008, and 2012 all came from the HEDA. 2010 data was downloaded from the Arizona secretary of state website (`http://apps.azsos.gov/results/2010/general/counties/`). Cochise County and Graham County did not have usable data available for download for 2010, for either presidential or House elections.

Arkansas: All Arkansas data came from the HEDA, but a problem emerged when checking the 2012 data. Inconsistencies in the data led us to believe that some counties may have mislabeled which vote tally belonged to each party for the presidential election, especially where the sum of the Democratic and Republican votes was less than the reported total vote count. To ensure all data was correct, the Harvard data for the 2012 presidential election was replaced with data from `http://results.enr.clarityelections.com/AR/42843/113233/en/summary.html`.

California: No 2000 precinct-level data could be found for California. The data from 2002–2010 came from the HEDA. The 2012 data was added from the Secretary of State's website (`http://statewidedatabase.org/d10/g12.html`).[20]

Colorado: No precinct-level data was available for 2000 or 2002. Data for 2002–2010 came from the HEDA. The 2012 data was added from the Secretary of State's website (`https://data.colorado.gov/Elections/2012-General-Election-Precinct-Level-Results/hacs-xn85`).

Connecticut: Data for all years was available from the HEDA, but we detected an error in the file for 2004—the Republican presidential votes did not appear reliable. Correct Republican presidential vote data for 2004 was downloaded from the Secretary of State's website (`http://www.sots.ct.gov/sots/cwp/view.asp?a=3188&q=392558`).

District of Columbia: Although DC is not a state, its voting data was collected

[20] The specific data used was in the SOV column, the "by srprec" link.

as well. However, DC does not have a representative in the House, so only presidential voting data was collected for DC. The data for 2004, 2008, and 2012 was available from the HEDA, but the 2000 data was downloaded from the DC Board of Elections website (https://www.dcboe.org/election_info/election_results/elec_2000/general_elec.asp).

Delaware: Election information was available from the HEDA for the year 2002 onward. Presidential voting data for 2000 was available from *David Leip's Atlas of U.S. Elections*, but no House voting data for 2000 could be found.

Florida: No election data for Florida could be found until the year 2010. 2010 election data was provided by HEDA, and the 2012 data was downloaded from the Secretary of State's website
(http://dos.myflorida.com/elections/data-statistics/elections-data/precinct-level-election-results/).

Georgia: No election data could be found for 2000 and 2010. HEDA provided election data for the available years.

Hawaii: Election data for 2000 and 2002 was downloaded off the Secretary of State's website (http://files.hawaii.gov/elections/files/results/2000/general/precinct.pdf for 2000 and http://files.hawaii.gov/elections/files/results/2002/general/precinct.pdf for 2002). Data for the remaining years was available from the Harvard database.

Idaho: All years had election data available in the HEDA. However, Idaho's 1st Congressional District was missing Republican votes for the year 2002, so we replaced the House voting data with data downloaded from the Secretary of State's website
(https://sos.idaho.gov/elect/results/index.html).

Illinois: No precinct-level election data could be found for any Illinois election until 2012, which was provided by HEDA.

Indiana: No precinct-level election data could be found for any Indiana election.

Iowa: HEDA provided precinct-level election data for every year except 2010. Election data for 2010 was downloaded from the Secretary of State's website
(https://sos.iowa.gov/elections/results/precinctvotetotals2010general.html).

Kansas: All Kansas election data came from HEDA.

Kentucky: No precinct-level election data could be found for Kentucky from 2000–2006. HEDA provided election data for 2008–2012.

Louisiana: All Louisiana election data came from HEDA.

Maine: Election data was available from HEDA for all years, but the geographic identifiers for the 2010 file were unclear. As a result, data for 2010 was reimported from the Secretary of State's website (`http://www.maine.gov/sos/cec/elec/results/index.html`).

Maryland: HEDA data was available for every year's elections except 2002, for which no election data could be found.

Massachusetts: HEDA data was available for 2004–2012. Data for 2000 and 2002 was downloaded from the Secretary of State website
(`http://electionstats.state.ma.us/elections/search/year_from:2000/year_to:2000/office_id:5/stage:General` and
`http://electionstats.state.ma.us/elections/search/year_from:2000/year_to:2000/office_id:1` for 2000, and
`http://electionstats.state.ma.us/elections/search/year_from:2002/year_to:2002/office_id:5/stage:General` for 2002).

Michigan: Data was available from HEDA for the years 2000–2010. However, for the years 2000--2006 and 2012, geographically more-specific data was available from the Secretary of State's website (`http://miboecfr.nictusa.com/cgi-bin/cfr/precinct_srch.cgi`).

Minnesota: All Minnesota election data came from the HEDA.

Mississippi: Data for 2004–2012 was available from the HEDA, but we found problems in the 2004 data file for Carroll County—missing precinct names and vote tallies. Corrected information was downloaded from the Secretary of State's website
(`http://www.sos.state.ms.us/elections/2004/General/Carroll.pdf`). No data could be found for 2000 or 2002.

Missouri: Data for 2002–2010 was available from the HEDA. No data could be found for 2000 or 2012.

Montana: All Montana election data came from the HEDA.

Nebraska: HEDA data was available for the years 2004, 2008, and 2012. No data could be found for the other years.

Nevada: HEDA only had information for Nevada for 2010. Data for 2004, 2006, 2008, and 2012 was downloaded from the Secretary of State's website (`http://nvsos.gov/sos/elections/election-information/precinct-level-results`). No data could be found for 2000 or 2002.

New Hampshire: All New Hampshire election data came from HEDA.

New Jersey: HEDA contained data for the years 2000–2008. Data for 2010 and 2012 was downloaded from the Secretary of State's website (`http://www.nj.gov/state/elections/election-information-archive-2010.html` and `http://www.nj.gov/state/elections/election-information-archive-2012.html`, respectively).

New Mexico: HEDA had data for New Mexico in the presidential election years: 2000, 2004, 2008, and 2012. No data could be found for 2002, but data for 2006 and 2010 was downloaded from the Secretary of State's website (`http://www.sos.state.nm.us/Elections_Data/2006.aspx` and `http://www.sos.state.nm.us/Elections_Data/2010.aspx`, respectively).

New York: Data was available from the HEDA for 2006–2010. No data could be found for 2002. For 2000, 2004, and 2012, only presidential election data could be obtained from *David Leip's Atlas of U.S. Elections*.

North Carolina: Data was available from the HEDA for all years concerned, but data problems emerged for 2000, 2002, and 2008. North Carolina's 1st Congressional District was missing Republican congressional vote tallies for 2000 and Democratic congressional vote tallies for 2002. In 2008, the county of New Hanover was missing Republican congressional vote tallies. All three problems were remedied using data downloaded from the state's Board of Elections website (`https://dl.ncsbe.gov/index.html?prefix=ENRS/`).

North Dakota: Data was available from the HEDA for 2002–2012. Presidential election data was downloaded from *David Leip's Atlas of U.S. Elections* for 2000, but no data for House elections could be found.

Ohio: HEDA contained election data for the years 2004–2010. *David Leip's Atlas of*

U.S. Elections provided presidential election data for 2000, but no House election data could be found. No data could be found at all for 2002. Election data for 2012 was downloaded from the Secretary of State's website
(https://www.sos.state.oh.us/elections/election-results-and-data/2012-elections-results/).

Oklahoma: HEDA contains election data for the years 2004–2012. No election data could be found for the years 2000 and 2002.

Oregon: HEDA contains election data for 2008 and 2010. No election data could be found for any other years.

Pennsylvania: HEDA contains election data for 2000–2010. 2012 election data was downloaded from https://github.com/openelections/openelections-data-pa.

Rhode Island: HEDA contains election data for all years, but more geographically-specific data was available for 2010, so the HEDA data was removed and replaced with information downloaded from the website of the Rhode Island government
(https://www.ri.gov/election/results/2010/general_election/).

South Carolina: HEDA contains election data for 2004–2012. Election data for 2000 and 2002 was downloaded from the Secretary of State's website
(https://www.scvotes.org/cgi-bin/scsec/vothist?election=vhgen00&regvote=VOT and
https://www.scvotes.org/cgi-bin/scsec/vothist?election=vhgen02&regvote=VOT, respectively).

South Dakota: HEDA contains election data for 2004–2012. No election data was available for 2000 or 2002.

Tennessee: HEDA contains election data for 2002–2012. Election data for 2000 was downloaded from the Secretary of State's website
(https://sos.tn.gov/products/elections/election-results#2000).

Texas: All Texas election data came from HEDA.

Utah: HEDA contained election data for Utah only in the year 2008. No data could be found for any other year.

Vermont: HEDA contains election data for 2000–2004 and 2010–2012. However, the geographic labels on this data were unclear. Therefore, for 2000, 2004, and 2012, presidential election data was downloaded from *David Leip's Atlas of U.S. Elections*, along with clearer geographic labels. The 2006 data was downloaded from the Secretary of State's website (http://vtelectionarchive.sec.state.vt.us/elections/view/75468/). The 2008 presidential data was downloaded from *David Leip's Atlas of U.S. Elections*, and no House data could be found for 2008.

Virginia: HEDA contained election data for Virginia for the years 2006–2012. However, the 2008 data contained obvious errors—it provided data on twenty congressional districts when Virginia had only 11. We removed the 2008 data and replaced it with data downloaded from the Secretary of State's website (http://historical.elections.virginia.gov/elections/search/year_from:1789/year_to:2017). This website also provided us with the data for 2000–2004.

Washington: HEDA contained election data for the years 2008–2012. *David Leip's Atlas of U.S. Elections* provided Presidential election data for the year 2004, but no House data could be found for that year. No election data at all could be found for 2000, 2002, and 2006.

Wisconsin: HEDA contains election data for the years 2002–2010. No election data could be found for 2012. Data for 2000 was downloaded from (http://elections.wi.gov/elections-voting/results/2000/fall-general).

West Virginia: HEDA contains only election data for 2012 for West Virginia. No other years' election data could be found.

Wyoming: All Wyoming data came from HEDA.

Figure 1: Geographic Polarization is Conceptually Distinct from Overall Polarization

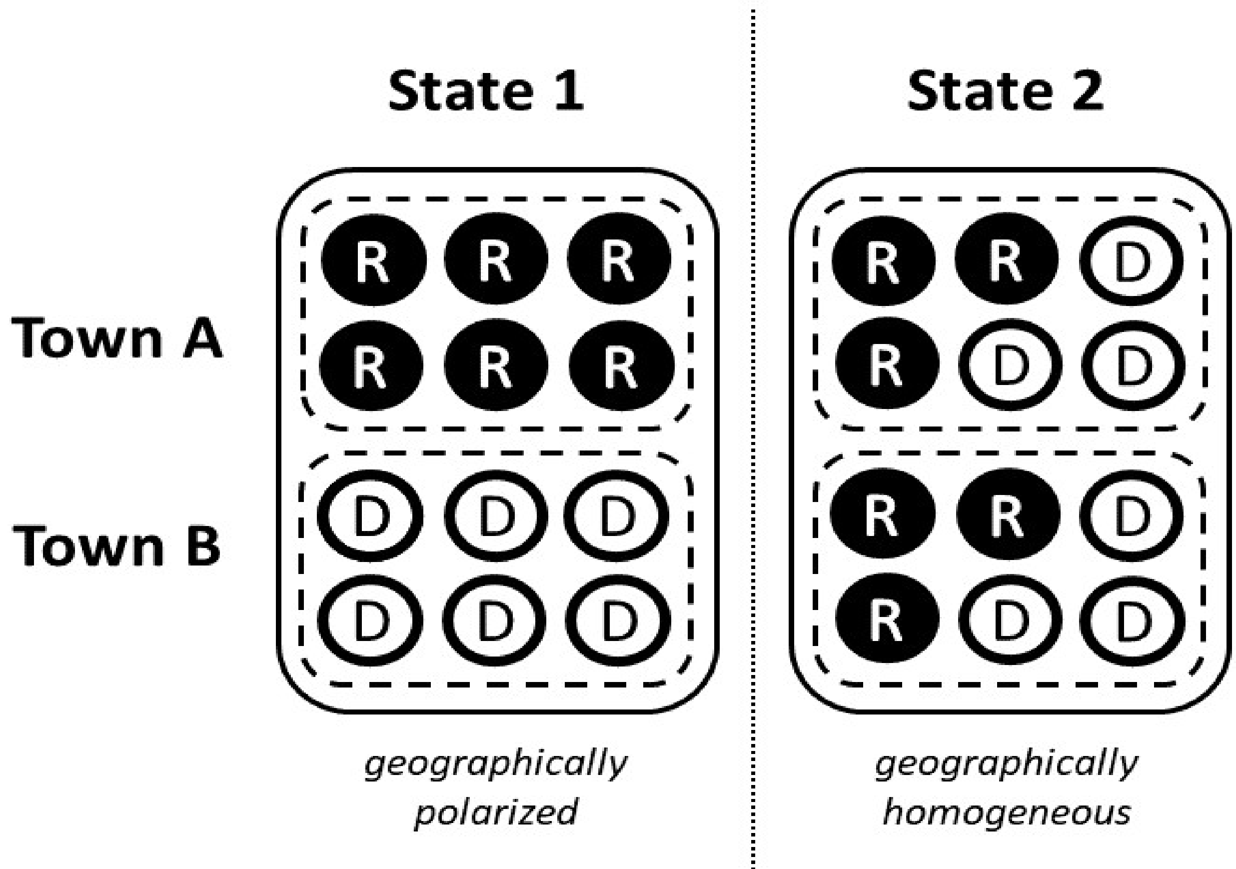
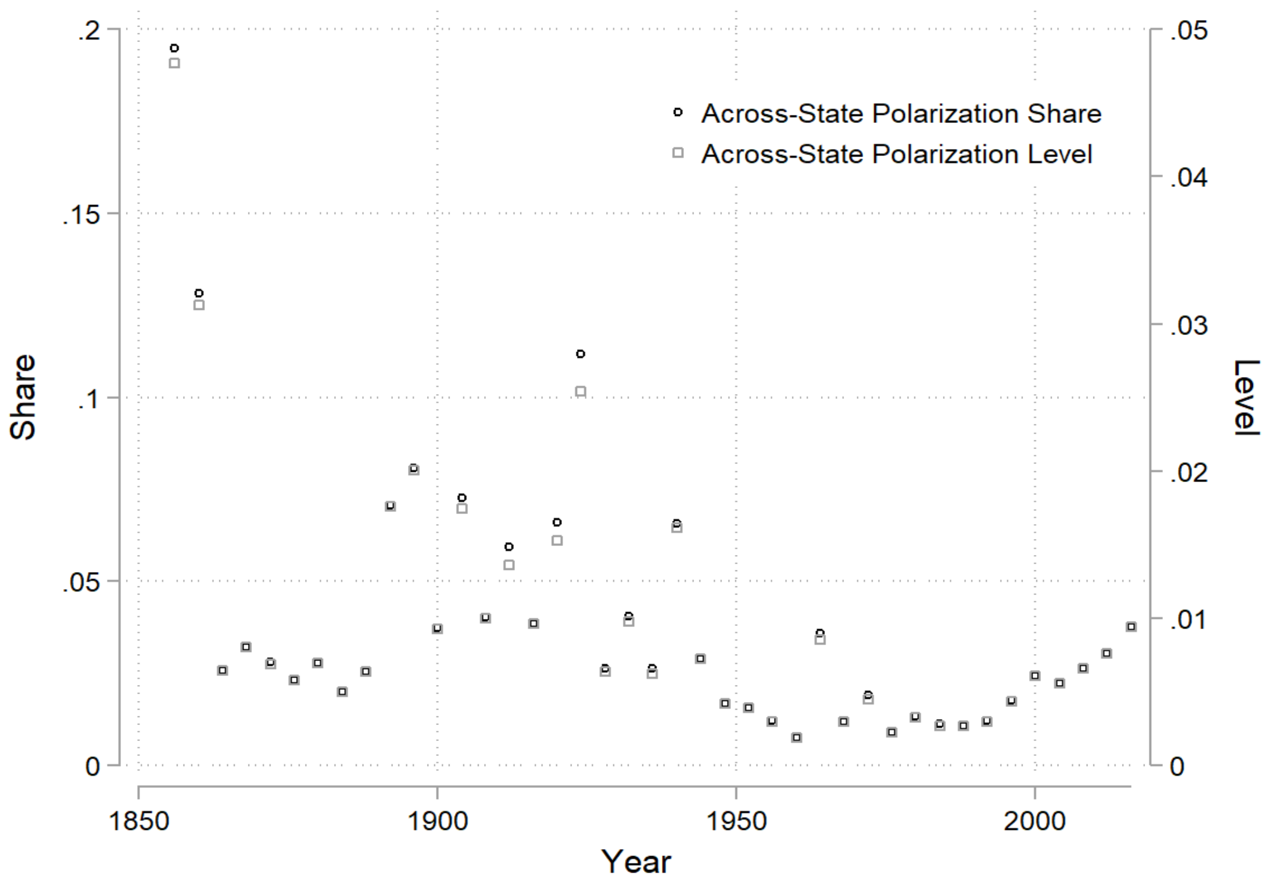
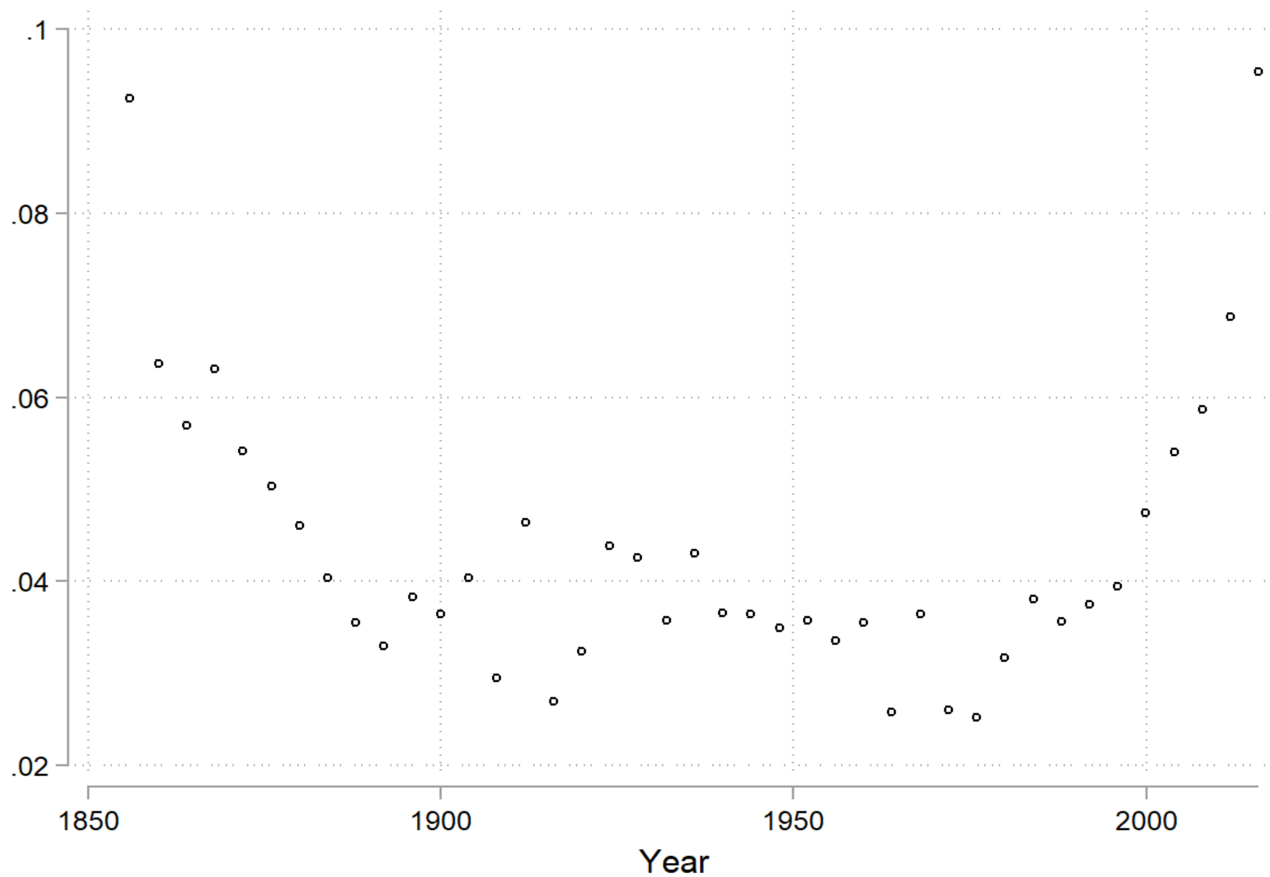


Figure 2: Across-State Polarization in Presidental Elections, 1856–2016



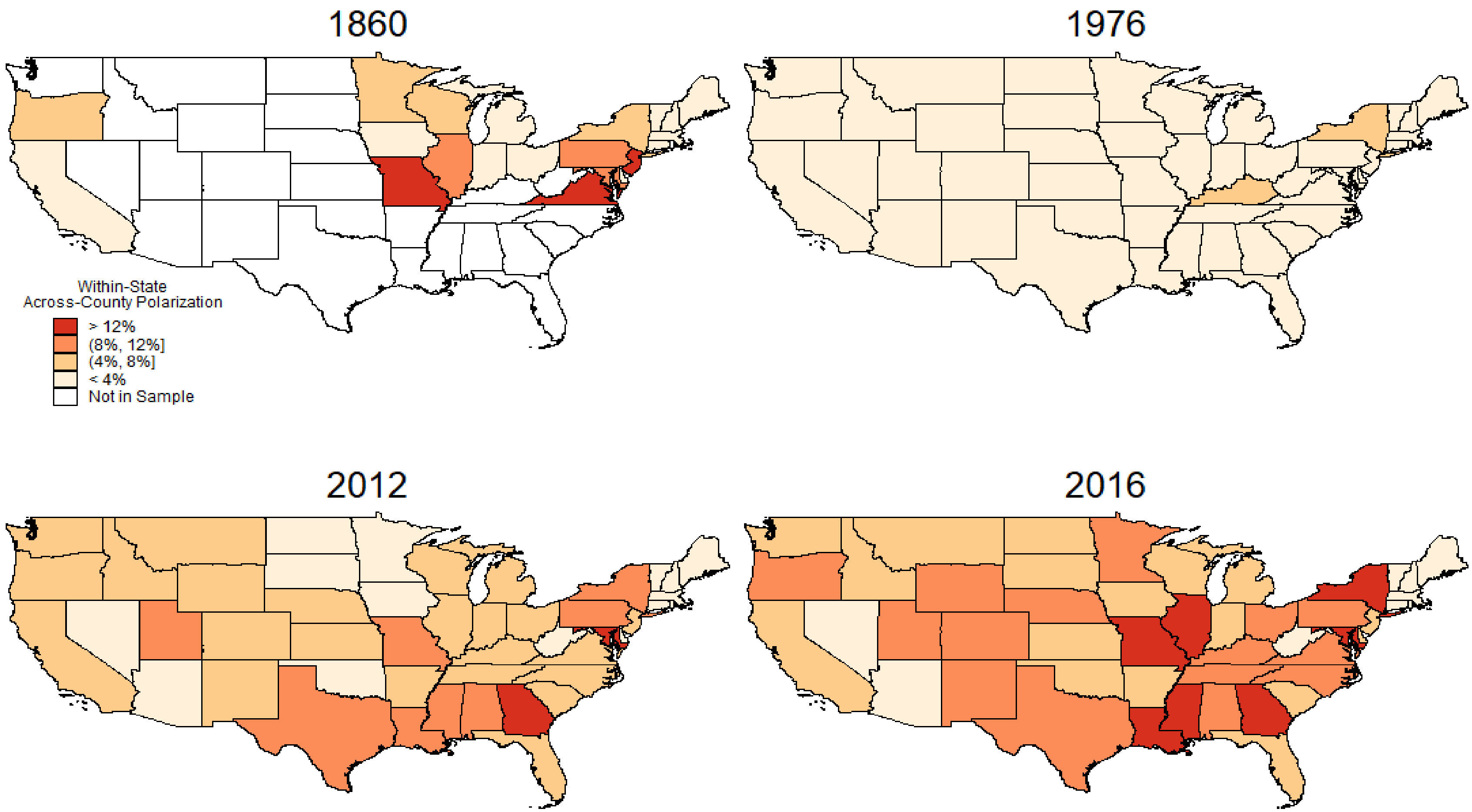
Note: Figure shows across-state partisan polarization for each presidential election from 1856 to 2016, in both levels and shares of the overall variance index for that year. As explained in the main text, we calculate and decompose the variance index using two-party Democratic vote shares (cf. equ. (2)). For a detailed description of the underlying data, see the Data Appendix.

Figure 3: Within-State Across-County Polarization in Presidental Elections



Note: Figure shows the within-state across-county share of partisan polarization for each presidential election from 1856 to 2016, based on the decomposition of the variance index in equ. (3). For a detailed description of underlying data, see the Data Appendix.

Figure 4: Heterogeneity in Within-State Across-County Polarization Shares



Note: Figure shows the within-state across-county share of partisan polarization separately for each state in the 1860, 1976, 2012, and 2016 presidential elections, as explained in the main text. For a detailed description of underlying data, see the Data Appendix.

Table 1: Geographic Polarization, 2000–2016

Year	Within-State Across-County Share	Nationwide Across-County Share	Within-State Across-Precinct Share	Nationwide Across-Precinct Share	Within-State Across-Precinct Share
2000	.047	.072	.110	.137	.113
2004	.054	.076	.108	.122	.123
2008	.059	.085	.112	.136	.142
2012	.069	.099	.153	.177	.152
2016	.095	.133	.175	.207	.185
Panel Structure:	Balanced	Balanced	Unbalanced	Unbalanced	Balanced

Note: Table shows the share of the variance index due to geographic polarization at the county and precinct levels, either within states or nationwide. All decompositions use the Democratic two-party vote share and are based on Equation (3). There are 28 states (incl. Washington D.C.) in our precinct-level data for 2000, 42 states in 2004, 46 in 2008, 45 in 2012, and 49 in 2016. The balanced precinct-level panel includes 27 states plus Washington D.C. For a detailed description of the data used in the table, see the Data Appendix.

Table 2: Predictors of Within-State Across-County Polarization in 2016

	Within-State Across-County Polarization Share					
Indep. Variable	(1)	(2)	(3)	(4)	(5)	(6)
Var. in Median HH Income	-.082	.174**				
	(.069)	(.071)				
Var. in Percent College Grad.	5.597***		6.228***			
	(1.758)		(1.706)			
Var. in Percent White	1.005**			2.269***		
	(.494)			(.437)		
Var in Pecent Black	1.032**				2.431***	
	(.445)				(.349)	
Var. in Urban Pop. Share	.033					.433***
	(.118)					(.175)
R^2	.599	.201	.376	.392	.430	.112
Number of Observations	51	51	51	51	51	51

Note: Numbers are point estimates and standard errors from regressing our measure of geographic polarization in a particular state on the variables listed in the left-most column. Specifically, the dependent variable in all regressions is the within-state across-county polarization share in the respective state, including Washington D.C. The independent variables are the county-level variance of median household income in the same state, the variance in the share of college graduates, the variance in the share of whites and blacks, as well as the county-level variance in the population percentage that is urban. Standard errors are heteroskedasticity robust and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Within-Congressional District Across-Precinct Polarization Shares in Elections to the House

Year	2000	2002	2004	2006	2008	2010	2012
Across-Precinct Polarization	.061	.079	.066	.061	.072	.087	.100

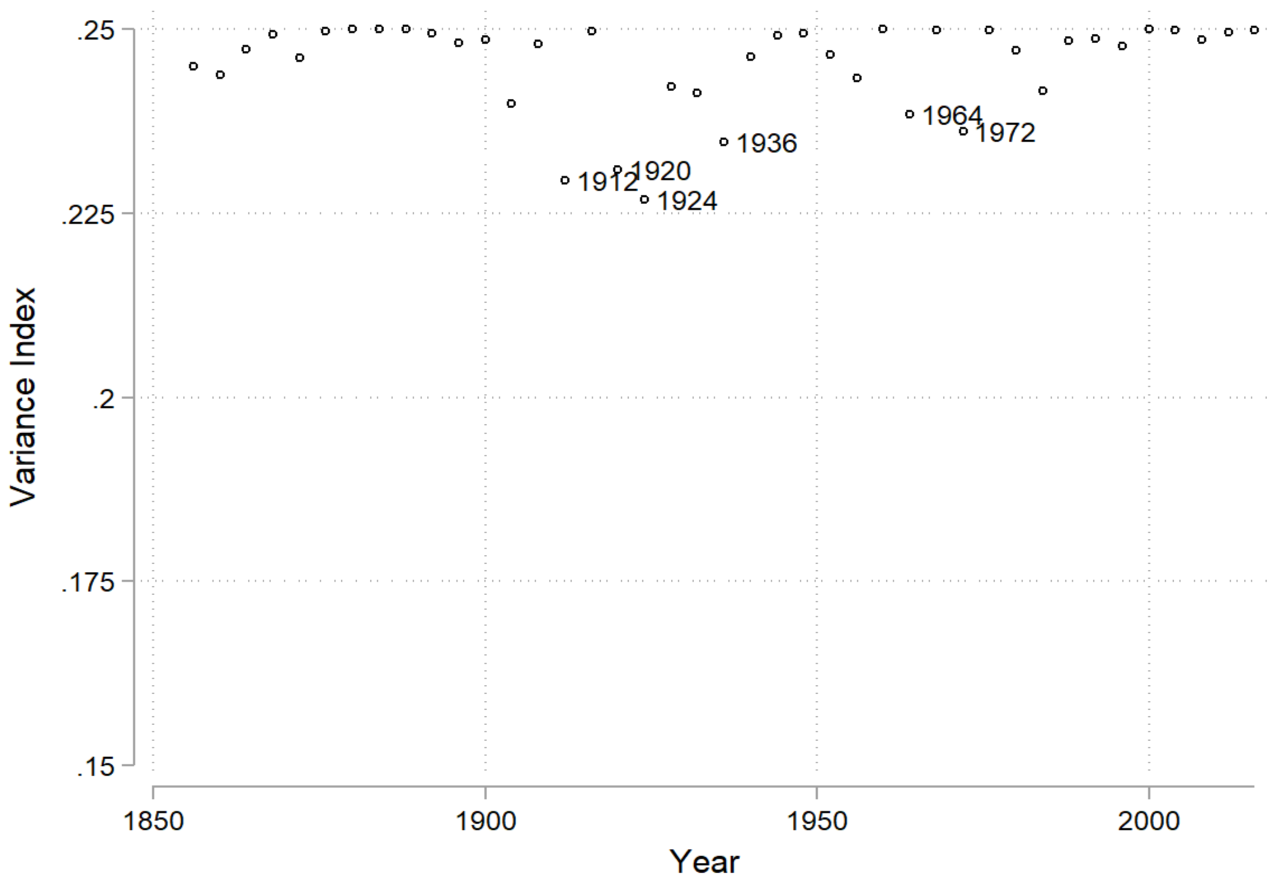
Note: Numbers are within-congressional district across-precinct shares of partisan polarization for every election to the House of Representatives between 2000 and 2012, restricting attention to a balanced panel of 27 states and Washington D.C. Polarization shares are calculated based on the two-party Democratic vote and a decomposition akin to that in Equation (3). For a detailed description of the underlying data, see the Data Appendix.

Table 4: Geographic Polarization Among Primary Voters

Year	Democratic Primaries	Republican Primaries
1984	.026	--
1988	.035	.005
1992	.009	--
1996	--	.009
2000	.007	.009
2004	.012	--
2008	.026	.007
2012	--	.003
2016	.019	.022

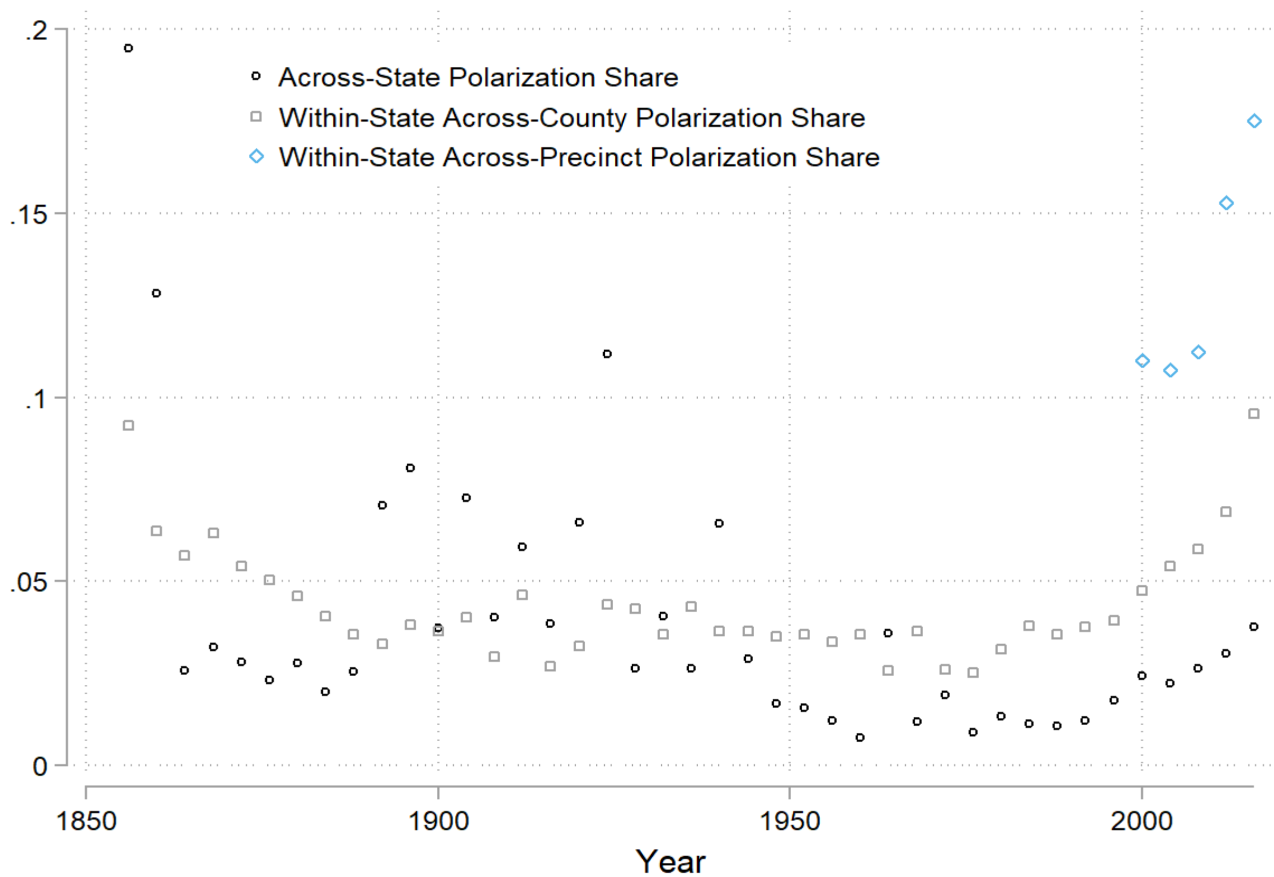
Note: Numbers are average within-state across-county polarization shares for all presidential primaries between 1984 and 2016. Since there are often more than three candidates on the ballot in a particular primary, we approximate voters' preferences by the respective candidate's ideological position. Decompositions are conducted separately for Democratic and Republican primaries, and Bonica's (2014) CF scores are used to approximate each candidate's position on the ideological spectrum. For a detailed description of the underlying data, see the Data Appendix.

Appendix Figure 1: Partisan Polarization in Presidential Elections, 1856–2016



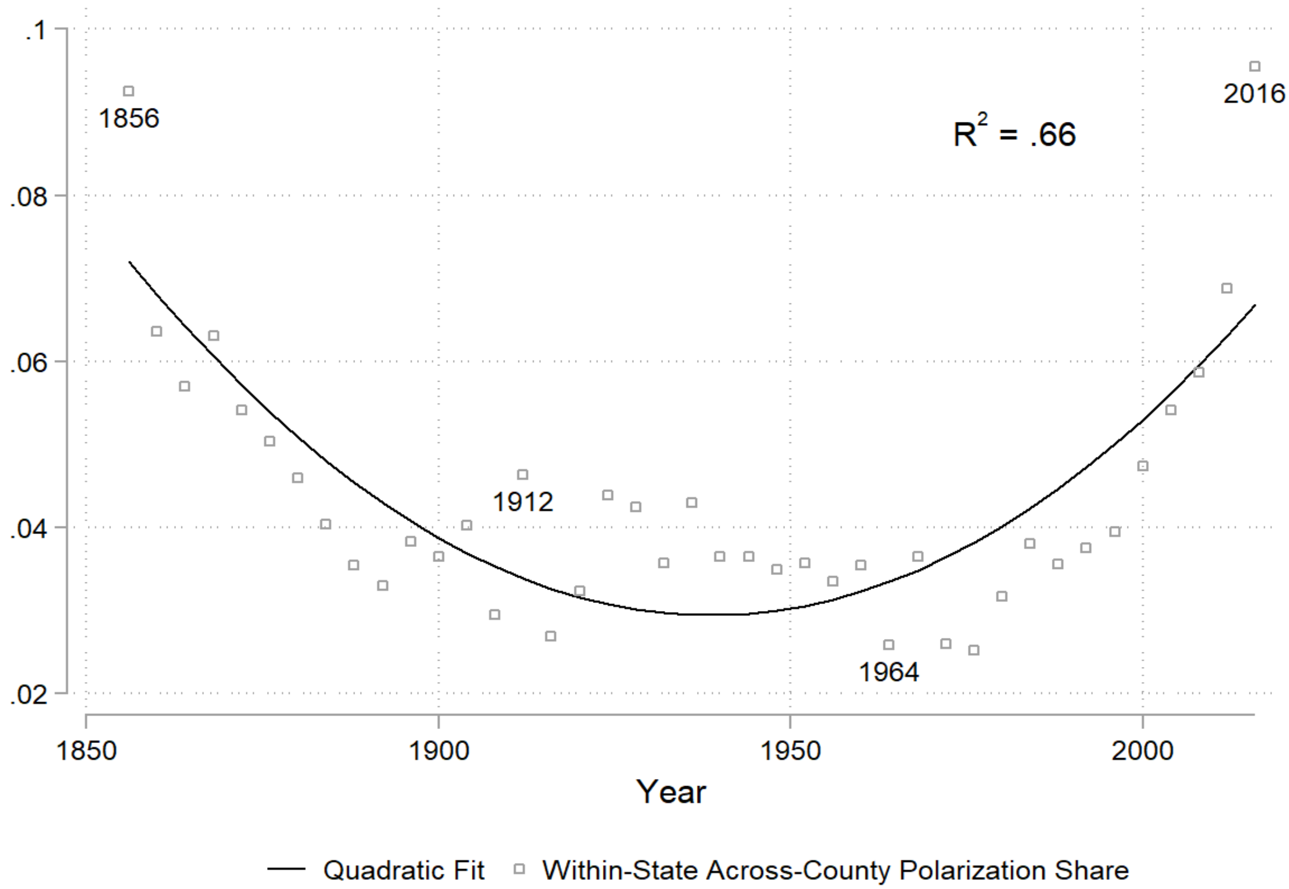
Note: Figure shows the overall variance index, i.e., P in equ. (1), for all presidential elections from 1856 to 2016. As explain in the main text, we calculate P based on the two-party Democratic vote share. For a description of the underlying data, see the Data Appendix.

Appendix Figure 2: Comparing Geographic Polarization at Different Levels of Spatial Aggregation



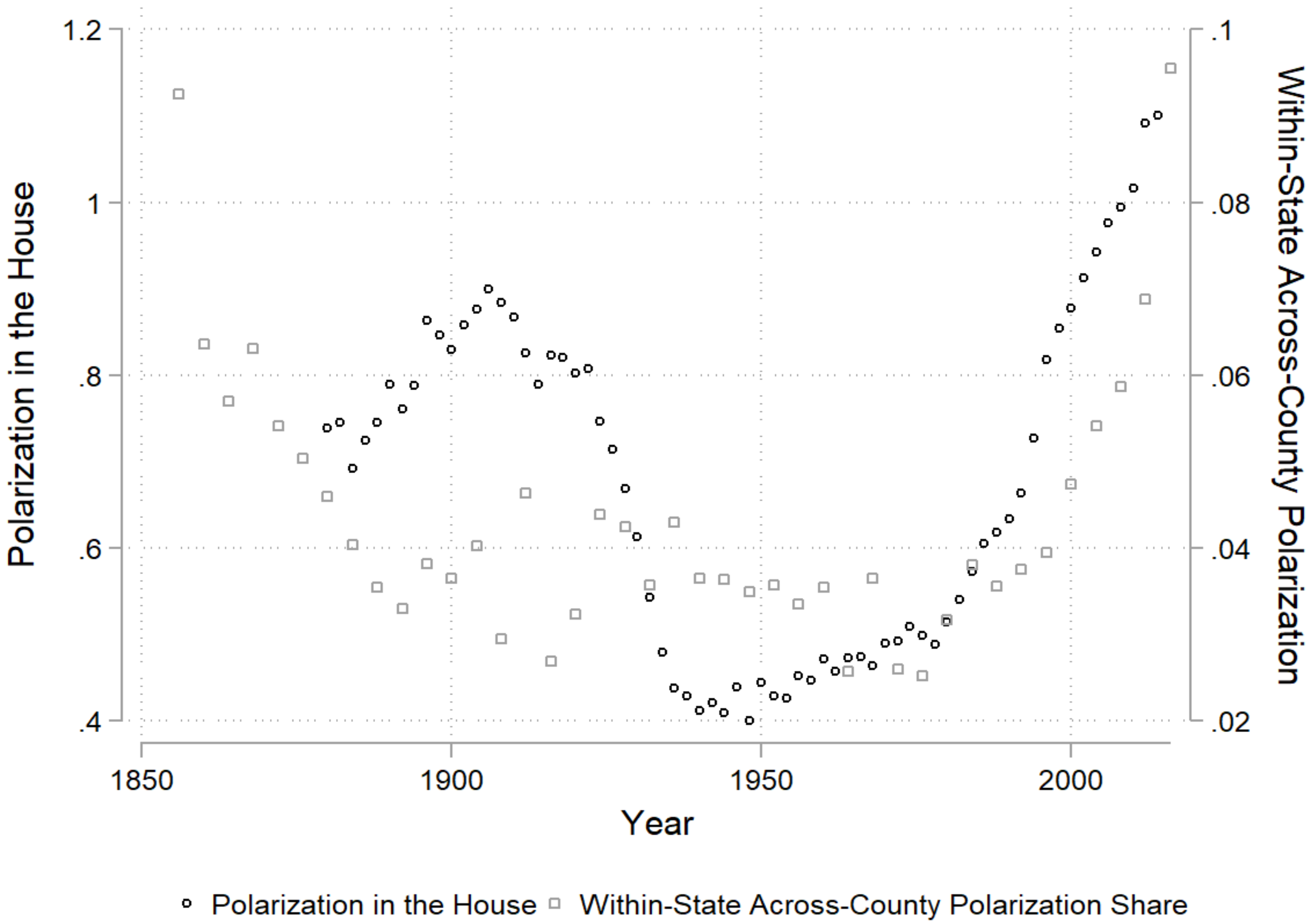
Note: Figure combines the time series in Figures 1 and 2 as well as Table 1 into one graph. For details on each, see the notes to respective exhibits as well as the descriptions in the main text.

Appendix Figure 3: Trends in Within-State Across-County Polarization



Note: Figure overlays a quadratic time trend on the within-state across-county polarization time series depicted in Figure 3.

Appendix Figure 4: Geographic Polarization Correlates with Polarization in Congress



Note: Figure overlays Poole and Rosenthal's (1997) measure of polarization in the House on our measure of geographic polarization depicted in Figure 3. The correlation between both time series is *ρ=.59* for entire time frame in which both are available, and *ρ=.95* for the post-1972 period. For a detailed description of the underlying data, see the Data Appendix.

Appendix Table 1: Geographic Polarization Among Registered Partisans in California

Year	Within-State Across-Precinct Share of State Variance	Within-County Across-Precinct Share of County Variance	Within-County Across-Precinct Share of State Variance	Within-State Across-County Share of State Variance
2006	.135	.083	.077	.058
2008	.136	.083	.077	.058
2011	.144	.086	.080	.064
2017	.164	.105	.098	.066

Note: Numbers are within-state across-precinct share of state variance, within-county across-precinct share of county variance, within-county across-precinct share of state variance and within-state across-county share of state variance for partisan polarization shares based on snapshots of the California voter registration file from 2006, 2008, 2011, and 2017. Note that the third and fourth columns sum to the first column. For the purpose of calculating and decomposing our variance index, we only consider registered Democrats and Republicans.

Appendix Table 2: State-Level Heteregoneity in Across-County Partisan Polarization Shares

State	1860	1972	2012	2016
Alabama		.039	.093	.114
Alaska		.015	.075	.088
Arizona		.021	.017	.026
Arkansas		.037	.062	.083
California	.044	.012	.065	.074
Colorado		.023	.071	.101
Connecticut	.015	.007	.007	.011
Delaware	.020	.001	.043	.057
District of Columbia		.153	.057	.013
Florida		.016	.051	.069
Georgia		.031	.144	.174
Hawaii		.001	.004	.002
Idaho		.017	.056	.067
Illinois	.092	.026	.083	.133
Indiana	.036	.017	.060	.084
Iowa	.030	.011	.030	.058
Kansas		.024	.056	.082
Kentucky		.047	.056	.094
Louisiana		.031	.106	.130
Maine	.027	.013	.008	.030
Maryland	.101	.030	.147	.183
Massachusetts	.022	.008	.024	.032
Michigan	.012	.039	.052	.068
Minnesota	.048	.015	.038	.092
Mississippi		.034	.118	.128
Missouri	.238	.024	.099	.153
Montana		.017	.055	.069
Nebraska		.011	.048	.090
Nevada		.010	.026	.034
New Hampshire	.009	.009	.010	.007
New Jersey	.271	.015	.057	.069
New Mexico		.017	.081	.099
New York	.047	.052	.095	.135
North Carolina		.025	.063	.098
North Dakota		.011	.043	.062
Ohio	.040	.024	.058	.089
Oklahoma		.045	.023	.048
Oregon	.062	.010	.080	.114
Pennsylvania	.088	.035	.092	.119
Rhode Island		.004	.008	.008
South Carolina		.025	.058	.063
South Dakota		.014	.041	.047
Tennessee		.034	.083	.123
Texas		.030	.093	.123
Utah		.019	.087	.116
Vermont	.024	.003	.009	.036
Virginia	.474	.027	.072	.124
Washington		.006	.048	.083
West Virginia		.027	.020	.033
Wisconsin	.057	.017	.061	.084
Wyoming		.016	.061	.096

Note: Numbers are within-state across-county shares of partisan polarization calculated separately for each state in the 1860, 1976, 2012, and 2016 presidential elections, provided both a Democratic and Republican candidate were on the ballot that state. For a detailed description of underlying data, see the Data Appendix.